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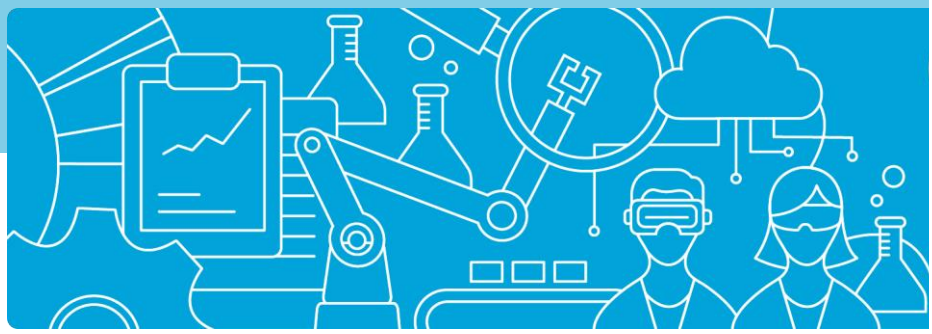

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Social Innovation – (Accompanying) Instrument for Addressing Societal Challenges?

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

CHAPTER 1: GENERAL INTRODUCTION

1 Background and objectives 12
2 Social innovation for social challenges: Three different contexts 12
3 Structure of the report 13

CHAPTER 2: SOCIAL INNOVATION AND SOCIETAL CHALLENGES - A REIVEW AND PROCESS MODEL

1 Introduction and overview 16
2 The multiplicity of social innovations 16
3 The process of social innovation 27
4 Actors in social innovation 38
5 Role and contribution of social Innovation in the context of societal transformations 45
6 Towards a conceptual model of Social Innovation for Societal Transformation 54

CHAPTER 3: SOCIAL INNOVATION CASE STUDIES

1 Introduction to the cases 65
2 Case Study “Energy Cooperatives” 67
3 Case Study “Autonomous Driving” 78
4 Case Study “Corona-Warn App” 92
5 Case study “Social Housing in Vienna” 98
6 Comparative analysis 114

CHAPTER 4: POLICIES IN SUPPORT OF SOCIAL INNOVATION FOR SOCIETAL CHALLENGES

1 Introduction 117
2 Rationales for policy intervention for Social Innovation 119
3 Social innovation policies in practice: Recent experiences from selected countries 133

CHAPTER 5: SOCIAL INNOVATION MEASUREMENT

1 Introduction 145
2 Methodological approaches to SI indicator and measurement: a critical review 146
3 Insights from selected SI datasets 154
4 Summary 167
5 How successful SI indicators may look like? Towards a research agenda 169

CHAPTER 6: POLICY IMPLICATIONS

1. Achievements 171
2. Policy implications 173

BIBLIOGRAPHY

EXECUTIVE SUMMARY

Background and objectives

The important role of social innovation (SI) for the development and successful implementation of system innovations to address societal challenges has been increasingly recognised in research and innovation policies since the first social innovation policy initiatives of the European Commission in the late 2000s and, subsequently, the explicit consideration of social innovation in the German High-tech Strategy. More recently, the interest in social innovation has been reinforced by the launch of five transformative missions as new element in the "Horizon Europe" Framework Programme for Research and Innovation.

The interest in social innovation focused initially on the role it can potentially play for fostering the transformation of major socio-technical systems, for instance in energy supply, or mobility. More recently, social innovation has received growing attention in relation to new and potentially disruptive technological developments, which often need to be embedded in complementary institutional, organisational, and behavioural changes to ensure that transformation pathways are pursued that are beneficial to society. The recent COVID 19 crisis has demonstrated that social innovations can also play a vital role in handling unexpected problems for which no immediate technological solutions are available. This study therefore distinguishes between three types of contexts in which social innovations can potentially play an important role for addressing societal challenges: SI for socio-technical system change, SI for managing disruptive technologies in society, and SI for better tackling and preparing for crises.

Against this backdrop, the overarching aims of the study are to improve the understanding of the role of social innovation for addressing and resolving these types of societal challenges and devise appropriate rationales and inroads for policy interventions. In more specific terms, the following six objectives are addressed:

- Develop a *conceptual framework and typology* of different types of social innovations, with a focus on those social innovations that help address major social challenges;
- Develop a *process model* of social innovation and its role for transformative change, taking into account the **ro***le of the particularly relevant actor and stakeholder groups;*
- Analyse empirically *the nature, scope, and contribution of social innovations* to solving major societal challenges and shaping the associated transformation processes;
- Identify *hurdles and obstacles* to the emergence, uptake, and generalisation of social innovation;
- Formulate suitable *rationales for policy intervention* to foster social innovation processes, and their limits;
- Analyse *framework conditions and policy instruments in selected countries*, aimed at fostering social innovation activities and subsequent processes of transformative change;
- Formulate *implications for the design of research and innovation policy measures* in Germany to stimulate and support social innovation.

Conceptual framework

Based on a comprehensive review of recent research, the study proposes a definition of innovation, which recognises the different types of primary purpose (social, hybrid, profit), business model (non-profit, hybrid, for-profit) and nature (social, socio-technical, technology-led) in order to differentiate nine types of innovations. Six of these types of innovation, namely the ones that pursue a primary social purpose, are considered as social in the broader sense, even if they are based on a profit-oriented business model (i.e., include social entrepreneurship) or have their origins in technology, but need to be complemented by new social practices.

On this basis, social innovation is defined as follows:

- Social innovations are social in their intended overarching *purposes* or ends and can be implemented based on non-profit-oriented as well as profit-oriented *business models*.
- In terms of their nature, they employ social (i.e., behavioural, organisational) *means* or combinations of social with other (e.g., technological) means to achieve these ends.
- Specifically, we define social innovations as *new initiatives* (ideas, products, services, and processes) or new combinations of existing initiatives (solutions) *applied in practice* to address social needs and create new types of social behaviour and relationships.
- They are thus innovations that are not only intended to be *beneficial for society* (1st order benefits), but also aim to *enhance society's capacity to act* (2nd order benefits).

- For reasons of uncertainty and complexity, it needs to be *assessed on a case-by-case basis* whether a social innovation is indeed beneficial (i.e., has positive social effects), and for whom.

Social innovations can be further differentiated, and several dimensions have been proposed in the literature to characterise social innovations. From a policy perspective, two dimensions stand out as particularly relevant, because they allow designing differentiated intervention strategies and corresponding policy instruments addressing key target groups and their interactions: the societal domain of origin (i.e., economy, civil society, or government) and the degree of interaction (i.e., fragmented, partially framed, embedded in society).
A process perspective is needed to explain how social innovation can diffuse and "generalise" to exert a wider systemic impact, lead to transformative change and thus help address societal challenges. Our conceptual understanding of social innovation draws on the multi-level perspective on socio-technical transitions, differentiated in terms of main stages transformation (niche formation, niche maturation, and socio-technical regime change). The change processes when moving from one stage, not only require changes in social practices, but their co-evolution with changes in organisations, markets, networks, institutions, policies, socio-cultural conditions, cognitive frames, and – if relevant – science and technology. They are underpinned by various kinds of generative and generalisation mechanisms, which result from the symbiotic and/or conflictive interests, strategies, and choices of a much wider range of actors than those usually considered in business innovations.

Empirical experiences

This multi-level perspective on social innovation and transformative change is used as conceptual foundation of four case studies that cover the three types of aforementioned contexts of social innovation.
The *energy cooperatives* case stands for social innovation that is connected to system change and can be considered front runners in the context of the German "Energiewende" as an example of a socio-technical transition of the energy sector towards sustainability.
Autonomous driving (AD) stands for a technological disruption, supported by significant investments by businesses, which could occur in the mid-term future. AD has the potential to respond to the social demand to reduce traffic, congestions and relieve cities from overcrowded parking lots. Furthermore, AD could meet people's need to be mobile at all times, as well as to reach places that are not within their vicinity. This is especially relevant for elderly people and people with disabilities, but also for younger people who do not have a driving licence.
In contrast, the *Corona Warn App* was a non-commercial development without major business interests. It was financed by the government to help overcome a crisis. The social quality attached to it was the need to protect vulnerable populations from being infected with COVID-19 and prevent a collapse of the public health system.
Finally, the *Housing in Vienna* case combines two types of contexts for social innovation: a crisis situation and system change. The case shows that a severe crisis that occurs at the landscape level can open up a window of opportunity for system change if the conditions for a niche to mature to generalisation are favourable. While the only case not taken from a German context, it is still a valuable example of how different pathways are charted in national settings and stretching over several decades.

Rationales for policy intervention in social innovation

Two major developments in the ambitions of innovation policy can be observed over the past years. First, there has been a shift towards directional innovation policy that not only asks for creating more innovation, but also strives to foster innovation and subsequent transformation to help address societal challenges. Second, the understanding of what constitutes innovation has broadened. Besides business innovations, social innovations are also considered as relevant "subjects" by policy-makers today. This second change is translated into policies to a lesser extent as compared to the first one.
Both developments point to a need to modify the widely accepted set of twelve rationales for policy intervention in innovation, grouped in market failures, system failures, and transformational failures. The modified set of failures encompasses adaptations to most of these twelve rationales. To account for the specificities of social innovation, further adaptations or interpretations are needed for some of the rationales.
Social innovation is linked to the failures' framework in two different ways. The first logic is about how failures affect social innovation processes, i.e., what kind of barriers typically arise in such processes and how

these are captured analytically by the framework. Barriers arising in social innovation can appear as either structural system or transformational failures, where all described failure mechanisms apply to SI.
The second logic is about how SI is expected to contribute to the mitigation of various failures, which arise in complex settings of socio-technical change processes in response to societal challenges. It is this second logic of the leverage potential of SI which makes a strong case for policy intervention in social innovation processes. First, social innovation is expected to reap benefits in response to the modified understanding of *market failures*. Some SI can contribute to the provision of *public goods*, other than knowledge, or more generally SI intends to create *positive externalities*, e.g. the provision of services of general interest, Second, the way social innovation can be beneficial in addressing *system failure* is straightforward, as it builds on the core character of SI: as social innovation is a mechanism to empower actors, it can mitigate *capability failures*. Further, institutional change can be a desired outcome of SI which in turn might help remove *institutional failures* affecting other types of innovation processes. Third, empowerment of SI actors is closely related to the mechanism which has been captured as *demand articulation (failure)* in the *transformation failures'* framework. SI is a channel to articulate (and address) specific social needs. Further, in SI, citizens do not remain in the role of users or 'need-owners', they also can act as (co-)developers of transformative change processes. SI can also help mitigate the *directionality failure* in the current trajectory of technological development, where it could enable the exnovation of unsustainable technologies.
Moreover, the relevance of these rationales changes when moving from early phases of niche formation towards niche maturation and regime changes. An important additional implication of the revised set of rationales consists of suggesting a pro-active approach to government policy, due to the long-term and future-oriented character of the social challenges that shall be tackled by (social) innovation.

Policy practices to foster social innovation

Targeted mini cases of novel social innovation policy instruments have been analysed in four pioneering countries: Portugal, UK, the Netherlands, and Finland. These policy examples point to a number of interesting lessons for Germany, to be considered when implementing the National Strategy for Social Innovation and Social Enterprises, published in late 2023:

- Following the experience of Portugal, establishing a policy approach for social innovation by way of launching a *national SI strategy* – as recently has happened in Germany as well - seems promising. There, the strategic approach has paved a way for a sustained government focus on SI, which also survived major changes in governments after national elections.
- In terms of rationales, focus, and pathway followed, Portugal and Finland with their focus on social enterprises and on value creation from social innovation show similarities with the German approach to SI policy. As not all SI create economic impacts, it is important to *acknowledge the variety of SI* and establish favourable conditions for other types of social innovation that could create positive externalities.
- The UK and Dutch approaches shed light on the potentially inclusivity-enhancing effects of social innovation and other social benefits, although in very different policy contexts, neither of which being comparable to the German situation (limited state action in the UK and 'polder model' in the Netherlands). What these experiences (as well as those from Portugal and Finland) nevertheless suggest for Germany is the need to *acknowledge the place-based, often local nature of social innovation and the need to acknowledge the challenges of the generalisation processes*, when the knowledge and practices are appropriated to other social and local contexts.
- The four cases do not map directly on the three contexts of social innovation for societal transformation as the conceptual backbone of this study, but we find that these contexts care implicitly represented in the cases and instruments. The *challenge of crises* as a general backdrop to the attention to SI can be observed in two countries. Portugal built its rationale for SI policies on the experience of the financial crisis of 2009 – 2010, and the Dutch approach to SI, at least historically, refers to pressing social crises resulting in poverty and homelessness. The *challenge of emerging technologies* and how they might be framed by social innovation has been relevant in the context of digitally enabled social innovation, for example in the Netherlands and Finland, where technological business innovation is acknowledged to go hand in hand with social innovation. Despite the turn towards more directional R&I policies for *socio-technical system change* towards sustainability, it seems there is so far less experience in leveraging the potential

of SI for transformative system change. In the case of Finland, the turn towards a broad, institutionalised foresight approach offers space for reflection about major transitions involving a large number of stakeholders. It is one of the limitations of the new German SI strategy that it underestimates the transformative power of SI and the value of participatory and collaborative approaches to transitions.

- All countries studied have tried out *new organisational* arrangements or reformed the set of national agencies, which fund and support R&I. This has various consequences for unleashing the potential of SI, as the cases show. For the discussion in Germany on the governance and reform of R&I funding to facilitate transformative or mission-oriented policies, the implications for the role of SI should be considered more thoroughly.

Measurement and indicators of social innovation

Traditional indicators of innovation are not suitable for measuring and capturing social innovation, but attempts have been made in recent years to account for the specificities of SI at multiple levels. The number of exploratory and experimental initiatives to measure SI and develop indicators is increasing, but the critical review of these novel approaches leads us to conclude that SI indicators are not yet sufficiently developed to serve as sound operationalisation of a process-based conceptual model of SI; and one that would enable meaningful comparison across countries. There are several reasons for this.

- *Direct and explicit measurement of SI is scarce:* There are very few indicators, if any, that directly and explicitly measure SI. Indicators that intend to capture SI activities, e.g., actors and projects, face the challenges of accuracy, transferability, meaningful measurement, and comparison. Despite the endeavour to open the black box of SI, the development in measurement approaches so far have seen arguably no major breakthroughs.
- *Under-conceptualisation of SI underlies measurement challenges:* The diverse yet unsatisfactory indicators of SI are to a large extent due to the under-conceptualisation of SI. The definition of any concept presides over its measurement. Despite numerous attempted definitions, ambiguities and vagueness dominates the literature, and there is no consensus across different disciplines and research programmes on what exactly refers to social innovation and how to analytically identify it (and exclude non-SIs). For this reason, different methodological approaches seem to propose their own context-specific frameworks, thereby adding to the list of indicators and frameworks, rather than aiming at a common and standardised framework.
- *Systematic indicators suffer from a gap between ambition and implementation:* Partly due to the under-conceptualisation of SI, existing attempts to develop systematic indicators that try to be comprehensive and holistic exhibit rather mechanical and linear conceptual underpinnings of SI. The claimed comprehensive and systemic ambition has not been matched with the extent to which it is achieved. Another problem with such an indicator system approach is that once some of the standalone indicators lack usable data in a geographical context, then the possibility of such indicator system to be transferred and generalised is in question.
- *SI indicators are diverse, yet largely exploratory and unprepared for "measurement":* The SI indicators proposed in the literature and the growing body of research projects can be largely categorised into three types: quantitative indicators, qualitative indicators, and conceptual and methodological frameworks that guide the design of indicator (systems). Many of them are at the design stage of indicator (systems), but not necessarily applicable for genuine "measurement". Other methodological frameworks are guided by promising conceptual and theoretical developments in SI, but have rarely gone beyond the presentation of frameworks and towards operationalisation and application. A further category is qualitative "indicators" informed by the tacit and process-based aspect of SI concepts. On such basis, they derive selective aspects of SI from interview questionnaires and pilot surveys, and utilise them to inform a larger-scale survey design. Overall, conventional innovation indicators do not capture key specificities of SI, while SI-specific indicator systems, methodological frameworks and selective qualitative indicator sets have largely remained at an exploratory stage.

- *Challenges also lie in data availability:* The lack of appropriate data to capture different dimensions and aspects of SI is an important factor leading to the under-development of SI measurement and empirical research. Most existing indicators are not designed specifically for SI and thus prevent targeted measurement. SI measurement trying to use surveys to collect SI-specific data is at a pilot stage and very limited in scope. Besides, these surveys tend to be sensitive to socio-economic, political and cultural conditions of the place where surveys were developed.
- *International comparison is not yet possible:* Accompanying the underdevelopment of SI measurement and indicators is the lack of data for international comparison. If the macro level is an important level of SI measurement considering its wider societal impacts, spillovers and transformative change, then this task is imminent. However, a lot of available indicator systems incorporate framework conditions and contextualised capacity at the micro and meso-level only, e.g., regional resonance, which makes international comparison less viable.
- *Measurement of SI for transformation is largely absent but pressing:* Few methodological studies have thought about SI indicators from the perspective of transformative change. While the traditional impact assessment and social value creation research partly touches upon different facets of the societal outcomes of SI, the notion of transformation and its implications for outcome-focused measurement has not been systematically explored. This should be a pressing task if SI is perceived to play a transformative role.

These observations suggest some *principles for future research* into the measurement and indicators of social innovation. First of all, it is essential to have a *clear conceptual framework and definition* in place as foundation for operationalisation. The ecosystem and process model of social innovation and transformation developed in this study, geared towards capturing the role of SI for addressing societal challenges, is one possible direction to work on in order to develop indicators that take into account the levels, activities, actor constellations, mechanisms and directions of change related to the generation and generalization of SI. Second, the measurement and indicators of social innovation need to strike a *balance between simplicity and generality on the one hand and context-sensitivity on the other hand*. Compared to profit-oriented (business) innovation, SI is often close embedded in local contexts and social relations as the spaces where tacit forms of knowledge are created and new social practices explored. Third, even though SI is a boundary-spanning and level-spanning phenomenon, thus calling for multi-level and multi-actor analysis, a *clear focus on an appropriate level of measurement and analysis* should be decided based on the specific questions and research objective pursued. If the inquiry goes beyond the micro-level of actors in an SI ecosystem (e.g., social enterprises, citizens, etc.), then a higher-order level of observation needs to be given priority to capture the systemic character, interactive learning, diffusion and generalisation features of SI. And fourth, measurement approaches need to be practical and should be accompanied by a *clear agenda on credible data collection strategy and reliable data access*. In this regard, machine learning and natural language processing techniques as those piloted in the European Social Innovation Database (ESID) open up new and promising avenues for SI data collection.

Policy implications

The final step in this journey consists of suggesting general policy implications as derived from the conceptual and empirical research conducted, and more specifically for R&I policies:

1. Fully recognise in R&I policies the growing importance of social innovation for addressing societal challenges. This claim is linked to two *profound changes in the rationales and societal role of R&I policies*, namely i) a *broader understanding of innovation* and the actors potentially involved in it, and ii) *higher and more transformative ambitions of outcomes and impacts* are expected from R&I policies, which are conditional upon coherence with demand-side sectoral policies, iii) the recognition of the uncertainly and normative ambivalence of innovation, and thus the *need for directional guidance* by R&I and other policies, and iv) a growing complexity of such comprehensive, directional and transformative mixes of R&I policy strategies, instruments, and governance processes, requiring an *experimental approach to the exploration of novel systemic solutions* for addressing societal challenges.
2. Focus R&I policies for social innovation not only on the early stages of experimenting with new solutions, but also on the *progression from social innovations to system innovations*, and accommodate policies to the specific requirements of the different stages. The character and the *need for support of social*

innovation change over its life cycle, and call for a differentiated set of policy instruments and mixes, addressing niche formation, maturation and regime change, respectively. This requires flexibly *combining supply side, demand side and bridging instruments at the intersection with sectoral policies.*

3. The diffusion of social innovations beyond their initial local contexts of ideation often requires other mechanisms than those known from the diffusion of profit-oriented product, process, and service innovations. R&I policies need to explore additional *intervention points and mechanisms to foster the generalisation of social innovations for societal challenges,* often as part of novel systemic configurations of social, organisational, technological, and behavioural changes ('system innovations').
4. Transformation pathways together with the underlying generalisation processes require high levels of reflexivity in order to be adapted along the path. *Strategic intelligence, spaces for reflection, and iterative, interactive learning processes* are needed in order to adjust problem understanding and possible solutions as part of a truly "agile" R&I policies for social innovation
5. The *range of organisations for which social innovation matters is widening* – and with it the group of potential addressees of R&I policies. Social innovations are not just enacted by *non-profit/CSO entrepreneurs,* but equally important in *organisations with a profit-seeking business model* (with reinvestment of profits)**,** as long as such a profit-seeking business model is embedded in a vision and ambition of *striving for a social purpose*. Both groups are confronted with particular barriers to social innovation that justify supportive policy action, and possibly even calling for permanent public support in areas where the retreat of public services of general interest (e.g., in rural areas) leaves important citizens' needs unaddressed.
6. Given the distributed character of many social innovations, centralised governance is often at odds with their specific characteristics. In fact, social innovations often emerge under highly contingent local conditions. This suggests that *supporting social innovations requires a non-hierarchical, decentralised approach.* In other words, for social innovations to flourish, the *forces of self-organisation in society need to be nurtured and supported* through mechanisms of distributed coordination ('Kontextsteuerung').
7. Social innovations play multi-facetted roles for the three types of societal challenges investigated (i.e., system transitions, disruptive technologies, crises). They help *address different types of market, system and transformational failures* that occur frequently in these contexts. This justifies *targeted policy support to social innovation, which also depends on the stage of advancement and maturity of social innovations.*
8. In all three contexts, requirements for (social) innovation are derived from future social needs, which stresses the importance of *anticipating such needs to prepare for policy action well in advance.* This observation also calls for rethinking how rationales for policy intervention are formulated. Rather than referring to 'failures' to which government reacts upon their occurrence, *a turn towards 'proactive' rationales to justify the need for forward-looking policy interventions* is called for.
9. Experience with social innovation policies in some pioneering countries show that new policy mixes are needed to give social innovation a boost. While keeping in mind the specificity of national cultures and policy styles, the analysis points out that i) *persistent support for social innovation, enduring over several legislative periods***,** is key to ensuring the *availability of 'patient' social investment funding***,** ii) both *support to early 'niche' development of social innovation and later stage 'maturation' funding* are needed and require a suitable mix of funding instruments, iii) the need *to integrate social innovation in existing instruments and programmes* is important to ensure complementarity with other types of innovation, and iv) the advantages of *integrating support instruments for social and other forms of innovation in 'one-stop-shops' for (social) innovators*, possibly focused on specific areas such as education, labour, or health enhances the reach and the effectiveness of policy support..
10. The measurement of social innovation continues to be a major challenge, for conceptual, methodological and data availability reasons. For the advancement of our understanding of social innovation and its impacts, it is of utmost importance not only to invest into the development of new approaches, but in particular into the *agreement on a common definition and conceptual framework of social innovation as well as the harmonisation of data collection procedures* across countries, by drawing on sound categories and process models of (social) innovation, such as the one developed in this report.

CHAPTER 1: GENERAL INTRODUCTION

By Matthias Weber

1 BACKGROUND AND OBJECTIVES

The starting point of this study is the growing recognition over the past years of the importance of social innovations for the development, scaling and embedding of novel systemic solutions to address societal challenges (BMBF 2014; EFI 2021), especially when these require the transformation of societal (socio-technical) subsystems. Its overarching aims are to

- improve conceptually and empirically **the understanding of the role of social innovation** for addressing and resolving various types of societal challenges, and
- devise **rationales and inroads for policy interventions** in processes of social innovation.

Social innovation started to play a more prominent role in research and innovation policy debates in the EU in the late 2000s, when EU Commission President Barroso highlighted that social innovations are essential elements to help address current social and economic challenges (Barroso 2011). The German High-tech Strategy has also taken social innovations on board as an area of major importance for the achievement of its ambitions (BMBF 2014). More recently, the interest in social innovation was reinforced at the EU level by the emphasis put on missions as novel elements in the EU Framework Programme for Research and Innovation "Horizon Europe" (European Commission 2021b). In particular, transformative missions require an interplay between various forms of innovation leading to transformations of socio-technical systems in areas such as energy supply, mobility, health, or food supply (Kuittinen et al. 2018; Wittmann et al. 2021).

However, the importance of social innovation is not confined to transforming established large socio-technical systems. The recent COVID 19 crisis has demonstrated that social innovations can play a vital role in handling unexpected problems for which no techno-scientific solution is available, and they are crucial for strengthening what is often called societal resilience.

Finally, recent discussions at the OECD and other fora have stressed the importance of social innovation for the successful and socially responsible uptake of emerging and potentially disruptive technologies in society (OECD 2022b). The earlier social innovations come into play to frame a new technology, the more likely it is that these technologies will be brought to bear in a socially benign way.

Against this backdrop, the overarching aims of the study are to improve the understanding of the role of social innovation for addressing and resolving these types of societal challenges, and to devise rationales and inroads for policy interventions in processes of social innovation. In more specific terms, the following six objectives are addressed:

- Develop a **conceptual framework and typology** of different types of social innovations, with a focus on those social innovations that help address major social challenges;
- Develop a **process model** of social innovation and its role for transformative change, taking into account the **role of the particularly relevant actor and stakeholder groups**;
- Analyse **empirically the nature, scope and contribution of social innovations** to solving major societal challenges and shaping the associated transformation processes;
- Analysis of **hurdles and obstacles** to the generation, scaling and generalisation of social innovation;
- Identify suitable **rationales for policy** intervention in social innovation processes, and their limits;
- Analyse **framework conditions and policy instruments in selected countries**, aiming to foster social innovation activities and subsequent processes of transformative change;
- Formulate **implications for the design of research and innovation policy** measures in Germany to stimulate and support social innovation.

2 SOCIAL INNOVATION FOR SOCIAL CHALLENGES: THREE DIFFERENT CONTEXTS

In line with earlier debates, we want to stress that social innovations often have perceived social needs (e.g., issues of marginalisation, vulnerabilities, inequality, injustice, social exclusion etc) and major societal challenges (e.g., the mitigation of and adaptation to climate change) as their starting points. Against this backdrop we distinguish three types of situations or contexts in which social innovations play a key role for addressing societal challenges:

1) **SI and system change**

   Social innovations take on particular importance with regard to long-term processes of transformation of large socio-technical systems and the "wicked problems" that arise in these processes, often referred to as transitions (Wanzenböck et al. 2020). These are particularly well researched in the context of energy supply, but also occur in other systemic contexts, for example in the areas of mobility, nutrition, or health. Here, we argue, social innovation can play a crucial and even leading role for making socio-technical transitions happen and in a socially acceptable – or even desirable – way.

2) **SI and (disruptive) technologies**

   Radically new and potentially disruptive technological developments often entail a need for institutional, organisational, and behavioural changes, without which the societal embedding of disruptive (and thus often controversial) technologies is likely to meet with important barriers. Examples are legion, and comprise areas such as artificial intelligence, blockchain, autonomous driving, or neuro-technologies (OECD 2022b). Very often, these disruptive technologies evolve very quickly, and thus reinforce the so-called Collingridge dilemma (Collingridge 1980), which states that a) it is very difficult to anticipate the potential positive and negative consequences of new technologies in their early stages of development, and thus to affect their trajectories in a benign direction in this early stage already; and b) once these technologies are sufficiently advanced to understand their consequences well, they are already highly entrenched, and thus their trajectories can hardly be influenced any more. Still, social innovations can play an important accompanying and framing role for disruptive technologies, and the earlier this is started, the more likely will they be socially acceptable and supported.

3) **SI and crisis phenomena**

   Global, as well as local crisis phenomena, from pandemics to floods, have become more frequent in recent years. Resilience to prepare for, and agility to respond to such crises are therefore increasingly important (Weber et al. 2021b). In both respects, social innovations play an important role for mitigating crises and their impacts, and they may compensate for the lack of other, for instance technological, options. This potential role of social innovation independent of whether a crisis occurs abruptly (as in the case of COVID-19) or evolves rather slowly (as in the case of poverty), even if these differences in the pace of change between 'sudden' and 'progressive' crises is very significant from a policy perspective.

In all three contexts, social innovation promises to foster goal-oriented change and thereby help address societal challenges; a process that often requires major transformations. These normative ambitions underpinning social innovations should not be taken for granted; as any other innovation, social innovation is subject to complexity, uncertainty and ambiguity, and can thus give rise to benign as well as problematic consequences. In spite of these caveats, the main object of enquiry of this study is what we call *social innovation for goal-oriented societal transformation* (SI4ST), i.e., social innovation that pursues a collectively desirable outcome and impact, while recognising that the achievement of such impact is not guaranteed.

3 STRUCTURE OF THE REPORT

The next chapter, Chapter 2, will revisit existing definitions, typologies and concepts that have been developed over the past years to help understand what social innovation is all about, and how it may lead to wider changes in society. On these grounds, we propose a conceptual framework to describe the formation and generalisation of social innovations – often in conjunction with other types of innovation – to help address major societal challenges. Chapter 3 will study empirically four different case examples of social innovation, covering the three aforementioned contexts, in order to demonstrate the usefulness of the conceptual framework for analysing how social innovation emerges and contributes to addressing major societal challenges. Chapter 4 turns to the rationales underpinning innovation policy, and how they need to be adapted to meet the specific requirements of social innovations and their wider societal impact. It also looks into a number of international experiences with novel policy instruments aiming to support social innovation. The data and indicators to measure social innovation and its effects are addressed in Chapter 5, indicating main data sources as well as their potential and limitations. The final Chapter 6 presents the main policy implications from the study.

CHAPTER 2: SOCIAL INNOVATION AND SOCIETAL CHALLENGES – A REVIEW AND PROCESS MODEL

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1 INTRODUCTION AND OVERVIEW

The objective of this chapter is to review the current state of knowledge on social innovation and in particular in terms of i) systematising the variety of concepts and definitions of social innovation, ii) the process and organisational embedding of social innovation, iii) the roles of various types of actors involved in social innovation, and iv) the role, contribution and potential impact of social innovations for goal-oriented societal transformation (Grin et al. 2010)

Accordingly, the chapter is composed of six main sections. Section 2 brings together and systematises definitions, dimensions, and typologies of social innovation, with priority given to definitions and typologies that promise to be fruitful with regard to SI4ST. Section 3 addresses the process perspective on social innovation and subsequent transformation, including the relationship between social and technological innovation. Section 4 looks at the variety of actors involved in social innovation activities, their roles and motivations as drivers of social innovation, as well as the inter-organisational networks they form to mutually complement their capabilities and better address their needs. Section 5 considers the impacts of social innovations, in particular in the context of socio-technical transformations in response to societal challenges. Here, we differentiate our analysis in terms of the three types of contexts introduced before. In the concluding Section 6, we revisit the insights into the key characteristics of social innovation in the context of societal transformations and present a synthesis of the definitions, concepts and process model we suggest as the basis for the subsequent chapters of this report.

2 THE MULTIPLICITY OF SOCIAL INNOVATIONS

2.1 Definitions

Types of innovations: Their purpose, nature, and other features

Learning and creating new knowledge can lead to innovative ideas ('inventions'), but these by themselves are not innovations. For an innovative idea to turn into an innovation and have some sort of benefit or impact, it must be taken up and implemented, as innovation means putting a new idea into practice. Innovation, therefore, implies that not only something new is created, but it is also used by people, leading to its implementation in an organisation, its diffusion in markets or its acceptance in society. Innovations of any kind are characterised by interactive (Kline and Rosenberg 1986) and complex learning processes involving different actors and sources of knowledge (Borrás and Edler 2014; Caraça et al. 2009; Cowan et al. 2000; Garud et al. 2013). Certain innovations contribute to transformations, i.e., to put it simply, these are those needed to address grand societal challenges, and which are at the same time of systemic character and have the potential to spur systemic change.

We propose two key dimensions along which innovations will be distinguished throughout this paper: the principal *purpose* and the *nature* of innovations. Their purpose can be towards social ends (tackle a societal problem or create new societal opportunities), or business ends (improve the performance of a firm or create a new firm). In real life we also observe hybrid innovations, those pursuing a societal purpose, but following a business logic, and thus using business organisational forms and business methods and practices. Examples include firms operating similarly to their competitors in a given market – but employing people suffering from various types of disadvantages and/or discriminations. Other social enterprises offer products and services addressing a social objective and while their aim is to stay economically viable or even profitable. When they make profit, they reinvest it into their cause rather than paying it out to investors (either to develop their capacities to address the social need or fund other social projects).[1]

As for their nature, that is, what is changed by an innovation (or: what its object is), innovations can be purely technological, non-technological,[2] or a combination of the two, that is, socio-technical. When characterising a given innovation, we maintain a 'hierarchy' between these dimensions: the purpose defines if it is a profit-

[1] For-profit firms can also aim at serving the needs of disadvantaged people or addressing other societal challenges with new goods or processes Andries et al. 2019.

[2] For reasons of clarity, we prefer to speak of non-technological innovation rather than of social innovation (in terms of nature) in order to avoid any misunderstanding with the use of the term social innovations (in terms of purpose). However, we need to be aware that some authors refer to social innovation in the first instance in terms of their nature (e.g., Howaldt and Schwarz 2010; Howaldt et al. 2014a.

oriented, social or hybrid innovation, while its nature refers to its object: what is being changed by it. This distinction is crucial both from a theoretical and a policy point of view. For example, new organisational solutions can be an integral part of a firm's innovation activity or can be elements of social innovations. The types, ways, and frequency of contacts among people, as well as their communication and co-operation channels, methods, and patterns are changed in both cases; still, in terms of purpose, the first one is a profit-oriented innovation, while the latter one is a social innovation. Further, changes in social practices (networks, institutions, cognitive frames, etc.), without an explicit purpose to tackle a societal problem or create a new societal opportunity is not a social innovation (in terms of purpose), even if it may have major social consequences. A trivial example is the impact of the widespread diffusion of television sets: that was a business innovation, causing immense changes in the every-day life of hundreds of millions, if not billions, of people.[3]
Innovations can also be characterised by their *degree of innovativeness, geographic scope, scale*, as well as the *source and type of knowledge* utilised for innovation. In terms of innovativeness, innovations can be either incremental or radical, and even disruptive. Incremental innovations lead to a moderate change or improvement to existing goods, services, processes, and solutions, but do not challenge the existing artefacts or solution fundamentally. The latter is done, in turn, by radical innovations, which are also more likely to contribute to transformations.
Regarding geographic scope, innovations can be implemented at a local, regional, national, or transnational level. In terms of scale, they can take place at a level of i) individual goods (products and services) and other solutions (business and social practices, methods, organisational forms, etc.) or ii) systems (technological systems as a set of interrelated goods, forming a new economic sector; socio-technical systems or techno-economic paradigms; see Section 5).
Finally, we can also describe innovations by the type of knowledge base they mainly rely on. They can be research-driven, relying on formalised R&D activities or practice-driven, having their origin in practical knowledge, accumulated through learning by doing, using, and interacting. Knowledge can be codified or tacit: formalised R&D activities mainly produce codified knowledge, while practical knowledge is often tacit. Yet tacit knowledge is also accumulated while conducting R&D activities and some elements of practical knowledge can also be codified (e.g., in the form of manuals and blueprints). Successful innovations require both codified and tacit knowledge.
There is a tendency in social innovation studies to juxtapose social innovations with technological ones. However, this is largely a result of the history of how these concepts were brought into policy debates rather than based on any systematic ground. The social innovation concept entered policy debates around societal challenges and societal transformation in the early 2000s, while earlier the area of innovations and system transformation was dominated by the OECD school of thought around (predominantly technological) innovations by firms. Building on economics of innovation of the 1960s (e.g., Arrow, Nelson, drawing also on earlier work by Schumpeter), this line of research was further inspired by insights from management of innovation and science and technology studies. The field gained coherence through the influence of evolutionary economics (Nelson and Winter 1982) in the 1980s, including the recognition of the non-linearity of innovation processes (Kline and Rosenberg 1986), and the systemic perspective on innovation (Freeman 1988; Lundvall 1992; Nelson 1993) on national innovation systems, later on followed by work on sectoral, regional and technological innovation systems).
These lines of research provided the basis for setting standards for data collection by statistical offices (the Oslo Manuals, e.g., OECD and Eurostat 2018), primarily, but not only in the OECD countries, thus establishing a shared understanding, a common research framework, and an extensive data infrastructure for harmonised empirical analyses on (business) innovation across countries. It identified key mechanisms, thus contributing to a nuanced understanding of how innovation activities come about in the business sectors and diffuse in markets. Research on profit-oriented innovations tended to put a strong emphasis on R&D-based innovations and their role in fostering economic growth, competitiveness, and employment.
In contrast, social innovation gained increasing attention as a means to solve the grand challenges of the 21st century (Benneworth et al. 2015). At the policy level, a cornerstone was the Renewed Social Agenda launched

[3] A more shocking example is offered by Gillwald 2000) depending on the theory one uses the Ku Klux Klan can either be called a social innovation or not. It is a social innovation if one uses "social change" as the criterion, but it is not if one uses the purpose as the criterion (referred to in Rüede and Lurtz 2012. We can also mention new social structures and practices imposed upon the entire population of countries by dictators as fundamental social changes that are not social innovations.

by the Barroso Commission in 2008.[4] Although the 2005 edition of the Oslo Manual had already been published at this time, strongly emphasising the need to measure both technological and non-technological business innovations, social innovation scholars tended to continue contrasting social innovations with technological ones.

In practice, this differentiation between technological and social innovation turns out to be rather artificial, as most innovations rely to some degree both on new technologies and new social practices (more generally: non-technological changes). Acknowledging this, the OECD has re-phrased its framework and coined the term "business innovation" to stress their focus on innovation driven by profit motives, considering both technological and non-technological forms of innovation motivated by that purpose.[5] Similarities and differences between social and technological innovations are summarised in Box 1.

It is therefore important to keep in mind for analytical purposes, as well as from the angle of policy-making that both social and profit-oriented innovations can – and in most cases do – rely on technological innovations. A prominent example of this for social innovations are "digital social innovations" (see Section 3).

Some purely technological innovations can be found primarily in the business realm to enhance productivity, competitiveness, or growth. Yet, when radical innovations are introduced – either new consumer products are being produced or new production equipment is applied – non-technological innovations, especially new organisational solutions and managerial methods, are also required (Pavitt 1999; Tidd et al. 1997). Likewise, innovations with a purely social purpose and nature do exist in a variety of forms.

Box 1: Similarities and differences between social and technological innovations

While we question the simplified distinction between social and technological innovations, it might be useful to highlight some similarities and differences.

The major elements of contrast include:

- The *results* of technological innovations are artefacts (or software packages), whereas the results of social innovations can be new services, institutions, cognitive frames, social networks, organisational forms, and social practices (see the next section for a more detailed discussion on service innovations). However, social innovations often rely also on technological artefacts and technological solutions.
- The *locus* of innovation in the OECD school of thought are businesses. The 2018 edition of the Oslo Manual uses the term business innovation, reserving the term technological innovation to product and process innovations, thereby distinguishing those from non-technological innovation (organisational, managerial, marketing, and business model innovations). The term "social innovation" also appears in this – most recent – edition as a further, separate category: "Innovations defined by their (social) objectives to improve the welfare of individuals or communities." (p. 252)
- *R&D* plays a prominent role in the OECD line of thinking around profit-oriented (business) innovations (less so, however, for service innovations). Hence, in the (technological) business innovation literature, academia–business (university–industry) relations and R&D alliances play a decisive role, whereas academia tends to be much less relevant for social innovation (Cinar and Benneworth 2021). Other authors, however, suggest that universities have the potential to become useful partners in social innovation processes (Benneworth and Cunha 2015; Göransson et al. 2021).h
- Social innovations and technological business innovations involve different kinds of actors. Reflecting the challenge- and need-oriented nature of social innovation, in particular NGOs, civil society actors are more prominently represented in social innovations.

The most important *similar elements are as follows:*

- *Networks and collaborations*: Social as well as profit-oriented technological innovations are implemented by humans and necessitate various types of exchanges and cooperation between these actors. Hence, communications, collaborations, interactions, and exchanges between actors are central in both. In the literature on profit-oriented (business) innovation on knowledge transfer and knowledge spill-overs, this

[4] https://ec.europa.eu/commission/presscorner/detail/en/IP_08_1070

[5] Businesses introduce new goods, production equipment and technologies, as well as non-technological innovations, e.g., new managerial, financial, and marketing methods, organisational solutions, and business models. For a detailed typology of business innovations, see the Oslo Manual OECD and Eurostat 2018.

is not only interpreted as beneficial for all actors: knowledge that spills over through social relations, mobility of personnel etc., is seen as negative by those businesses that invested in R&D and innovation to create new knowledge, whereas it is viewed as positive from a macroeconomic perspective.

- *Institutional change* is prominent in both streams of literature, for technological business innovations it is mostly part of the context, in social innovation thinking institutional change is sometimes seen as the object of change (as in the extended social grid model of social innovation, see (Ziegler et al. 2019), as well as by (Terstriep et al. 2022)).

Definitions of social innovation: purpose vs. nature

The term 'social innovation' has been around for decades (Drucker 1957), if not for almost two centuries (Godin 2012) and has been used in a variety of contexts. As a result, there is a plethora of definitions that emphasise different aspects of social innovation. Following the two dimensions of innovations presented above, we can identify two main types of definitions:

- Type A) the ones focussing on the purpose of innovation; and
- Type B) the ones focussing on the nature of change processes (or object of change) of innovation.

Type A) SI definitions, which put the emphasis on the purpose of innovation: "Social innovations are novel initiatives or novel combinations of known solutions, aimed at tackling a societal problem or creating new societal opportunities, applied in practice." (Havas et al. 2020) This approach is taken in the context of several EU policy documents (European Commission 2017), where the term social innovation is defined as part of the "European Pillar of Social Rights" to reaffirm the EU's commitment to the following three categories: 1) equal opportunities and access to the labour market, 2) fair working conditions, and 3) social protection and social inclusion.

Social innovations are often expected to contribute to the creation or improvement of public goods and public services. However, it needs to be taken into account that the understanding of what public goods are not only differs across countries (e.g. between Anglo-Saxon and continental European countries), but have also evolved over time (e.g. in terms of the division of labour in the provision of public goods and services between public, private and third sectors:

- In some countries, third sector- and civil society-led social innovations have played an important role in compensating for an unsatisfactory *under-provision or social inequalities in the supply of public services* (e.g. education, poverty reduction, health).
- Another important category of public services where social innovations have been significant in recent years are *public infrastructure services* in areas like energy supply, water supply, mobility, waste management or crises management. Next to improving the *quality of services provision, environmental and health concerns* are important motivations for enhancing the role of social innovations in these areas.
- Public goods and services are also addressed in the context of social innovation that are primarily embedded in economic activities (e.g., regarding work organisation and health), or the *provision of commercial digital (and other emerging) technologies, infrastructures and services that enable new forms of social practices and interaction entailing public benefits* (e.g., digitally enabled social networks to build communities of practice on rare diseases; healthier forms of work organisation).

The public goods and services typically addressed by social innovations thus relate to a variety of social and environmental purposes, but also to infrastructures and other 'commons' the provision of which falls – at least in many advanced countries – under public responsibility.

Type B) definitions of social innovation stress that SI is aimed at introducing new social practices and/or changing social relations: "Changes in [human] structure and organization are social innovations" (Simms 2006).[6] Howaldt and Schwarz (2010, p. 21) offer a detailed definition that also focuses in the first place on the nature of change rather than on its purpose: "A social innovation is a new combination and/or new configuration of social practices in certain areas of action or social contexts prompted by certain actors or constellations of actors in an intentional targeted manner with the goal of better satisfying or answering needs

[6] From this perspective, technological innovations are seen as modified or brand-new artefacts (goods, production equipment, etc.).

and problems than is possible on the basis of established practices. An innovation is therefore social to the extent that it, conveyed by the market or "non/without profit", is socially accepted and diffused widely throughout society or in certain societal sub-areas, transformed depending on circumstances and ultimately institutionalized as new social practice or made routine." The purpose of an innovation is deliberately left open in their definition and can be either business-oriented or social, while, as they explicate, "in essence innovation occurs on the level of social behavioral patterns, routines, practices and settings" (Howaldt and Schwarz 2010, p. 24).

Moreover, they argue with reference to Lindhult's work that "(t)he commonly found normative link between social innovation and socially esteemed values overlooks the fact that different purposes and interests can indeed be pursued with a social innovation depending on the related utility and prevailing rationale and that these accordingly by no means have to be regarded as "good" per se in the sense of being socially desirable depending on interests and social attribution in order to be called social innovation, 'there is no inherent goodness in social innovation' (Lindhult 2008, p. 44), their utility or effects can also be ambivalent depending on a point of view, just as with technical innovations. Expanded assessment criteria are also needed in evaluating social innovation and a social discussion process must be initiated enabling an exchange of different perspectives and rationales." (Howaldt and Schwarz 2010).

The material difference between social change and social innovation (i.e., leaving aside the fact that social innovation is about introducing new social practices, whereas social change has a much wider scope) rests in the latter being associated with "planned and coordinated actions" (Greenhalgh et al. 2004, p. 582). While (unintentional) social change is described as "the process of change in the social structure of a society in its underlying institutions, cultural patterns, corresponding social actions and conscious awareness" (Zapf 2003, p. 427), social innovations are the result of intentional and goal-oriented action to establish new social practices in certain arenas (Kesselring and Leitner 2008; cf. Hochgerner 2012); or, to put it differently, of "collective actions in pursuit of a goal" to "rearrange how things are accomplished" or permanently establish a new "default practice" by "user acceptance" (Gerber 2006, p. 12).

There are also definitions incorporating both aspects (i.e.,Types A and B), such as the one by the Bureau of European Policy Advisers: "Social innovations are innovations that are social in both their ends and their means. (…) Specifically, we define social innovations as new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations. In other words, they are innovations that are not only good for society but also enhance society's capacity to act." (BEPA 2010).

This definition is well in line with the findings from reviews of social innovation literature. Based on a literature analysis of 318 sources, Rüede and Lurtz (2012) identified the following three top categories of social innovation definitions: i) social innovation for "doing something good in/for society" (127 contributions); ii) social innovation for "changing society in terms of practices and/or structures" (52 contributions); and iii) social innovation for "contributing to local development" (39) contributions). Similarly, in a more recent and more comprehensive literature review, Edwards-Schachter and Wallace 2017) found that social innovation mostly targets "social goals/social values" or addresses "unmet social needs".

Another line of argumentation is based on research in the service sector and on innovation literature that addresses the specific characteristics of service innovation (Gallouj and Savona 2009). This strand of literature shows that social innovations have particular characteristics that make them a special subset of services (Windrum et al. 2016). Similar to service innovations, social innovations are often intangible in nature, and organised as public or private services. In specifically addressing unmet social needs, issues of social [in]justice or societal challenges, social innovation initiatives are (in contrast to most service innovations) guided by different purposes than profit, such as private education services or meeting general standards of public education (e.g., the PISA tests). As Noya (2011: 21) explains: "Social innovation is necessary because many social challenges are resistant to conventional approaches to solving them. (…) The main goal of social innovation is therefore to address complex social challenges by providing innovative solutions." This does not mean that, for example, private service innovations do not lead to social well-being, but they are driven by the expectation of profits, whereas social innovation is stimulated by the value created for society as a whole.

Addressing grand societal challenges would require all the different types of innovations mentioned in this sub-section, with relevant, 'ambitious' goals. Following our reasoning on the need for a complex understanding of the main features of innovations – as opposed to a simplifying juxtaposition of technological vs. social innovations – we summarise these main features in Table 2.1.

Table 2.1: Purpose and Nature of Innovations

Purpose Nature	Social	Hybrid	Profit
Non-technological (or: social nature)	"Pure" SI: addressing social needs; solutions have been painstakingly developed, no competition because there are no other solutions in sight for a burning issue; solution may be very local; when the solution ultimately changes how society approaches a problem, there are changing social practices involved, networks, cognitive frames, institutions	Social entrepreneurship – not technology-based	New organisational, managerial, and financial solutions introduced by firms
Socio-technical (or: hybrid)	Socio-technical or technologically enabled social innovations (e.g., social housing, potable water, fully digital education during COVID-19 lockdown)	Social entrepreneurship with a crucial technological component (e.g., digitally enabled social entrepreneurship)	New production processes significantly changing the intra-firm social relations (inside groups and among different groups of employees), or inter-firm relations (e.g., organising supply chains, etc.)
Technological	Technological innovations with a social benefit that do not lead to changes in social practices, but are rather "hidden" (e.g., open-source software)	Social entrepreneurship based on "hidden" technologies not entailing changes in social practices, but with a social purpose and commercial business model, e.g., sensors for clean water supply systems	New consumer goods, services, and production equipment for gaining market share and/or enhancing competitiveness, productivity, profits, and growth

Source: own compilation

Assigning individual social innovations to a single cell of this matrix is in many cases not appropriate, because social innovations also pass through a life-cycle in the course of which they may change both in nature and purpose. For instance, car-sharing has moved from the top-left cell (early 'neighbourhood' car sharing initiatives) to the centre even centre-right of the matrix, because the vast majority of car-sharing is nowadays provided as profit-oriented services (but often still with some social and environmental benefits). Similarly, digitally enabled social innovations often starts at the bottom left because they are triggered by new technological opportunities, then moves to the centre once new social networks and practices get established which ultimately may turn into mainly profit-oriented activities. In other words, social (as well as other kinds of) innovations undergo a 'journey' and may get re-configured in terms of their nature and purpose.

2.2 Typologies of social innovation

The diversity of social innovation and its inherent 'resistance' to be defined in a clear-cut way has always been a puzzle. Beginning in 2010, empirical analyses of social innovation were intended to pave the way for clearer, more straightforward definitions. EU projects like SI DRIVE, CRESSI, TEPSIE, TRANSIT, or SONNET[7] all focussed on a "conceptually-informed and empirically-grounded understanding of social innovation" (Wittmayer et al. 2022).

Typologies of social innovation may be helpful because they structure a field that is diverse and difficult to grasp. Tracey and Stott 2017) observe that "many of the ideas and practices grouped under the label of social innovation may have relatively little in common". Hence, for institutional support and policy programmes it would be pertinent to have clearer boundaries of the initiatives to consider. We assume that typologies may better underpin the design of governance approaches and guide devising policy instruments and planning interventions in the future.

[7] See CRESSI (https://www.sbs.ox.ac.uk/research/centres-and-initiatives/skoll-centre-social-entrepreneurship/creating-economic-space, last accessed 28/07/23), SI-DRIVE (www.si-drive.eu, last accessed 22/02/23), TEPSIE (https://www.dti.dk/tepsie-european-social-innovation/32866, last accessed 26/09/2023), TRANSIT (https://transitproject.eu/, last accessed 26/09/2023), SONNET (https://sonnet-energy.eu/, last accessed 26/09/2023).

Importantly, even the field of typologies around social innovation has become vast in recent years. For a 'reader-friendly' overview, we would group them in the following way:

- *Typologies that focus on phenomena that have an overlap with social innovation*, for example a typology of citizen co-production (Linders 2012) or a typology of eco-innovation (Faucheux and Nicolaï 2011).
- *Typologies that further detail one type of social innovation*, like social enterprises (Alter 2007; Zahra et al. 2009; Mair et al. 2012; Smith et al. 2013; Battilana and Lee 2014), or a particular dimension of social innovation like a typology of empowering network constellations (Pel et al. 2020). (Phillips 2010) developed an open innovation typology, addressing also social innovation aspects, while (Shier and Handy 2015) focus on types of social innovation by social service non-profit organisations and their effects on social change.
- *Typologies of social innovation as a higher-level concept*, trying to structure and delimit the field (Jaeger-Erben et al. 2015; Schartinger et al. 2020; Wittmayer et al. 2022).

In the following, we will focus on the third type of typologies, i.e., those typologies that attempt to find a structure in the variety of initiatives, projects, or long-term developments that fall under the broad phenomenon of "social innovation".

A typology of (green) social innovation

In line with Windrum et al. 2016), Schartinger et al. 2020) understand social innovations as a form of services that impact on societal practices. The introduction of the new services allows to develop different routines in everyday life, and thus provides alternatives to the current ways of handling certain things. An example would be that the introduction and promotion of repair services allows to break current cycles of wasting resources by discarding items that have only minor dysfunctionalities and can easily be repaired. Social innovations are hence anchored in the service innovation literature. However, apart from the special characteristics of services (Gallouj and Savona 2009), social innovations are characterised: first, by particular incentives, i.e. they intend to address an unmet social need or a social problem, and are hence driven by motives other than the profit motive. Second, social innovations are characterised by empowerment: they are not merely consumed on the basis of preferences, income, and prices. Third, imitation is desired. Social innovators do not want to exclude others from their solutions; once they have found an innovative solution to a problem, they are willing to share it. This is a non-competitive approach compared to businesses that protect innovative solutions with intellectual property rights and other methods to earn temporary monopoly profits.

The typology is empirically driven, using data on a broad range of social innovation initiatives with a focus on process dynamics. The dimensions that result in the typology refer to societal domains and to process dynamics: First, societal domains distinguished are civil society, the economy, and government, and they characterise where social innovation originate. Second, process dynamics are characterised by the intensity of interaction, ranging from fragmented/ local/ niche initiatives via fragmented but partially framed initiatives to societal/ global initiatives. In the fragmented type, social innovations are local and not at all embedded in wider networks or frames. They respond to a local need and depend on local resources and means. Instead, social innovations that are fragmented but partially framed still respond to local needs but show at least some awareness of the wider debates around the issues addressed or see themselves as part of a wider community. When the degree of interaction is societal or global, initiatives are (part of) and well-integrated in wider or global movements. This breadth already shows that social innovation is not reduced only to civil society actors and grassroot initiatives, but they can occur in all three domains, and comprehend initiatives that have grown beyond the local and have the potential to become global movements, however with fuzzy boundaries and potential overlaps.

Table 2.2: Typology of green social innovations

Degree of interaction /Societal domain	Economy/ Market	Civil Society	Policy
Fragmented/ Niche	(1) Company-based	(4) Temporary niche	(7) Experimental
Fragmented but partially framed	(2) Entrepreneurial	(5) Community-based	(8) Embedded
Societal/ Global	(3) Disruptive	(6) Global movement based	(9) Top down

Sources: (Schartinger et al. 2020)

The company-based type of SI (1) refers to initiatives in relation to corporate social responsibility (CSR) where new services are introduced inside companies with the aim of establishing new practices by their employees (e.g., waste management, energy saving). The entrepreneurial type (2) is represented by work-integration social companies (WISEs). Here the organisations have social as well as environmental goals. An example is the area of repair, where WISEs offer new services that are economically viable and shall impact on consumption practices of households. The disruptive type (3) refers mostly to digital platforms, e.g., for sharing. They are often seen as disruptive because they work against current business models and "traditional" regulations (e.g., UBER or AirBnB, even if their 'green' ambitions are minor as compared to their commercial). This first column under economy/ market describes initiatives *at the fringe of the concept of social innovation*. In the literature they are not always seen as social innovations but are also referred to as *hybrid innovations* or completely beyond the social in terms of *"platform capitalism"*. Airbnb has led to new social practices among people who before had not offered accommodation. One may of course also argue that this is just digitally enabled diffusion of the practice of renting private rooms. AirBnB has a clear profit motive and does not address a social need; it serves a demand for a different type of – and often cheaper – accommodation.

The second column includes initiatives at the core of the social innovation concept, coming from civil society actors, such as citizens, non-governmental organisations (NGOs) and non-profit organisation (NPOs), responding to burning social needs, including environmental ones. These social innovations can be strictly local, based on engaged individuals muddling through and struggling to set up localised solutions (4), to more professionalised and 'growing' initiatives that are often connected to a global societal trend (5). In that case they often have developed a structured organisation and relations to actors like policy-makers. Global movements (6) like Greenpeace also belong to this realm with highly professional organisational set-ups and routinely established campaigns for mobilising people.

In the political domain, social innovation types range from experimental (7), i.e., project or single-contract based initiatives, like public procurement with social and environmental clauses, to those embedded in programmes (8). Here, the European RTD Framework Programme may be an example of financing innovation actions or coordination and support actions (CSAs) that explicitly focus on building of coalitions and systems linkages and participation of a wide range of actors. Their intention to generate social learning processes around areas and issues of particular interest makes it often hard to argue that they do not conform to the notion of social innovations. But importantly, not all CSAs funded by the framework programme correspond to a social innovation. However, if they involve social learning as a key aspect, plus generate impact by initiating change process on a collective level they may as well be. Lastly, the top-down type (9) refers to changes implemented via novel regulations or policies that affect social practices.

A typology of social innovation in sustainable consumption practices

Jaeger-Erben et al. 2015 take a social practice approach and focus specifically on social innovations in the area of (sustainable) consumption practices. This field of study is particularly relevant for two reasons. (1) The behaviour of consumers plays a significant role in sustainable development, as a large share of emissions contributing to climate change are connected to consumption. Moreover, consumers are the necessary counterparts to all other market actors – be they for-profit, non-profit, or social entrepreneurs. More generally, their behaviour is central to the success of social innovations. (2) Everyday consumption practices tend to be

routinised and are, therefore, rarely questioned, unless explicitly taken into consideration. As a result of this focus on consumption practices, this typology has a stronger focus on more informal (or even non-organised) actors and structures than other typologies.

The authors divide the innovation process into three phases: (1) the innovation phase, dominated by variation or challenge of established social practices; (2) the selection phase, which involves an evolutionary selection and experimental implementation of alternative practices within a niche, and (3) the stabilisation phase, during which the structures necessary for the innovation stabilise and diffuse to a broader group of consumers.

During the innovation phase, alternative social practices can be differentiated by their problem and solution orientation. The *problem orientation*, i.e., on what basis established practices are being challenged, can either be based on 1) problematic meanings, and thus challenge established norms, values, expectations, cultural assumptions, etc. or 2) the lack of services, infrastructures, and products that allow for alternative consumption, challenging material arrangements. The *solution orientation* describes the focus, with which alternatives are constructed and can be on alternative (often community-based) social settings, on individual (consumption) competences, or on alternative material settings. Using these two orientation dimensions, the typology identifies five *modes of alternative consumption practices* during the innovation phase: (1) community-creating, (2) competence-expanding, (3) resource-light and waste-avoiding, (4) commonly organised, and (5) need- and utility-oriented consumption (Jaeger-Erben et al. 2015).

Once alternative practices are established, i.e., during the selection and stabilisation phases of the innovation process, Jaeger-Erben et al. (2015) distinguish social innovations based on four dimensions:

- Innovativeness: degree of change
- Formality: degree of formality in the organisation of practices
- Engagement: necessity and degree of personal engagement and self-organisation of consumers
- Communality: necessity and degree of forming groups or communities

Using case studies, the authors finally combine the manifestation of these four dimensions (each with three "values": high, medium, or low) as well as the mode of practice to identify and characterise five types of social innovations for sustainable consumption: Do-It-Together, Strategic Consumption, Sharing Communities, Do-It-Yourself, and Utility-Enhancing Consumption (see Table 2.3 for details). Besides an extensive list of case study examples, Jaeger-Erben et al. 2015) also offer recommendations for policy measures that can be used to support each innovation type.

Table 2.3: Typology of social innovations in sustainable consumption

Type of Social Innovation	Mode of alternative consumption practice	Innovative-ness	Formality	Engage-ment	Communal-ity	Examples
Do-It-Together	Community-creating	high	high	high	High	producer-consumer-communities, community-supported agriculture, urban gardening, energy cooperatives, community-organised bus-services for remote regions
Strategic Consumption	Community-creating	high	low	medium	High	energy saving campaigns like Energy Neighbourhoods, different types of user integration like living labs and lead users, Carrot Mobs, Club Mobs
Sharing Communities	commonly organised	medium	medium	medium	Medium	house swaps, airbnb, couchsurfing, carpooling, neighbourhood networks for sharing/ swapping, food sharing, co-working spaces, walking bus
Do-It-Yourself	competence-enhancing; resource-light and waste-avoiding	medium	low	high	Low	FabLab, Repair Cafes, upcycling workshops, Meine Ernte (vegetable gardens for rent)
Utility Enhancing Consumption	utility and need-oriented; resource-light and waste-avoiding	low	high	low	Low	Refurbishment, car sharing, bike/ tool rental, second-hand initiatives, platforms for making underused goods publicly known (vacant buildings, fruit trees that may be harvested by the public, etc.)

Source: (Jaeger-Erben et al. 2015)

A typology of social innovation in the energy sector

Wittmayer et al. 2022 build on a socio-institutional perspective and a transformative social innovation understanding that puts changes in social relations in focus. Empirically, the authors analyse social innovation in the energy sector (SIE), which they define as:

"*(combinations of) ideas, objects and/ or activities that change social relations, involving new ways of doing, thinking and/or organising energy*." (Wittmayer et al. 2022, p2)

With a core focus on changes in social relations, the typology of SIE developed by Wittmayer et al. 2022) is also structured along different types of social interactions, namely cooperation, exchange, competition or conflict. Conflict can also be a form of social interaction that characterises the social innovation process (both as driver of certain activities or as a reaction to changes in the energy system). The second dimension that structures the typology of SIE is how social innovations manifest themselves in terms of new ways of doing, thinking, or organising energy.

Instead of arguing for a normative understanding of social innovation, the aim of the authors is to broaden the understanding of social innovation. Similar to Schartinger et al. 2020), the authors argue that social innovation can originate from actors from different social spheres and include different types of activities and social relations.

Table 2.4: Typology of social innovations in the energy sector

		Social relations as social interaction			
		Cooperation	**Exchange**	**Competition**	**Conflict**
Manifes-tations	**Doing**	**(1)** Local energy production and consumption **(2)** Cooperative energy production & consumption **(3)** Collaborative eco-efficient housing	**(7)** Local peer-to-peer electricity exchange	**(13)** For profit services and technologies	**(16)** Action against specific energy pathways
	Thinking	**(4)** Advocacy for specific energy pathways	**(8)** Energy education **(9)** Non-profit consulting **(10)** Peer to peer learning	**(14)** For-profit consulting	**(17)** Campaigns against specific energy pathways
	Organising	**(5)** Participatory energy dialogues **(6)** Participatory experimentation and incubation	**(11)** Platforms for direct energy transactions **(12)** Investment and finance mechanisms	**(15)** Energy gamification & nudges	**(18)** Networks against specific energy pathways

Source: Wittmayer et al. (2022), p. 7

3 THE PROCESS OF SOCIAL INNOVATION

The next step to understand how social innovation is conceived and related to social challenges consists of disentangling the different process models that underpin various strands of social innovation research. Literature sources from the 2000s tend to draw on linear or phase models of social innovation, and it was only with the wave of projects on social innovation funded under the European Union's 7th and Horizon 2020 framework programme that more sophisticated co-evolutionary and systemic frameworks got established more widely. We draw here on the extended social grid model (developed by the CRESSI project) and the comprehensive theory of social innovation and social change (developed as part of the SI-DRIVE project) as examples of such coevolutionary models, but also on a series of projects dealing with transformative social innovation in the follow-up to the TRANSIT project. The latter already hint to a systemic understanding of social innovation and social change, which was further elaborated in the social ecosystems literature and entailed also considerations regarding the interactions between technological and non-technological/ social innovation, not least with regard to the enabling function of (digital) technologies for social innovation.

3.1 Linear and phase models of social innovation

For decades, business innovations had been perceived as a sequence of clearly discernible activities, such as basic research, applied research, product development, prototyping, manufacturing in small batches, scaling up to mass production, marketing, and sales. That is the science-push model of business innovations in a nutshell. Then other observers claimed that innovation is induced by 'detecting' demand for new products, and thus market research became the starting point in the demand-pull model of business innovations, followed by product development and the other activities already identified in the science-push model. Both kinds of linear models offer a schematic view of innovation, implicitly suggesting that innovation is not only an easy-to-understand process, but also easy to implement through stages (of activities), following each other in a pre-defined, logical sequence.

Any practitioner knows that in real life innovation is never that simple and never a linear process. With time, innovation models became more complex, for example by incorporating feedback loops between various activities (e.g., Kline and Rosenberg (1986)) and creating more networked models of innovation (Caraça et al. 2009). Although business innovation models have become much more sophisticated, many observers of social innovation initially adopted linear models again to describe the process. Examples include Mulgan (2006), Murray et al. (2010) and Benneworth and Cunha (2015). All these approaches define social innovation processes as a series of steps or stages. The most detailed one is that by Benneworth and Cunha (2015), which includes seven stages: idea generation, creation of experimental space, demonstrator, decision to expand, support coalition, codification, and diffusion. These stages can be helpful in some aspects of analysis, such as to think about which actors and resources are needed at different times in the SI process, but as a description of the actual development of social innovations, they lack complexity, opportunities for feedback and room for differing dynamics throughout the process. Some authors acknowledge these shortcomings but fail to address them systematically in their models (Murray et al. 2010; Mulgan 2006). This bears the risk that decision-makers will too readily rely on simplified models, since they appear easier to understand and use, but ultimately do not represent the complex process of social innovation realistically.

3.2 Towards a more systemic understanding of social innovation

More 'systemic' perspectives on social innovation stress the interactions with other forms of innovation, in particular technological ones (in terms of their nature), and the embedding of social innovation in a network of actors, as well as in institutional contexts. We first look into the debates about the relationship between social and technological innovation, and the enabling role of digital technologies in particular, before moving to the – still early-stage – developments in social innovation ecosystems research as the most widely used systemic framework.

3.2.1 Social innovation and technological innovation

In terms of our innovation framework, the distinction between social and technological innovation refers to the object of innovation. Whereas technological innovations refer to novel artefacts (products) or production

processes, social innovations focus on social needs, develop novel solutions for a societal problem and in the course of implementation and involve a change in social practices (often related to organisational and institutional changes). Social and technological innovation are often opposed to each other (Howaldt et al. 2014), while in practice they can be tightly inter-connected. Technologies can support novel approaches that solve problems of inequality, marginalisation or injustice. Many new technologies would never have been taken up widely without introducing simultaneously complementary changes in behaviour, organisation, or institutional frameworks. In other words, these are co-evolutionary processes of socio-technical change.

Although the primary purposes of innovation represent a different dimension to characterise innovations, social innovations tend to be geared towards social or collective welfare, whereas technological innovations are often discussed in relation to the potential economic returns they could generate for companies (i.e., profit-oriented [business] innovations). These and other similarities and differences between social and technological innovation have already been discussed in Section 2.

Moving towards a process perspective, collaboration between different types of actors is of major importance for both social and technological innovations, but the latter have privileged for decades the relationships between researchers and businesses, whereas the former have included a much broader range of actors as carriers of social innovation. With the blurring of the boundaries between social and technological innovation "camps", it seems now common wisdom that social and technological innovation should be understood as closely connected. This is particularly relevant in relation to the three types of contexts of societal challenges, which all seem to require drawing on the widest possible range of innovative solutions, independently of whether they are social or technological in nature, as long as they contribute to resolving the challenges.

For such a more integrative take on social and technological innovation, it is nevertheless important to be aware of the differences in terms of underlying mechanisms and incentives that drive the processes of innovation and generalisation of social and technological innovations, respectively.

Technological innovation dynamics

Processes of technological innovation have been extensively studied over the past seven decades. Early linear models of innovation (science-push and demand-pull models, Bush 1945, Schmookler 1966) have been superseded by interactive frameworks like the chain-linked model (Kline and Rosenberg 1986) and later on by systemic models of various kinds. Understanding the dynamics of innovation, initially just captured by descriptive stage models, was informed by evolutionary mechanisms (following Nelson and Winter 1982), co-evolutionary concepts (Rip 1995) and models that draw on insights from complex systems science (Andersen 1994).

The insights derived from these models emphasise the importance of collaboration and learning, as well as the formation of institutions to foster innovation and diffusion of technological innovations. Often, these models have their origins in the investigation of innovation processes at the micro level but are reflected also in corresponding heuristics at the meso-level, for instance in terms of various generations of innovation systems concepts, which have dominated innovation policy debates for more than two decades.

Among the key mechanisms driving innovation and diffusion dynamics are

- Collaboration and recombination of knowledge in networks that lead to a continuous improvement of innovative solutions through user-supplier interactions, or – in other conceptual framings – through the interaction of quadruple helix actors (science, industry, government, civil society).
- Self-reinforcing mechanisms, such as interactive learning (within and outside of organisations), network externalities, economies of scale, etc., which foster the uptake of innovation and lead to the emergence of dominant designs.
- The shaping of institutions to provide stable conditions and ensure incentives for innovation, such as IPR regimes.

Overall, several decades of innovation studies have elicited a very sophisticated conceptual and instrumental knowledge of technological innovation, oriented primarily towards business purposes.

Social innovation dynamics

Although research on social innovation can be traced back to the early 19th century (Godin 2012), it has been much less prominent in innovation studies over the past few decades. Their rediscovery went hand in hand with the recognition that besides business purposes of innovation, others do matter for addressing major

societal challenges like inclusion, equality and justice. Definitions and concepts of social innovation are very diverse, and there is a much less standardised understanding of social innovation than for technological innovation,[8] not to speak of matters of management or impact assessment.
Similarly, the knowledge about the mechanisms underpinning innovation, diffusion and transformation dynamics is less advanced than for technological innovation. Still, there are a number of similarities in terms of underlying mechanisms. In particular, knowledge spillovers and interactive learning are also crucial for social innovation, as does the formation of institutions to stabilise social innovation activities. Agency can be highly distributed, covering a wide range of actors.
However, some of the key mechanisms underpinning technological innovation and their uptake are not effective in the context of social innovation:

- Less reliance on R&D as a key source of novelty, although social science research might be needed in many cases,
- Profit orientation and with it the ability to invest in further R&D to reinforce the drive of innovative activities,
- More limited power of self-reinforcing mechanisms like network externalities that enable the emergence of standards and dominant design,
- Absence of IPR regimes, rewarding innovation activities financially.

On the other hand, social innovations are characterised by a number of other mechanisms that facilitate their uptake and replication:

- Great willingness to share knowledge about social innovations, due to the absence of solutions to a social problem, hence absence of competition and profit orientation, i.e., knowledge diffusion is not hampered by IPR,
- Co-evolutionary dynamics implying that cognitive, network and institutional elements need to be "in tune" for social innovations to emerge and generalise (Beckert 2010).

Towards a socio-technical perspective on innovation

Recent research on both technological and social innovation suggests a growing complementarity between these strands (Weber 2023). While it is important to understand the mechanisms that are key for mobilising the social and the technological dimensions of innovation respectively, most innovations of relevance in our industrialised societies are socio-technical in nature and characterised by a co-evolution of their technological and non-technological features. This was also recognised in one of the largest EU-funded projects on social innovation (SI-DRIVE), which found that about 90% of the social innovations mapped by the project were socio-technical (Howaldt et al. 2018; Anderson et al. 2018). CrESSI, another EU-funded project, has also shown the reliance of social innovations on technological and profit-oriented innovations using a historical case studies approach, e.g., on social housing and the provision of potable water.
From the point of view of (social) innovations, for addressing the three types of societal challenges in the focus of this study, it seems important to recognise the 'hybrid' socio-technical nature of most innovations and highlight the necessity to address (and not overlook) the interactions between their social and technological dimensions, rather than to try to isolate the social dimension. This does not deny the existence of 'pure' social innovations or 'pure' technological innovations, but in fact, they are comparatively rare.

3.2.2 Digital (Enablers of) Social Innovations[9]

Definition and key characteristics of digital social innovation

Digital social innovation (DSI) is a comparatively new phenomenon that has grown in significance in particular with the introduction of digital platforms and social media. In the majority of cases, it may be more appropriate to speak of *digitally enabled* social innovation. According to the EU-funded DSI4EU project, digital social innovation can be defined as:

[8] The Oslo Manual is a key reference for innovation and its measurement. It is meant to provide guidelines for measuring innovation and offers definitions from that angle. Difficult-to-measure innovations, e.g., using new inputs, entering a new market, or creating a new market are not covered by the Oslo Manual.
[9] This section is draws on updated extracts from Weber 2019.

"(a) type of social and collaborative innovation in which innovators, users and communities collaborate using digital technologies to co-create knowledge and solutions for a wide range of social needs and at a scale and speed that was unimaginable before the rise of the Internet".

This definition stresses that some social innovations make extensive use and benefit from digital technologies (e.g. platforms, apps). In DSI, i.e., new forms of social practice that remedy a social need are sometimes made possible by the close interaction of the social and the technical. Other related concepts, such as civic technology, social technology, or ICT-enabled social innovation, may overlap with digital social innovation, but tend to stress other aspects.

The network effects associated with digital platforms imply that the utility of a network increases with each new node that is added to the network. They help overcome one of the most important barriers to the diffusion and institutionalisation of social innovations, namely the lack of sufficiently forceful self-reinforcing mechanism driving forward the processes of scaling and widespread uptake of social innovations in society. Whereas many technological innovations benefit from economies of scale (i.e., decreasing unit costs with growing output) and competitive forces, these powerful drivers of innovation and scaling dynamics are much less effective in the case of social innovations. Network effects and the willingness to share may at least partly compensate for this deficit, even if they are fully effective only beyond a critical network size.

In spite of these network effects, the growth and uptake of DSI is hampered by barriers at both project and system levels. At system level, for instance, DSI projects and organisations are still poorly connected to each other, both within and across countries and regions. This, however, is an important prerequisite for boosting network effects, enabling knowledge-sharing and, ultimately, scaling, replicating and generalising DSI. AS consequence, there is a perceived lack of funding and investment in DSI in Europe. Digital skills shortages further hamper the widespread uptake of DSI. It has also been one of the reasons why many civil society organisations and the public sector have adopted DSI rather slowly (Misuraca et al. 2016).

The new digital social practices and their scaling are enabled by four specific characteristics of open digital systems, namely open knowledge, open data, open hardware, and open networks. This kind of open technological infrastructures has given rise to the creation of a variety of ecologies and applications on which DSI builds. Outstanding among these in terms of their enabling role for DSI are social media and social networks for information and knowledge exchange, and crowd-based instruments for the sourcing and mapping of information and for financing DSI. The opportunities offered by open digital systems can be exploited in a wide variety of areas, ranging from mobility, housing, and energy supply to learning, health and financial services.

Digital *social* innovations differ from other kinds of digital innovations in terms of their (social) purpose and the emphasis on digitally enabled changes in social practices. The importance of intended social or environmental benefits of DSI contrasts with the focus on profit-orientation and economic benefits that is typical of most other digital innovations. However, even well-intended DSI may easily give rise to misuse: examples such as fake news or embedded discrimination call for a responsible and ethical use of DSI.

Application areas of DSI

Nowadays, DSI initiatives can make use of a broad range of established and emerging technologies to empower citizens, facilitate collaboration and deliver social impact. They have the potential to transform the ways in which public services are delivered, reduce environmental impacts, and empower citizens to participate in activities that were reserved for experts in the past. So far, DSI has been particularly relevant in the following areas of application (Bria et al. 2015):

- Health and care: Chronic or orphan diseases can be addressed through digitally enabled networks of patients worldwide. Knowledge exchange and mutual learning between people with disabilities is facilitated by DSI.
- Finance and economy: DSI can give access to novel forms of financial intermediation, including mobile banking and micro-credits.
- Food, environment and climate change: New types of local smart grids, but also new mobility solutions based on sharing models or new forms of food supply have the potential to reduce harmful environmental impacts.
- Digital democracy: Digital fora create new publics and arenas of political debate, giving people easier access to democratic processes of opinion formation.

- Cities and urban development: DSI solutions offer easier access to public and social services, for instance in areas like housing, social care, or e-government.
- Science: DSI allows involving citizens directly in processes of knowledge creation through citizen science or open user-driven innovation.
- Skills and learning: Online services are nowadays available to upgrade skills, share learning experiences and enable peer learning.
- Culture and arts: FabLab and maker communities benefit from DSI to build decentral production activities and exchange software through an open-source model.
- Work and employment: Coordination of supply and demand on labour markets – paid or unpaid – is easier and quicker if DSI solutions are used, including voluntary labour or the integration of migrants into work environments.

Social functions enabled by DSI

The key feature of DSI as compared to conventional social innovation is their enabling role for novel interactive or collaborative social practices. With the help of digital technologies, these social practices can be performed at a new quality level and give rise to a corresponding change in important domains of social interaction (Bria et al. 2015):

- Collaboration: New practices of collaboration and sharing, which in the past were hampered by comparatively high coordination costs, are now possible through electronic intermediation and instantaneous online interaction.
- Participation: Digital social media enable the formation and mobilisation of social communities and the creation of new virtual arenas of debate. These can give rise to new forms of democratic participation but also to social practices that could undermine democracies, for instance through amplifying fake news in the echo chambers of confined virtual communities.
- Access to information: The availability of, and access to, vast amounts of online data offer new opportunities for new practices of information and knowledge sourcing, but also of pooling and visualising that knowledge.
- Awareness raising: Access to information and knowledge can be used to enhance transparency, raise awareness in physically distributed social communities, mobilise these communities and stimulate action much quicker than in the past.
- Acceleration and incubation: Access to information and knowledge also means access to alternative (additional) financial and other resources. In conjunction with the awareness-raising function of digital network, new types of social practices can be incentivised.

Barriers to the uptake and generalisation of DSI

In spite of high promises and several successful and socially benign examples of DSI, its impact in society has been difficult to measure so far. The potential of network effects for scaling DSI has not yet been fully brought to bear. Reasons for the reluctance to engage in DSI reside in the fast pace of innovation and change in digital technologies, and thus the high level of uncertainty associated with DSI, which – taken together – make fast learning about their pros and cons a must. This suggests several potential inroads for public policy, e.g. investment in DSI support infrastructures (e.g., incubators, accelerators, network-building, and training initiatives), facilitate knowledge exchange about good practices, or support the emergence of a wider range of DSI initiatives.

Resource constraints are another factor hampering the wider uptake of DSI. Private and public funders are often called upon to support social innovations in order to ensure their viability and compensate for the limited returns they often generate. The situation is slightly better in the digital sector where ingenious new financial and business models have been developed, and private funds mobilised. Still, DSI initiatives would benefit from policies and regulations to facilitate access to alternative financing models and to support the uptake of open-source solutions in order to advance DSI.

Mapping exercises, such as the EU-funded DSI4EU project, have shown that DSI initiatives need to strengthen cooperation among themselves to be able to benefit from network effects and strengthen their position vis-à-vis incumbent players in the main application areas. DSI initiatives could benefit from cooperation with established civil society organisations and their pre-existing structures and networks to strengthen the bottom-up culture of DSIs by embedding them in stable and supportive institutional environments. Research is still

needed on the complementary role of DSI in innovation ecosystems of different application areas to better understand how sustainable models of DSI could look like and what conditions are needed to enable the scaling and replication of DSI.

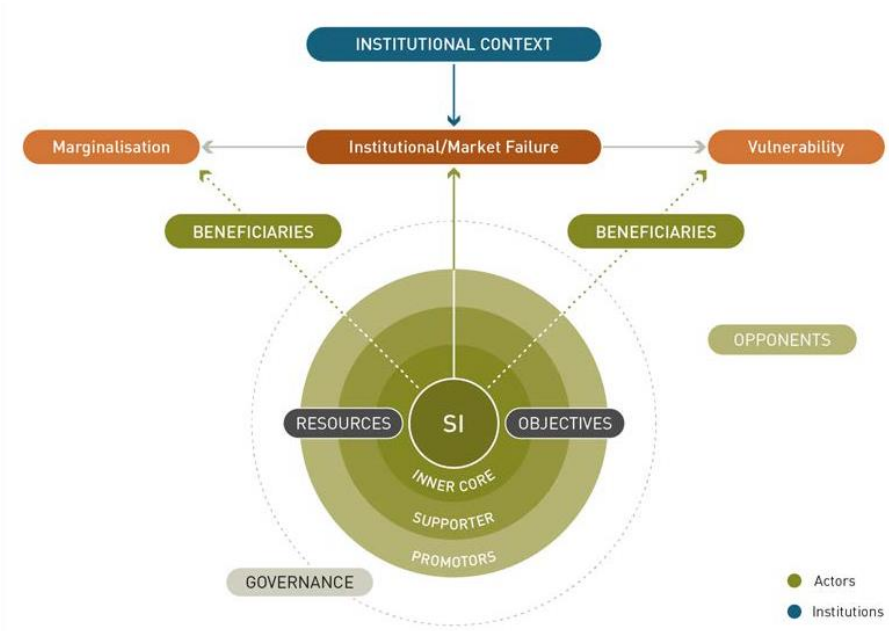
3.2.3 Social innovation ecosystems

The social innovation ecosystems perspective is informed by the business-centric perspective on innovation ecosystem, and its integration with the multi-actor, multi-level governance perspective. Systems thinking puts knowledge and learning at the centre of an innovation process (Fischer 2000). This process does not take place in a vacuum; it is an embedded phenomenon resulting from complex and diverse linkages and interdependencies. The "ecosystem" concept reasonably accounts for the networked, co-produced agency that characterises innovation nowadays (Etzkowitz and Leydesdorff 1998; Rinkinen and Harmaakorpi 2018). Further, with an analogy drawn to the biological mechanism rooted in evolutionary thinking, the ecosystem perspective emphasises the non-linear, emergent, and organic nature of innovation processes (Nelson et al. 2018).

While generic key features of innovation system and ecosystem have been used as a relevant lens to look at the process and dynamics of social innovation (Alperstedt and Andion 2021), the resulting social innovation ecosystem framework should not be seen as yet another sub-type of innovation ecosystems. Rather, it is a refreshed, integrated perspective that combines systems thinking and the peculiarities of social innovation dynamics. First, in the ecosystem of social innovation, bottom-up activities and initiatives driven by a wide range of actors take up an important space, which partly marks how social innovation departs from other types of innovation. Second, multiple actors interact at multiple levels in the ecosystem (Stephenson 2013). This leads to complex interdependencies and actor constellations whose capabilities and activities shape the trajectory of social innovation. Third, the context in the social innovation ecosystem strongly affects social innovation dynamics.

Therefore, it is the diversity of actors and their interactions at different levels revolving around learning and knowledge creation for social innovation embedded in a certain context that defines a social innovation ecosystem. Along this line of understanding, (Terstriep et al. 2015) have identified and discussed the building blocks of social innovation ecosystems (Figure 2.1).

Figure 2.1: Social innovation ecosystem



Source: (Terstriep et al. 2015)

For analytical simplicity, (Terstriep et al. 2015) suggest focusing on actors and spaces, which is similar to the classification of major players and environmental conditions by (Bloom and Dees 2008). Actors are defined as individuals or organisations that bear agency of action and bring about change in social systems. This includes traditional triple helix players and in recent years incorporates civil society, social enterprises, and

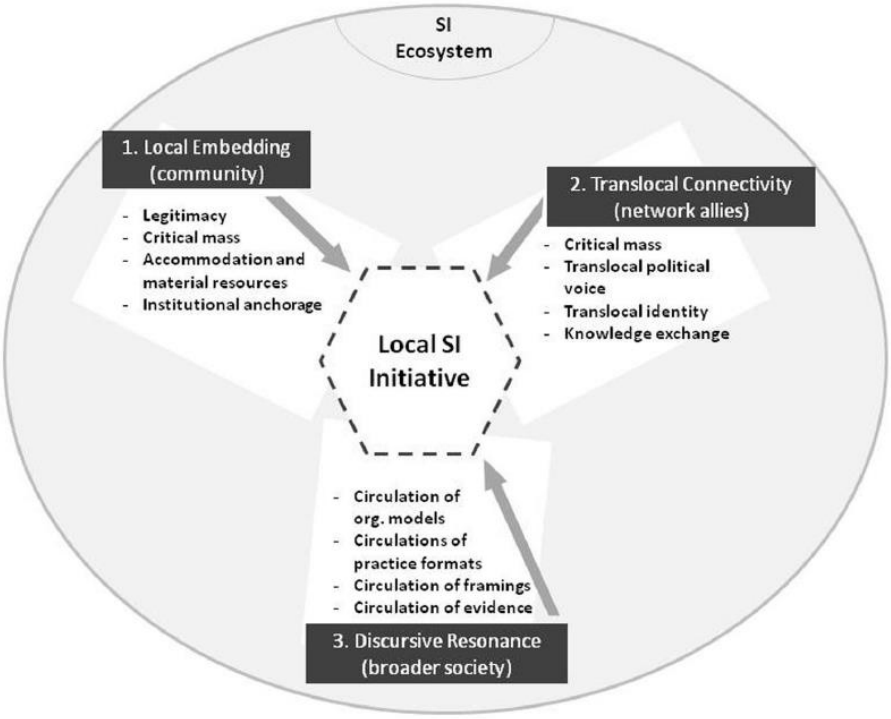
more informal, bottom-up social units such as grassroots movements. Because SIs often address the needs of marginalised and vulnerable groups in response to market and institutional failures (see Chapter 4), they arise from inter-sectoral resource orchestration, learning and problem solving. The process of SI hence concerns how actors from different sectors, as well as boundary-spanning actors, mobilise resources to achieve certain societal objectives. Instead of focusing on individual rationality as in neo-classical economics, a SI ecosystem emphasises actor constellations, collective action, and coordination in exercise of change agency, reflected in various forms of interdependence such as actor networks, public-private partnerships (PPPs) and so on.

The context is the other critical dimension of SI dynamics from the ecosystem perspective. As part of a larger existing social system, a SI ecosystem faces the problem of fitting into the incumbent actor networks, formal and informal rules, and social structures. This has important consequences for SI as compared to other types of innovation ecosystems because actors come from various spheres of the society and many bottom-up mechanisms are at work, which may well lead to tensions with the existing institutional framework and other "regime" conditions in the ecosystem. Therefore, when analysing a SI ecosystem, a comprehensive perspective is important to understand both enabling and constraining mechanisms that affect SI process (Terstriep et al. 2015). Barriers and constraints to SI can arise from actor resistance, as well as inertia and mismatch of institutional environment and framework conditions. As such, SI processes inevitably deal with contestation among actors and their constellations, as well as with actors' attempts to influence and change their institutional context. The latter, if successful, can give rise to institutional changes that are supportive to SI processes (Terstriep et al. 2022).

Given the importance of actor constellation, interaction, and coordination, a critical issue in leveraging SI ecosystems for successful SI initiatives is the meta governance that concentrates on the "empowerment of networked constellations". (Pel et al. 2020) point out three key processes that specify SI ecosystem dynamics:

- Local embedding: SIs need to take root in their immediate surroundings where local stakeholders play an important role in construction of legitimacy, critical mass, space, and infrastructure.
- Trans-local connectivity: This transcends geographical and territorial boundaries and contributes to the diffusion and generalisation of SIs.
- Discursive resonance: This goes beyond immediate steps and surroundings and is a collective process that helps innovative ideas and solutions gain political and scientific authority.

Figure 2.2: Key processes of empowerment of actors



Source: Pel et al. (2020)

3.3 Co-evolutionary models of social innovation

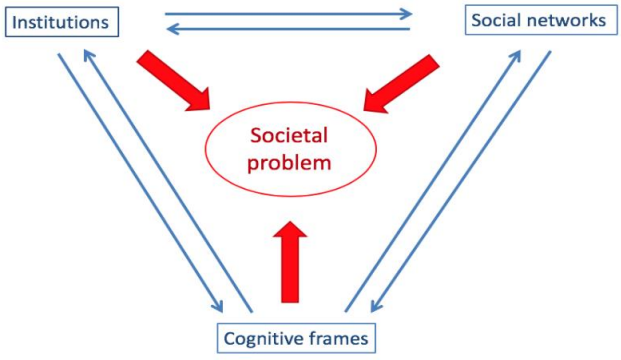
3.3.1 The Extended Social Grid model: networks, cognitive frames, and institutions

The extended social grid model (ESGM) has been developed to analyse social innovations aimed at tackling marginalisation of certain social groups. It focuses on the analysis of multiple, entwined social sources of power to analyse multi-faceted social innovation processes. It draws on (i) Beckert's social grid model developed for analysing markets by considering the role of institutions, social networks, and cognitive frames (Beckert 2010); (ii) Mann's theory on the sources of power (Mann 2012); and (iii) the capability approach (Nussbaum 2006; Sen 1999).

The dynamic version of the ESGM is motivated by the following line of arguments: "Social innovation discourses have typically focused primarily on innovation not just 'for', but also 'with' citizens (BEPA 2010). (…) this focus is justified and important, as only in this way will a joint 'problem' and 'solution' discussion of the social issue be possible. (…) this implies that there is a need to think of people not just as 'objects' that are empowered by a social innovation but, rather, as 'agents' who can co-create a social innovation process. Participation, therefore, plays a crucial role in effective social innovation or, in Nussbaum's formulation, participation 'in decision-making that governs one's life' (Nussbaum 2006, p. 77) plays a central architectonic role as it co-creates the way capabilities (health, education) are perceived, discussed and enacted." (Nicholls and Ziegler 2019, pp. 23–24)

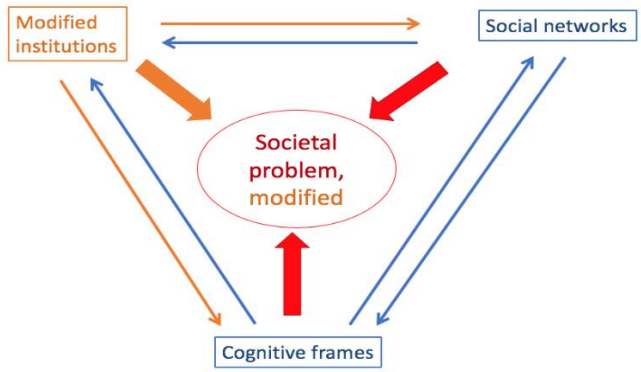
As the ESGM posits, the reproduction of societal problems, or the possibility to create new societal opportunities are determined by three social forces, that is, institutions ('rules of the game'), networks, and cognitive frames (Nicholls and Ziegler 2019; Ziegler et al. 2019). When a societal problem is persistently reproduced, SI practitioners and policy-makers need to consider the interactions of these three social forces: only those social innovations can tackle a societal problem that target all three social forces. (Figure 2.3) Otherwise, the 'untouched' social force(s) is (are) likely to reproduce that societal problem in a modified form. (Figure 2.4)

Figure 2.3: Reproduction of a societal problem: no intervention



Source: Havas and Molnár (2020), drawing on Beckert (2010)

Figure 2.4: Insufficient, failed social innovation



Source: Havas and Molnár (2020)

A given SI also needs to be sustained, and sufficient funds need to be made available, otherwise the societal problem cannot be tackled, or a new societal opportunity would not be created. These are the typical cases, and causes, of failed, insufficient interventions, using policy language.
Four main observations from the extended social grid model are highlighted in the concluding chapter of the book presenting the results of the CrESSI project (Ziegler et al. 2019):

- the need to move beyond a narrow analysis of economic space as markets if social innovation for the marginalised is to be understood in its full complexity and its impacts recognised beyond a reductive focus on business;
- the importance of a reflexive use of power in recognition of the reproduction of marginalisation (as well as the multi-level opportunities that emerge once this move is made);
- the role of beneficiaries in social innovation not only as participants but also as patients or subjects and, hence, the need to consider the role of (justified) paternalism in social innovation;
- a note of caution regarding the ability to trigger systemic structural change from local niche action.

3.3.2 A comprehensive theory of social innovation and social change

The SI-DRIVE (Social Innovation – Driving Force of Social Change) project pursued the ambition to develop a comprehensive theory of social innovation and its underlying concepts, processes, and impacts. The theory developed by the project is based on seven central building blocks that are briefly explained below (Howaldt et al. 2017):

(1) Foundational is a **comprehensive definition** of social innovation as "a new combination or figuration of practices in areas of social action, prompted by certain actors or constellations of actors with the goal of better coping with needs and problems than is possible by use of existing practices. An innovation is therefore social to the extent that it varies social action, and is socially accepted and diffused in society (be it throughout society, larger parts, or only in certain societal sub-areas affected)" (Dhondt and Oeij 2014, p. 122). Briefly put, SI encompasses new practices, methods, processes, and regulations. This comprehensive definition of social innovation focuses on "new social practices" and allows integrating the manifold meanings of social innovation under a shared umbrella definition that is based on and leading to a common concept and framework.

(2) The operationalisation of the definition of social innovation is achieved via **five key dimensions**:
   - concepts and understanding;
   - societal needs and demands addressed;
   - actors and networks;
   - resources, constraints and capabilities;
   - process dynamics.

   These key dimensions fundamentally affect the potential of social innovations, their scope, and their impact. They also promise a systemic understanding of social innovation and how it may interact with social change.

(3) A central role in this theory is played by **social practices and their reconfiguration** in shaping and contributing to social change. Social innovations are then about the emergence of new social practices. They subsequently serve the purpose of establishing new institutions guiding and stabilising new forms of social practice.
   This embeddedness of social innovations in institutional settings and the discrimination between different levels of action and their interrelation is further refined by the introduction of so-called **"practice fields"** as areas where specific social needs are expressed. They are positioned between the macro-level of policy fields" with their respective institutions and the micro level of related SI projects/initiatives". This is a kind of micro (SI initiatives), meso (practice fields) and macro (policy/institutional fields) view of social innovation, with concomitant implications for governance. The practice fields – for instance in areas like mobility, energy supply, health, or education – provide homogeneous and stable conditions for analysing social innovations in these fields, and how they contribute to addressing social needs. They also correspond to the level at which bundles of new social practices (experiments) can lead to a reconfiguration of dominant practices and institutions, and thus to social change.

(4) A **wide range of actors** is involved in these recursive processes of social innovation and social change. They are active at the different levels and across the lifecycle of a given innovation and form a network that can draw on a combination of individual and shared resources. Within this framing, public policy, as one specific type of actor, continues to be an important barrier or enabler for social innovation (Howaldt et al. 2017) by shaping the framework conditions for complex and dynamic social innovation ecosystems where the relationship between "the new" and "the existing" are continuously negotiated. The role for public policy and government thus consists of creating suitable framework and support structures, integrating resources of economy and civil society, as well as supporting measures by science and universities (e.g., education for social innovation performance, know-how transfer)

(5) The **empowerment of actors and human resources** play a crucial role for the development and diffusion of social innovations. In addition, successful social innovations are based on many presuppositions and require appropriate infrastructures and resources. Moreover, social innovations depend on specific conditions as they aim at activating, fostering, and utilising the innovation potential of society as a whole rather than only of research, government. and industry, which have been considered for long as the key actors in relation to (technological) innovation. This widening of the range of actors considered is fundamental to the comprehensive theory of social innovation proposed and constitutes what the authors call a new paradigm of innovation (Howaldt et al. 2014a).

(6) What is particularly important from a process perspective are the **complex mechanisms underpinning social innovation** and how they lead to social change. First of all, social change is understood in terms of co-evolutionary changes in structures, policies, institutions, practices and behaviours, thus also calling for complementary innovations to cope with the complexity of the challenges at hand.

Second, these co-evolutionary processes are driven by recursive, self-reinforcing dynamics between social innovation and institutional change. If successful, social innovations (understood as emerging new social practices) can lead to the establishment of new institutions, norms and values, that further guide and stabilise these emerging new social practices and thus ultimately lead to social change. In other words, there is a recursive relationship at play between social innovation and the institutionalisation of new social practices, quite similar to evolutionary and complex systems thinking about technological innovation, which emphasises self-reinforcing mechanisms between (technological or social) innovations and institutional change. It is also important to note that institutionalisation of new social practices may go hand in hand with the de-institutionalisation of established social practices ("exnovation"), driven by similar co-evolutionary or complex dynamics.

What follows from this understanding is the importance of experimentation with how social innovation relates to new social practices. A new (social) practice must lead to self-organised processes of imitation and adoption in society or societal subareas; only then one can find out whether or not it has the potential to become institutionalised, and how. Due to complexity, uncertainty, and ambiguity, this cannot be determined ex ante (Renn et al. 2011). These self-organised processes are understood as non-linear and non-sequential form of spreading, institutionalisation, and routinisation. This is also why scaling strategies of actors, or group of actors are not sufficient, even if they combine strategies for scaling out and scaling up. These strategies are an important part of the process of diffusion and institutionalisation that may be seen as a necessary condition or essential prerequisite for a social innovation.

(7) Finally, the **generative mechanisms underpinning these recursive dynamics** need to be disentangled: How does SI diffuse? How does SI get institutionalised? How are established social practices challenged and de-institutionalised? According to (Howaldt et al. 2017), the generative mechanisms of social change can be divided into three groups (see Box 2 for further details):

- *Input and process mechanisms* – these consist of the inputs and basic processes that social innovation needs to affect social change: learning, variation, and selection.
- *Driver mechanisms* – these consist of the drivers that social innovation needs to effect social change: conflict/tension, competition, and cooperation.
- *Structural mechanisms* – these consist of the wider structural changes caused by social innovation when addressing societal needs and challenges: diffusion of innovations, planning and institutional change.

Box 2: Generative mechanisms underpinning the theory of social innovation and social change

Overall, the theory of social innovation and social change builds on nine key generative mechanisms, which have varied roots in structural-functionalist, evolutionary, and conflict-based social theory and provide useful sensitising concepts for case study analysis and comparison, as briefly characterised in the following (based on Howaldt and Schwarz 2016).

1) **Learning**: Creation of new knowledge, both tacit and codified, leading to empowerment, capacity building, and improved absorptive capacity.
2) **Variation**: Emergence of novelty, new collective ideas, values, beliefs, fashions, culture, behaviour.
3) **Selection**: Adoption/non-adoption, imitation, and complementary innovation, leading to diffusion, decline or even death of initiatives.
4) **Conflict/tension**: Struggle between existing and new ideas, between fast technical and slow institutional change, and between the interests of different actor groups.
5) **Competition**: Pressure to improve the performance of innovations and their likelihood to succeed, possibly leading to competitive advantage in the pursuit of self-interest.
6) **Cooperation**: Importance of altruism, trust, networks, social movements, institutional structures, leadership for enabling innovation and change.
7) **Diffusion of innovation**: Driven by societal challenges, demand for action and change, including both the role of technological innovations as well as new social practices, as well as wider contextual forces, such as beliefs, ideas, values, religions, and culture.
8) **Planning:** Through the incorporation of social innovation in the planning procedures of public administration, the way is paved for a wider understanding of social change, and the means to achieve it.
9) **Institutionalisation of change**: Goal-oriented policies ensure the institutionalisation of new social practices and thus stabilise the pathway to social change.

While there are some similarities between the comprehensive theory of social innovation and social change, and theories of 'transformative' social innovation (see subsequent sections), there are nevertheless some noteworthy specificities. The comprehensive theory of social innovation and social change suggest a fluid interplay between practices and arrangements that mutually influence each other in their stability and dynamism. It thus differs from the more rigid systemic concepts of socio-technical system or multi-level perspective by thinking of social change as a self-sustaining process, which can be described in terms of the interactions between loosely linked practices and arrangements. In other words, it assumes greater plasticity, and thereby shifts the focus of interest onto the co-existence of different elements with, in some cases, opposing dynamics and onto the diverse mixtures of social practices. These mixed social practices can be dynamically reinforcing, crossing and opposing one another, and lead to the emergence of multiple innovation streams, in which cross-sectoral actor groupings, learning processes, experiments and initiatives are involved.

4 ACTORS IN SOCIAL INNOVATION

This section gives an overview of the types of actors involved in social innovation activities, together with the roles they assume. It draws on different approaches identified in the scientific literature on how types and roles can be systematised, taking into account the motivation, incentives, and organisational or institutional constraints with which these actors are confronted.

4.1 The variety of actors involved in social innovation

As the plurality of different definitions, typologies, and process models of social innovation already indicated, the concept is to some degree fluid and varied. A major characteristic of SI is that there is a wider array of actors potentially relevant (than for purely technological business innovations).

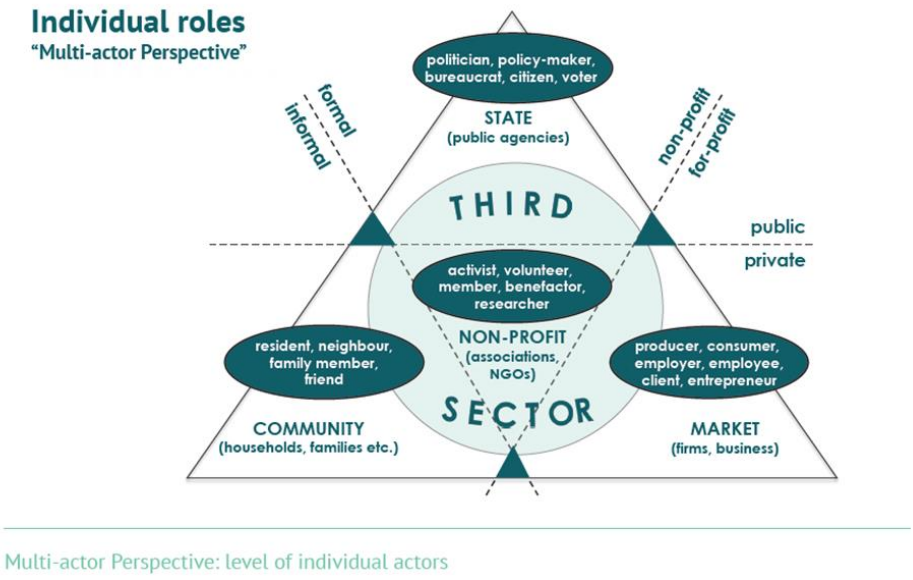
While some authors still refer to the triple helix model that includes government, industry and academia as the three relevant actor groups involved in the process of innovation (Bonomi Savignon and Corvo 2018), **most SI studies work with the quadruple helix, which also includes civil society** (sometimes including the community) (Bellandi et al. 2021; Nordberg et al. 2020) or even quintuple or penta-helix models, where the environment is added as a fifth dimension in the social innovation ecosystem (Carayannis et al. 2019).

However, because actors involved in SI are so heterogeneous and varied, the TRANSIT project (Avelino and Wittmayer 2018) suggests dividing actors into sectors rather than defining clear-cut and fixed categories. The sectors are divided along three axes: **formal – informal; non-profit – for-profit;** and **public – private**. This results in four sectors, as well as intermediate organisations at their intersections:

- State (formal, non-profit, public)
- Market (formal, for-profit, private)
- Community (informal, non-profit, private)
- Third Sector (mostly formal, non-profit and private, but extending to some degree into all three other spheres).

Each of these sectors includes specific individual actors (Figure 2.5).

Figure 2.5: Actor types and actor roles in social innovation



Source: Avelino and Wittmayer (2018)

The third sector is arguably the most diverse. It may include non-governmental and non-profit organisations (NGOs and NPOs), grassroots movements and other societal organisations, associations, informal groups or networks, donors/ philanthropists, foundations and even some forms of cooperatives. In this perspective, the third sector also includes academia, which is often a separate sector in more traditional triple or quadruple helix models. Depending on the context, it often makes sense to analyse the individual actor types in each sector separately, as their resources, motivations, and roles in the SI process can differ significantly.

The SIMPACT project (Butzin and Terstriep 2018), in turn, focuses on distinguishing actors based on their role in the social innovation processes. Four separate categories of actor roles are defined. **Developers** are at the core of the social innovation process and are responsible for initiation and operation of the solution. They are "able to translate knowledge about unsatisfactory circumstances into an innovative idea in order to improve the situation" Butzin and Terstriep (2018: 78). **Promoters** are partners of the social innovation process, providing infrastructure, funding, and connections to policy programmes. **Supporters** are involved in lobbying and dissemination activities that help diffuse the innovation. Finally, **knowledge providers** possess highly specialised knowledge needed for the given social innovation initiative but are otherwise not strongly involved. The four roles identified in SIMPACT are focused on the supply side of the innovation process, leaving the user (demand) side – i.e., beneficiaries of socially innovative practices, structures or products – underrepresented.

The two approaches detailed above are fairly straightforward, focussing primarily on actors and their roles. The multi-channel interactive learning model of social innovation as yet another example of a systemic model (henceforth, "multi-channel model of SI") by (Havas et al. 2020), provides a much more detailed and complex view of actors in social innovation processes (Figure 2.6). It combines prior work by Caraça et al. (2009) on business innovations with the extended social grid model of social innovation (Ziegler et al. 2019) and places the focus on societal problems and new societal opportunities.

The main building blocks of the multi-channel model of SI are

- the **types of actors** involved in, or affecting, SI;
- the **types of interactions** among the actors; as well as
- the **types of knowledge** (co-)created, exchanged, and utilised for, or during, a SI process.

These actors and processes are impacted by three types of social forces:

- the **institutions** governing the interactions among the actors,
- the relevant **social networks**; and
- the **cognitive frames** of the actors.

These social forces not only affect actors and processes, but also interact with each other. Cognitive frames influence what formal and informal rules are set and how these are applied, as well as how social networks evolve. In turn, social networks have an impact on who is involved in setting the 'rules of the game' and how these rules are applied, as well as on the evolution, propagation, and 'perpetuation' of cognitive frames.[10]
The actors and their forms of interaction are framed by the micro and macro level environments of an SI, which are composed of the education and training system, the cognitive frames on social innovations, the policy governance system for social innovations, the knowledge infrastructure available for social innovators, regulations (and regulators) affecting social innovations, and the funding opportunities for social innovations. From a different angle, the flows of knowledge, funds, and other resources are also of crucial importance.
Two types of actors play a distinctive, crucial role: social innovators, that is, the architects and/or leaders of a SI initiative,[11] together with the other SI practitioners. They act as an interface and a bridge between a given SI and its micro and macro environment. That is why they are depicted separately in Figure 2.6, at the 'periphery' of the 'circle' composed of the other SI actors.
Clearly, both the macro and the micro level environments affect a given SI and all its actors, but this is not indicated by arrows in Figure 2.6 to keep it relatively simple.

Havas et al. (2020) also identify possible types of interactions among actors, which in part take on a similar form as the axes identified in the Multi-Actor Perspective above:

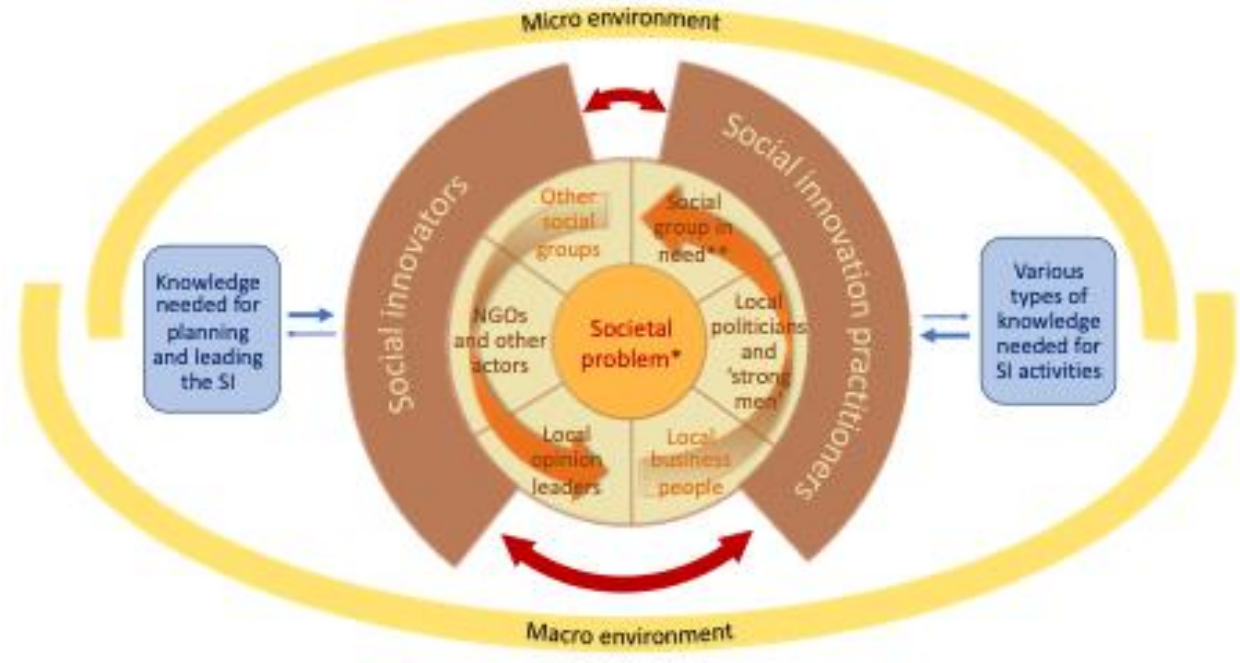
- hierarchical vs reciprocal
- market vs non-market
- formal vs informal
- discussing opinions on major societal issues, factors influencing the given societal problem

[10] The interactions among the three social forces are analysed in more detail in Havas and Molnár (2020), when real-life cases are presented as illustrations of the model.
[11] They are the *developers*, using the SIMPACT vocabulary.

- knowledge exchange, co-production of knowledge.

For example, politicians and other decision-makers are likely to prefer entering into hierarchical interactions with the other SI actors, while SI practitioners and NGOs typically build and maintain reciprocal interactions. Business people have financial/business interactions with the other actors, whereas social groups, SI practitioners and NGOs keep societal interactions, occasionally with some pecuniary elements. All actors have both formal and informal interactions with the other types of actors, but the 'weight' of formal and informal interactions is likely to vary by actors. All actors are involved in knowledge exchange, co-production of knowledge, although play a different role, and contribute with different types of knowledge to these processes.

Figure 2.6: The multi-channel interactive learning model of social innovation



Source: (Havas et al. 2020)
Notes: * or new societal opportunity; ** potential beneficiaries of a new societal opportunity

These interactions among the key actors influence how the relevant institutions are set and applied, how social networks evolve, as well as how cognitive frames are formed. In turn, these three social forces (i.e., institutions, social networks, and cognitive frames) influence the interactions among the actors.
For the sake of simplicity, the major elements of the micro and macro environment of an SI are not detailed in Figure 2.6; rather, these are listed in Table 2.5.

Table 2.5: The main elements of the micro and macro environment of a social innovation

Macro environment	Micro environment
Political opportunities or barriers	Local politicians and other decision-makers, personal connections among local actors and SI practitioners
Policies affecting SI initiatives, funding opportunities	Local policy schemes (if any), funding opportunities
Information infrastructure on social issues	Information infrastructure on local social issues (if any)
Education system	Local and nearby (available) schools
Municipal system	Local power structures
Labour market	Local and nearby (available) job opportunities
Social care system	Social care at the local level
Public opinion on the social innovation	Public opinion on SI initiatives at the local level
National media	Local media

Source: Havas et al. (2020)

4.2 Types of actors in social innovation: motivations, roles, and challenges

A SI ecosystem is characterised by diverse actors' interaction with each other and their interaction with the environment where SI process is embedded in (Alperstedt and Andion 2021; Terstriep et al. 2015). Through this lens, the way how actors mobilise resources and capabilities to achieve societal and other objectives, driven by their respective motivations and incentives, shapes the trajectory of SI process and the evolution of a SI ecosystem in turn. Both actors and the complex interactions take place at multiple levels, including micro-, meso- and macro-level that are interrelated through innovation activities. Drawing on the sector-based actor classification and role conceptualisation specified in 4.1, this sub-section further discusses the respective contribution to SI process, the roles played by actors – either individually or jointly –, and the constraints and challenges faced by them. How actors' roles change with the dynamics of SI process is also discussed.

4.2.1 The properties of different types of actors in the SI ecosystem

1) Motivations and incentives

Actors' motivations and incentives to participate in the SI process generally correlate to some degree with the characteristics of the sector they come from. Thus, market-based actors are at least in part motivated by financial or utility incentives: for-profit companies (Herrera 2015), not-explicitly-sustainable consumers (Bonini and Oppenheim 2008) and users most strongly so. The efficiency in resource allocation and market exchange is prioritised by this set of actors. Social enterprises and sustainable consumers also have financial and utility incentives but they are more strongly motivated by non-pecuniary aspects related to social purpose, e.g., sustainability, equity of access, or poverty reduction. Sustainable consumers, by comparison, put more emphasis on the social value of consumption apart from the utility of products and services. Many community-based actors draw their motivation from the enhancement of social identity and social capital (Jaeger-Erben et al. 2015); equally important as a motivation for many citizen innovators is solving problems that they themselves are affected by (Ziegler 2017). Public sector actors are involved in SI to increase public welfare beyond traditional way of public administration. Because third sector actors are so diverse, they must be regarded separately. Academia has distinct organisational forms and boundaries. It is inherent to the nature of academic organisations to be involved in innovation processes according to the traditional triple helix model of innovation systems. In addition, there is a growing call for academic organisations to assume the "third mission", i.e., societal engagement. This makes higher education institutes (HEIs) an increasingly relevant actor in SI initiatives (Anderson et al. 2018). Researchers within and outside these organisations have personal motivations, too, which can be diverse and include pecuniary incentives, career advancement, appreciation, research support and so on (Sormani et al. 2022). Other diverse, more informal and fluid actors in the third sector engage in social innovation, especially to address societal needs and gaps, for example, NGOs and foundations.

2) Roles, capabilities, and contributions of different types of actors in the SI process

A resource-based view of actors and capability approach to SI ecosystem can be adopted to examine each actor's capacity and contribution and hence respective roles in the SI process (Biggeri et al. 2017). This theoretical perspective takes stock of the importance of resources and capabilities possessed by change agents. The trajectory of SI is dynamically shaped by their activities in learning and co-creation. However, this does not mean that actor's role corresponds exactly to their capacity; in fact, the analysis that follows shows the potential tension and mismatch between them which could hinder SIs.

Within the role conceptualisation presented in section 4.1, each individual type of actor plays multiple roles. For example, an individual is a political citizen, consumer, and volunteer in his or her private life and contributes in these roles to the creation, "use" and diffusion of SIs. As an employee of a company the same individual provides specialised skills for the process of SIs as part of his or her professional life. For an actor in a certain context, different roles are not equally prominent. Further, some roles may have a more profound influence on SI than others. Likewise, because of the necessary complementarity in resources, assets, competences, and the boundary-spanning nature of SI process, it is common that a certain role is jointly played by multiple actors. For example, knowledge co-creation often takes place between social enterprises, funding bodies and users (beneficiaries) in the SI ecosystem (Terstriep et al. 2022).

Developers of SI are at the core of a SI processes. Often the initial idea needs to be developed and an organisation should be established to start the SI initiative. This represents actors directly involved in the initial stage of the SI, as well as the operative work of the established organisations. In many cases the inner core

consists of individuals, civil society, employees, and the organisation itself, hence mainly from the third sector, social enterprises, and the community (Terstriep et al. 2015). The initiation of SI cannot be accomplished alone by single actors; it necessitates collaboration among actors from various fields, because of the need to pool physical resources (e.g., space, infrastructure, clothes, food, facilities, materials), funding, and skills. These actors also contribute to the operative work of the SI organisation. Notably, actors from the demand side, i.e., the beneficiaries and target groups of the SI initiative are actively involved in the operative work as well, as they can be the change-makers themselves Drayton 2006). By being engaged in developing a SI process, civil society actors tend to be social innovators or co-creators, on the one hand, and beneficiaries of SI, on the other. Actors from the policy field can also play an important role in developing a SI when they have a direct bearing on the issues and problems addressed by the SI initiative. Again, this is undertaken not by a single sector, but by specific governance arrangements, such as a public-private partnerships (PPP) that combine the competences of different actors to serve societal purposes (Brinkerhoff and Brinkerhoff 2011).

Supporters are close partners of developers in the initiation and operation of a SI process. They do not need to be fixed partners of the SI organisation but are close partners who are involved in the operative work as well. Such supporting relations often exist among non-profit or for-profit organisations. For-profit organisations contribute to the functioning and financial income for SI initiatives through buyer-supplier relation, or direct material donations (Martinez et al. 2017). Individuals that have informal access to the inner core of SI developers through social networks are important contributors to support SI processes. They offer additional and equally important human resources, competence, and operation management skills for the initial development of SI. Actors from the government sector sometimes act as the supporter to the inner core by diffusing SIs incorporated into existing policy initiatives, which is helpful to build up their legitimacy and publicity (Lehner and Nicholls 2014). In addition, HEIs and researchers play the role of supporters by project funding proposals that raise decision-makers' awareness to certain societal problems and justifying the necessity and means to solve them. Their dissemination and generalisation activities in academic research contribute to legitimising SI initiatives and change mindsets in wide societal circles (Morawska-Jancelewicz 2022).

Promoters come from various sectors, including economic, political, civil society, and the "third sector". The organisational types involve governmental departments, corporations, foundations, charities, associations and so on. Government as a public sector actor is a major promoter in provision of public funding and physical infrastructure directly, or SI-related programmes or partnerships whereby social innovators can access a wide array of potential partners for resources and couple themselves with existing policy programmes to gain relatively solid status of legitimacy (Tardivo et al. 2017). Through these mechanisms of support, public sector's involvement may be a source of capacity building. For example, New Art Exchange receives a large proportion of fund from the UK's Arts Council, the latter providing "support for capacity building as a means of strengthening governance arrangements in arts organisations and enhancing their ability to manage grant funding" (Terstriep et al. 2015). In terms of funding, the private sector is yet another important source of support (Martinez et al. 2017). This sector also channels funding into the third sector, such as foundations and trusts, which then channel money to SI initiatives that address specific societal needs, hence help materialise the idea of founders of an SI organisation (Terstriep et al. 2015). While the promoter's role is more or less associated with public or private finance, support from the private sector also takes the form of new business models, management, specialised skills to facilitate the creation and diffusion of SIs (Boons and Lüdeke-Freund 2013). The mature human resource system from businesses is an additional source of capacity building through provision of training and learning by doing during co-creation. Civil society actors often do not have the scale of funding comparable to public sector or corporations, but they are valuable promoters in terms of social capital, especially the trust built among SI actors and between a SI ecosystem with the wider socio-economic environment, and solidarity as a relational asset (Habisch and Adaui 2013).

Knowledge provider stands out as the fourth important type of role played by various actors. SIs learning and knowledge creation benefit significantly from users and beneficiaries, which offer first-hand insights into societal problems and needs as a large number of SIs originate from grassroots in civil society. Users' acceptance and participation contributes the success of SI solutions (Devinney et al. 2006). They are not only engaged in feedbacks and social innovators' learning by doing process, but also in some cases as co-creators, who are directly involved in the development or improvement of SIs, or personalisation of readily available solutions that assist the diffusion of SIs (Busse and Siebert; Jaeger-Erben et al. 2015) Private sector provides knowledge on ideas, solutions, and management of SI through business consultancy (Martinez et al. 2017).

While the public sector is less of a knowledge provider compared to users, HEIs and researchers are another candidate of knowledge providers the SI ecosystem (Kumari et al. 2019) in identifying problems and solutions, evaluating interventions, and generalisation of SIs. In addition, discipline-based and inter-disciplinary expertise can be directly applied in the problem-solving process in developing and diffusing SIs.

3) Challenges and constraints faced by actors

Findings from the SIMPACT project case studies indicate that public sector actors often "lack knowledge on how to work with social enterprises and what their precise role in the welfare system is" (Terstriep et al. 2015). This shows the contradiction between the institutional logics and governance structure in the public sector and the need for bottom-up, problem-oriented SI solutions from the perspective of other SI actors. Another institutional logic and related governance structure is based on market exchange. While the private sector provides many critical resources, including finance, labour force and specialised skills, the market failure argument (elaborated in more detail in Chapter 4) also applies to SI (Nicholls and Murdock 2012). Despite growing attention to principles of corporate social responsibility, societal needs are not viewed as the main objective of innovation activities by businesses (Herrera 2015), hence societal goods would remain underprovided, let alone the fact that the incumbency of many business establishments itself is a source of resistance to change.

Major social innovators act at the intersection and often the overlapping edges of different sectors with their respective institutional specificities. Organisations do not always impede societal change, but when it comes to SI that often emerges in response to market and institutional failure, the organisational structure is then frequently questioned and challenged (Živojinović et al. 2019). One important manifestation of institutional constraint resides in a variety of third sector actors and social enterprises, whose legal forms and organisational representations become a problem such that resources for SI process are under-mobilised and SI activities are inhibited. Taking social enterprise and social entrepreneurship as an example, due to a lack of harmonised regulation, its legal forms and statutes vary across associations, foundations or cooperatives (Wilson and Post 2013; Barroso 2011; BEPA 2014) and this hampers trans-territorial operation and diffusion of SIs.

There are also constraints and challenges faced by other actors in the third sector and community. For academia, existing organisational structures, management frameworks, funding and education arrangements in HEIs are not well tuned to SI-related "third missions", despite the growing awareness and advocacy to do so. This also constitutes an institutional barrier at the micro level faced by individual researchers and groups of them. However, one problem with academic actors seeking to address societal problems is that they tend to overlook the perspectives of the target groups (Terstriep et al. 2015), hence the results of research projects do not necessarily respond to societal needs. Other actors, such as consumers, communities, and actor groups may find themselves constrained by the fact that their agency is more distributed than that of other well established SI actors. The difficulty in collective action, joint provision of resources and societal goods and generalisation of SIs could be a challenge faced by these actors.

4.2.2 A dynamic perspective of the roles of actors in SI process

SI processes are non-linear, emergent, and subject to actor-environment co-production. While the exact steps in the dynamic process are debatable, there is a general progression from initial idea development to operationalisation of a SI solution, value creation, and the subsequent diffusion of SI, with loops of feedbacks and iterations. As the focus of innovation activities varies depending on the stage of SI processes, it is reasonable to expect that the roles played by different actors differ from stage to stage as well. For instance, it has been observed that third sector and community sector actors play a more dominant role in the inner core of SI ecosystem at the initiation, operation, and organisation stage.

With the consolidation and uptake of SI initiatives, the public sector steps in as an important actor by providing financial resources and legitimacy for SIs. However, this depends on how the SI initiative is framed in relation to governmental goals (Terstriep et al. 2015). The private sector also plays an important role throughout the entire process, initially providing early funding support and consultancy on project management and operation, and later channelling an increasing volume of societal investments into SIs to help generalisation (Herrera 2015; Martinez et al. 2017). The role of academia as knowledge provider and supporter also stands out over time, initially in co-learning and later in co-creation and legitimacy building (Kumari et al. 2020; Puente et al. 2021). On the demand side, the beneficiaries of SIs are a major source of knowledge when initiating SIs and when framing problems and possible solutions, just as users and citizens are important for sustaining SIs by making use of them and appreciating the social value SIs generate.

It is important to note that the roles of the actors may change in the course of the life cycle, and with it their relative influence of the shaping of SI. Civil society actors (NGOs, NPOs) together with social enterprises are the core actors in the SI process, followed by private companies, public actors, and other types of actors (Butzin

and Terstriep 2018). The relevance of public sector actors increases over time. There is often a mismatch between the major role played by certain actors and their resources and capabilities. For example, researchers should be an important source of knowledge provision but have been underrepresented in the area of social innovation so far (Anderson et al. 2018; Butzin and Terstriep 2018) Social enterprises and their sub-types (e.g., cooperatives) are core developers in SIs, but are constrained by physical and financial resources, as well as struggle with their organisational and legal forms in different contexts (Wilson and Post 2013). This could be a hindering factor for SI processes, let alone the detrimental influence of incumbent actors who act as opponents to SIs.

4.3 Empowerment and Disempowerment through Social Innovation

Against the background of the diversity of actors, their roles, and relations in social innovation processes, it is important to consider questions related to power structures and the empowerment or disempowerment of certain actors. This is due to three reasons. First, power structures might enable or impede the emergence and diffusion of social innovations. Second, the empowerment of novel actors is often argued to be a core function of social innovation. Finally, due to the empowering of novel actors, social innovations might unfold transformative power insofar as they challenge, alter, or replace social relations (Haxeltine et al. 2017).

To analyse the role of power in social innovation processes, Avelino et al. (under review) suggest distinguishing different forms of power and their manifestations. For example, “power to” refers to actors’ capacities to mobilise resources, “power over” refers to mechanism of forcing other actors to certain activities while “power with” refers to collective activities associated with social innovations. In the context of social innovation, “power to” might refer to the power to invest in the development and generalisation of certain social innovations or, in contrast, to lobby against certain ones, while “power over” might be linked to governmental support and the political will to pick up and support certain types of social innovations. “Power with” is the type of power mostly linked to social innovation initiatives and their strategies for example of collaborating in networks, initiating crowdfunding campaigns or jointly experimenting in lab formats (de Geus et al. 2021).

Furthermore, Avelino et al. 2019) discuss to what extent social innovation supports empowerment of novel actors. Empowerment is understood as a dynamic process “through which actors gain the capacity to mobilize resources to achieve a goal” (Avelino et al. 2020, p. 105) – for example, through collaborating with others in networks. Although (Avelino et al. 2019) generally stress the importance of power relations with respect to social innovation, they also raise other issues related to the empowering nature of social innovation:

- Processes of empowerment are likely to be mirrored by process of disempowerment of other (incumbent) actors.
- Empowerment is not an individual concept, power structures emerge in complex systems as a result from various action but cannot be intentionally steered.
- Power is self-developing; empowerment cannot mean that power is allocated to a particular group in society.

However, it still seems that many social innovations have a particular strength in developing new frames and associated mental models, as well as narratives that are novel in their way of understanding a problem or a need and redevelop or suggest new roles for particular groups or people in society.

Finally, this links to questions about the transformative power of social innovation. In order to have transformative impact, social innovations must be able to exercise ‘prefigurative’ power, i.e., the capacity to propose new and different ways of doing or thinking (de Geus et al. 2021). Further, transformations require reinforcing power linked to implementing novel organisational structures necessary for supporting and diffusing social innovations. Finally, transformative power is, therefore, also linked to countervailing power that challenges existing structures and institutions. To unfold transformative power, the combination of different types of power is decisive (Avelino et al. 2023).

5 ROLE AND CONTRIBUTION OF SOCIAL INNOVATION IN THE CONTEXT OF SOCIETAL TRANSFORMATIONS

The preceding sections focused mainly on social innovation, without too much attention to questions of impact and – more specifically – how social innovations contribute to the transformative processes needed to address the three types of societal challenges presented in the introduction, i.e., i) system change, ii) disruptive technologies, and iii) crises. Section 3 introduced different process perspectives on social innovation, and this section will be complementary in taking perspectives of societal transformation and social change as its starting point.

In the next sections, we revisit some influential perspectives that have shaped our thinking on transformative change in the past twenty years. In line with the observation that innovation studies are nowadays paying more attention to social innovation, we first revisit Schumpeterian perspectives on societal change, and more specifically the work on innovation (in general) and techno-economic paradigm shifts by Carlota Perez and Chris Freeman. It is contrasted with the more recent perspectives developed by the (sustainability) transitions community and in (transformative) social innovation studies.

5.1 Schumpeterian perspectives

For obvious reasons, societal changes and transformations are not the central issue for researchers analysing business (technological) innovations. Yet a well-known classification on the type and level of change, developed by Freeman and Perez (1988), Perez (1983, 1985, 2010) considers societal change explicitly at the level of technological systems and techno-economic paradigms. Business innovations at the level of *goods* (products and services) can be incremental or radical.[12] When radical innovations diffuse widely, they might induce societal changes to a different extent.[13] For example, when sailing ships were being replaced by steam ships, no fundamental societal changes occurred. While new players entered the sector and new business models were introduced to take advantage of the significantly faster delivery of goods between continents, the life of sailors has not changed drastically. Of course, for those people who lost their jobs, the change was fundamental. Clearly, a new set of skills was required to operate steam ships, and thus the training system had to adjust as well. Further, certain goods became available for new (a larger number of) consumers, and thus their consumption patterns changed to some extent. In several other cases the societal changes were fundamental, for example when cars, tv sets, contraception pills, antibiotics, mobile phones, and the internet became widely available. In these cases, not simply a "component of a sub-system" in a given system was replaced, but a new component was "injected" into an existing system, partly inducing, partly necessitating systemic changes. These changes led to either a fundamentally renewed system, a new system replaced the previous one, or a brand new system was created (almost from scratch). These examples clearly indicate that the *type* of change – incremental vs. radical – and the *level* of change – a single good vs. a system – can be closely interrelated, e.g., a "chain of changes" might be put into motion, leading to changes at other levels. A thorough understanding of these interconnections and repercussions is of major relevance both from a theoretical angle and for underpinning policies.

Moving to the next level of changes, from time to time a 'bundle' of radically new products, services, and/or production equipment and processes are introduced, which is termed as the emergence of a new *technological system*. A new technological system deeply affects several existing sectors at the same time or even creates new sectors. The diffusion of these radical technological innovations – e.g., electrical household equipment or plastic goods – necessitates financial and organisational innovations, new cognitive frames, behavioural changes, modified or new curricula to train (or retrain) the producers of these new goods, as well as finding adequate ways and forms of "educating" the consumers (users) of these new goods. Hence, a new technological system is a system, indeed: its elements on their own, or in isolation, would not be sufficient to induce significant changes. Clearly, there are major societal implications – changes – when a new technological system becomes established (e.g., much less time is to be spent on cleaning, washing, etc., and thus significantly more "free time" for other, including new, activities).

[12] Although this distinction is not applied to analyse process, organisational, marketing, financial or business model innovations, it can be readily extended to characterise those as well.

[13] Societal changes induced by radical innovations at the level of goods are not analysed in detail by Freeman and Perez.

When all crucial elements of an economic system – the major materials and inputs, the decisive technologies, business models and processes, the structure of the economy (both in terms of its sectoral composition and the structure of supply and demand), the interactions among businesses, the mindset of decision-makers, the behaviour and preferences of consumers – are being fundamentally changed, we speak of the emergence of a new *techno-economic paradigm*. Clearly, that is a lengthy and cumbersome process, with substantial economic and social costs, as well as societal transformation processes.

More generally, the systemic approach to analyse innovation processes in their broad socio-economic context, that is, the innovation systems school, also widened the scope of analysis by putting a strong emphasis not only on the economic impacts of innovation, but on its societal and environmental impacts as well.

Most scholars have assumed for long that business innovations have favourable impacts. This view is shared by many policy-makers, beyond the STI policy domain as well. Business innovations – in particular technological ones – are supposed to lead to improvements in the properties of goods; productivity and thus financial performance of firms; health conditions of people; the use of inputs and so forth. Ultimately, all these changes amount to an increase in the wealth of nations. It should be added, however, that business innovations, characterised as creative destruction, have a destructive element as well: incumbent firms need to adjust to new circumstances by abandoning some of their previous activities, reducing labour force, reorganising their production and business processes, changing management and other practices, etc. It is a crucial feature of market economies that firms are driven out of business by more efficient competitors. The net impact is still assumed to be positive, given the advent and subsequent rise of the new entrants.

This still widely held, optimistic assumption concerning business innovations has been questioned more recently.[14] Probably the most widely known cases of destructive business innovations by now are those financial ones that have been introduced in the name of 'dispersing the risk', but in essence allowed a few, well-informed and well-positioned actors to earn substantial profits while putting a huge burden on society as a whole (Soete 2013, pp. 141–142). The environmental burden of new products and technologies is also rather high in many cases.

At a first glance, it may seem difficult to bridge the Schumpeterian perspective on transformative change with three challenges addressed by this project. However, considering challenge 1 (*SI and system change*), it is worth recalling that many social and hybrid innovations are aimed at tackling the negative social and environmental impacts of the transformation of large socio-technical systems induced by technological innovations (and the related non-technological business innovations), e.g., in the fields of mobility (mass motorisation by using vehicles powered by internal combustion engines), heating, energy supply, and the modern chemical industry (all based almost exclusively on fossil fuels for decades). In some of these fields – not all, though – there are a growing number of social and hybrid innovation initiatives, especially to find new mobility and energy supply and consumption solutions at the level of communities (see the SONNET project's findings on energy). These social and hybrid innovations rely on radical innovations at the level of goods (both consumer products and production equipment) and emerging new technological systems (e.g., electric and hybrid vehicles: cars, motorbikes, scooters, and bicycles, with their physical and legal infrastructures, service providers, and business models). In other words, we argue the emergence of new technological systems is closely linked to social innovations, even though this was not initially in the focus of Perez and Freeman's analyses.

As for challenge 2 (*SI and disruptive technologies*), we can think of "tamed" disruptive technologies, e.g., robots used for elderly care and in hospitals. These solutions also rely on radical product innovations and the related organisational solutions and business models (depending on the type of service providers: private, private non-profit, public). The "taming" can be achieved by social and other non-technological innovations.

Considering challenge 3 (*SI to tackle a crisis situation*), existing technological and non-technological business innovations can be modified to be used for new purposes, that is, tackling the crisis. For instance, the various extant software packages for education and virtual meetings were heavily used during the lock-down period introduced because the COVID-19 pandemic. These are either incremental or radical product innovations and they are complemented by business model innovations in some cases. More importantly, social innovations – changes in social practices, cognitive frames, institutions and social networks – are also required when these business innovations are modified and often even turned into social innovations (in the sense that quite a few

[14] For a short overview of the literature stressing the negative societal and environmental impacts of business innovations, see, e.g., Havas and Molnár (2020).

of those were made available free of charge or at a low price during the COVID-19 crisis). The vaccines developed against the COVID-19 virus were also based on existing technologies, developed by profit-oriented firms, modified for this end. Finally, the 'business models' of researchers working in the private and public sectors were also changed substantially: quick and free exchange of newly created knowledge and free access to data sets became the norm almost instantaneously – overriding the previous IPR rules.

5.2 Multi-level perspective and Technological Innovation Systems (TIS)

Research on sustainability transitions has put an explicit emphasis on conceptualising transformative dynamics, thereby drawing partly on insights from evolutionary economics and complex systems thinking, but also from science and technology studies. A co- and quasi-evolutionary understanding of processes of social and technological change, with that of institutional development has been of central importance in this work. Besides the multi-level perspective (MLP) on transitions, systems approaches, like TIS (Technological Innovation Systems) and – more recently – MIS/ MSS (Mission-oriented/ Mission-specific Innovation Systems) have been suggested as heuristics to help analyse and explain innovation and transformation dynamics. The latter are based on a combination of structural and functional analysis at meso-level, underpinned by the analysis of actor strategies at micro-level, and the analysis of dynamic processes.
More recently, these micro- and meso-level frameworks have been embedded in macro-level frameworks such as deep transitions (Schot and Kanger 2018) and global innovation systems (Binz and Truffer 2017). These approaches, however, are always tied to a specific normative orientation towards – mostly environmental – sustainability, thus leaving alternative normative framings largely aside.

5.2.1 Transitions from a multi-level perspective (MLP)

The MLP emphasises socio-technical and institutional dimensions of sustainability transition, and it argues that sustainability transitions cannot be achieved as merely bottom-up or top-down processes but require an interplay of micro-level niche developments and meso-level regime changes.
Transitions are framed as long-term processes that are non-linear, meander back and forth and address a multitude of conflicts and problems along that pathway. Transitions are meant to overcome established and often path-dependent socio-technical system trajectories; challenges that cannot be overcome within prevailing governance structures and processes, but for which learning spaces need to be created in a bottom-up fashion, both for specific technological options and for wider institutional conditions. They require the interaction of social groups at different levels including local citizen initiatives, social movements, user groups, and policy-makers, as well as businesses that develop more sustainable solutions and business models, which can contribute to such a transition (a 'whole of society' approach).
Geels and Schot (2010) characterise transitions as co-evolutionary and encompassing changes in socio-technical systems at multiple levels. The niche level provides space for experimentation; it is the locus where it is possible to deviate from an existing path and obtain knowledge about user behaviour, collaboration needs, new practices and rules (Smith and Raven 2012). The regime level provides more stability in that there are institutions, infrastructures, and a common understanding of problems and possible solutions. Moving novel socio-technical solutions from the niche to the regime level is not just a matter of diffusion and scaling but requires the embedding of novel solutions in institutional environments that may equally require major changes. The third level, the socio-technical landscape provides even stronger structuration but is beyond the influence of single actors and considered mainly as a slowly changing context for innovation and socio-technical transformation (Geels 2002). A more detailed description of the mechanics of the MLP can be found in Box 3.
This broad picture of transition dynamics still faces many challenges (Smith et al. 2010) and was refined in many regards in the last two decades, for instance in terms of characterising different types of transition contexts and pathways (Smith et al. 2005; Geels and Schot 2007). It has also been applied to social innovations (Bui et al. 2016; Ó Tuama 2015; Hölsgens et al. 2018; Hynes 2016). A more detailed account of the mechanisms that are underpinning the uptake and embedding of novel solutions has been provided by Sengers et al. (2021), who distinguish four main types of 'generalisation pathways': replication & proliferation, expansion & consolidation, challenging & reframing, circulation & anchoring. A different take on how to address the challenge of moving from niches to regime changes has been proposed by Ghosh et al. (2021), who stress the importance of creating transformative outcomes as steppingstones towards both niche

development and regime change: opening up & unlocking regimes, building & nurturing niches, expanding & embedding niches.

These lines of reasoning reflect the strong emphasis of sustainability transition studies on bottom-up learning processes, co-creation, and experimentation. Their wider uptake depends on aligning with and/or destabilising the existing regime to create space for alternative solutions. Top-down strategies for changing regimes, e.g., by way of major institutional reforms, have overall received less attention in sustainability transitions. There is, however, a growing body of literature on the concept of exnovation, which is understood as the purposive and explicit phasing out or modification of unsustainable systems, including "existing (infra)structures, technologies, products and practices" (Heyen et al. 2017, p. 326) as well as associated or stabilising policies and other governance mechanisms. Exnovation research focuses both on identifying and overcoming resistance strategies by incumbent regime actors (e.g. Geels 2014; Heyen 2016) and on strategies for designing successful and socially acceptable exnovation processes (Heyen 2016; Heyen et al. 2017).

The entire transitions literature has its origin in the analysis of technologies and how they evolve from niches to widespread solutions and practices. Social innovation has been addressed in this strand of literature only in recent years, but it seems that the transitions framework is sufficiently open and flexible to accommodate for paying sufficient attention to (novel) social practices as important building block in conjunction with technological innovations. As regards the purposes of innovation, the sustainability transitions literature has been stressing the environmental aspect, but more recently has opened up to social purposes (e.g. in relation to just transitions).

Box 3: The multi-level perspective on transitions – a brief introduction

The MLP is a three-tiered framework that includes the landscape, regime, and niche level. The **socio-technical regime** at the centre encompasses six connected and interlocking elements: technology, policy, production networks & industry structures, markets & user practices, science and socio-cultural aspects, whose interactions are governed by cognitive, regulative, and normative rules (Geels and Schot 2010). Cognitive rules include belief systems, guiding principles, goals, innovation agendas, problem definitions and search heuristics; regulative rules are regulations, standards and laws. Examples of normative rules are role relationships, values and behavioural norms. These rule sets mirror very closely the three social forces described in the ESGM model (see Chapter 3.3.1), namely institutions, social networks and cognitive frames, which are understood to reproduce – and stabilise – particular societal problems. As a result of the co-evolutionary development of individual components of a regime and their resulting complexity, regimes are assumed to be "dynamically stable" constructs: they innovate, but only incrementally, not radically (Geels and Schot 2010, p. 21).

The bottom level shows the niche, which is a protected space – not subject to the pressures of market and other selection forces – in which new ideas can be initiated, experimented with and later consolidated. The niche gives innovations the chance to mature, "allowing the co-evolution of technology, user practices, and regulatory structures" (Dana et al. 2021, p. 2). Niches are heavily actor-centric (Sarasvathy and Dew 2005), with their success in no small part dependent upon the objectives, skills, values, and motivations of the actors involved (Bodenheimer 2019). They do not exist inherently; rather, they come into being through the creation of a new idea and may just as quickly disappear if the innovation is not successful. On the other hand, some niches may exist for as long as two to three decades (Geels and Schot 2010) as innovations undergo experiments in multiple different contexts, locations or at different scales, before they ultimately either succeed at becoming part of the regime or fail and disappear. In some cases, the purpose of the innovation may even change over the course of its time in the niche, depending on its development path. The many small and chaotic arrows both in the niche and in the regime during the phase of transformation are meant to indicate that the process of niche development and regime transformation are not linear and straightforward and involve many different actors and elements that co-evolve. It is a dynamic process of adjustment that can include feedback loops, a mixture of early adoption and resistance to change by incumbents and changing actor roles throughout the transition.

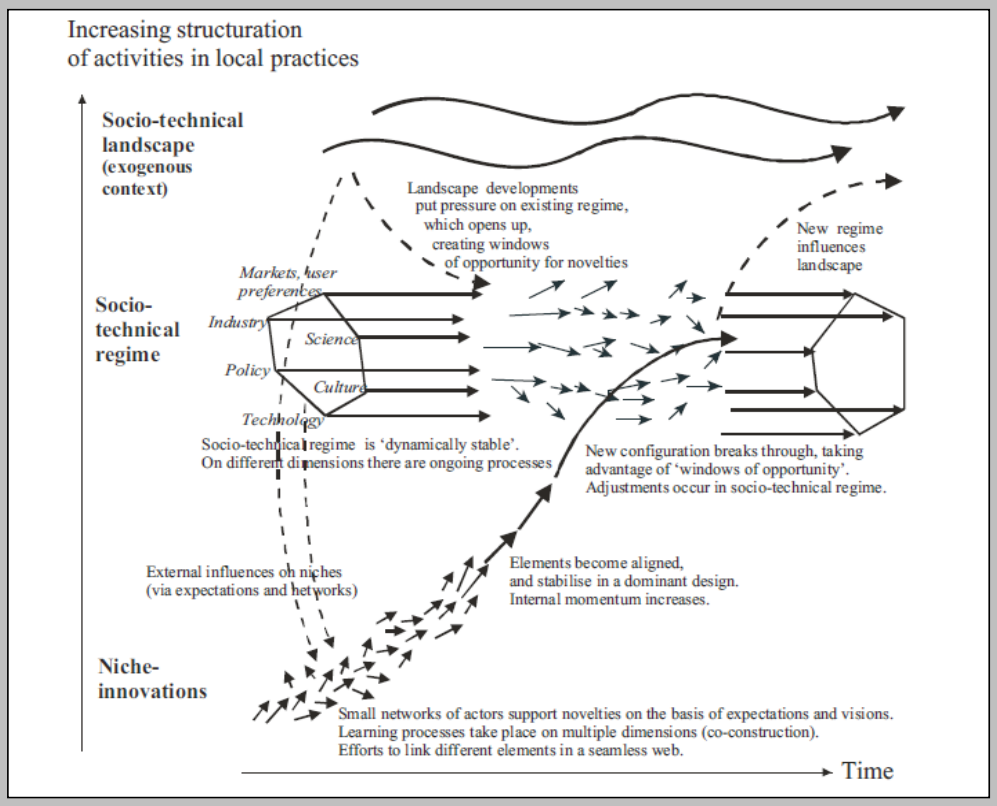


Figure 2.7: Multi-Level Perspective on Transitions (Geels and Schot 2010, p. 25)

The **socio-technical landscape**, at the top level, includes all exogenous processes with relevance to regime or niche. Examples of landscape factors include macro trends like climate change, demographic change and digital transitions, the nature of the political environment or cultural aspects that are not directly related to the system of transition. It is important to note that all three levels are always defined with reference to a specific transition, meaning that the specific manifestations within each level are case-specific.

The MLP is a heuristic that is very much process-oriented and highly **dynamic**, in part because of its long-term perspective on socio-technical transition. Its conceptualisation gives room to a large number of possible changes in the system over time, including the nature and purpose of innovations at the niche level, the amount and type of support or resistance by regime incumbents, as well as the landscape factors influencing both niche and regime. Over time, the actors involved and the roles they play may change, as well as the resources that are available and the alliances that exist. The purpose of the MLP is to describe a system in flux and to trace and better understand those changes from beginning to end.

To further support this understanding, Geels and Schot 2007) suggested four different **transition pathways** (Table 2.6) through which socio-technical transitions can take place. Which pathway applies in each case depends on three dimensions: (1) the speed and scope of the changes taking place (Suarez and Oliva 2005), (2) the nature of interaction between the regime and niche innovation (symbiotic or competitive), and (3) the degree of maturity of the niche innovation.

Regarding speed and scope, Geels and Schot (2007) focus on three types of external changes: specific shocks (high speed, low scope); disruptive changes (low speed, low scope); and avalanche changes (high speed, high scope). While both the development and maturation of niche innovations, as well as the opening up and transitioning of the incumbent regime may take place gradually, at other times it happens more suddenly when a so-called **window of opportunity** opens up. This is the case when landscape pressures align and suddenly put so much pressure on the regime that it is no longer able to adjust, in spite of existing path dependencies and co-evolutionary stability. An example of such sudden landscape pressures was the nuclear disaster at Fukushima, through which a window of opportunity opened up for nuclear power phase-outs.

Table 2.6: Overview of transition pathways (based on Geels and Schot 2007)

		Nature of Interaction	
		Symbiotic	Competitive
Status of niche innovation	Immature	Transformation pathway (disruptive change)	De-alignement and realignment pathway (avalanche change)
	Mature	Reconfiguration pathway	Technological substitution pathway (specific shock, avalanche, disruptive change)

5.2.2 Cumulative causation in technological innovation systems

A conceptualisation of (early) phase goal-oriented transformation dynamics has been developed drawing on the functions of Technological Innovation Systems (TIS) (Bergek et al. 2008; Hekkert et al. 2007). By analysing the suitability of structural and functional conditions for enabling (sustainable) innovations, this framework provides a useful basis for policy advice, and has been frequently used to inform policy strategies. Initially a rather static perspective, it has been 'dynamised' by proposing mutual reinforcements between the different TIS functions ('motors of sustainable innovation', cf. Suurs and Hekkert 2009). Conceptually, this approach builds on the notion of cumulative causation, as a simplified interpretation of complexity-inspired mechanisms.

Apart from its obvious focus on technological innovation, the TIS perspective is mainly suitable for studying early phase transformation processes rather than far-reaching transitions; a deficit in need of being addressed (Bergek 2019). As a response to this criticism, a first attempt has been recently made to extend this framework to analyse 'transformative' missions as specific examples of goal-oriented transformations (Hekkert et al. 2020), based on an amended TIS-type structural-functional analysis. This novel framework has thus far hardly been used in empirical studies, and it remains to be seen whether it will become as influential as the TIS-approach.

5.2.3 Deep transitions: linking transition studies and techno-economic paradigm shifts

At the confluence of the multi-level perspective in ST research and techno-economic paradigm shifts in IS, the concept of deep transitions has been proposed as a macro-level transformation envelope for socio-technical system transitions (Kanger and Schot 2019). These deep transitions are characterised by dominant meta-rules that guide the directionality of socio-technical system change over longer periods of time, similar to long waves. Deep transitions also open up the possibility of investigating multi-system dynamics, the linkages between transformation of different socio-technical systems, and how their coherence could be achieved with the help of meta-rules.

By opening up the black box of socio-technical landscapes in the MLP framework and by drawing on the literature on techno-economic paradigm shifts, deep transitions bridge between transitions research and work on techno-economic paradigm shifts.

5.3 Transformative Social Innovation

Building on a series of EU-funded projects,[15] the concept of Transformative Social Innovation (TSI) was developed and refined over the past years. The ambition of the TSI perspective is to better understand how SIs emerge, develop over time, interact with other processes of innovation and social change and, finally lead to the institutionalisation of social innovations in specified fields (e.g., energy). In line with the aim to understand the transformative capacities of social innovations, scholars defined TSI "as social innovation that challenges, alters or replaces dominant institutions in the social context" (Avelino et al. 2019, p. 196).

What is distinctive about TSI is its focus on interpreting social innovations through a relational lens. SI is not regarded as being attributed to the "achievements of individual champions" (Pel et al. 2020, p. 5) but the

[15] Most important among these are the projects TRANSIT, which developed theoretical foundations of TSI, SIMPACT, which dealt with the economic underpinnings of social innovation, and SONNET, which applied and refined it for the energy field.

transformative perspective articulates the distributed agency and institutional hybridisation involved in the underlying social innovation dynamics as well as its co-creative nature.
As such, it differs from other approaches that focus on SI as changes in social practices. TSI might involve changes in social practices and the spread of new knowledge but goes beyond this by asking about how knowledge and practices contribute to challenging established institutions (Haxeltine et al. 2017). The approach is systemic in the sense that SI is regarded as being based on the collaboration between several different types of actors that work on transforming institutions or, in contrast, stabilising them against the aim of social innovation initiatives. In this regard, TSI is not too dissimilar to SI ecosystems thinking. Avelino et al. (2019) also stress conceptual linkages between TSI and the Multi-level-perspective (section 5.1.2): successful transformation processes require changes not only at the micro level but also at other levels, where multiple change processes might interact.

TSI is based on a definition of social innovation that focuses on four main elements (Pel et al. 2020):

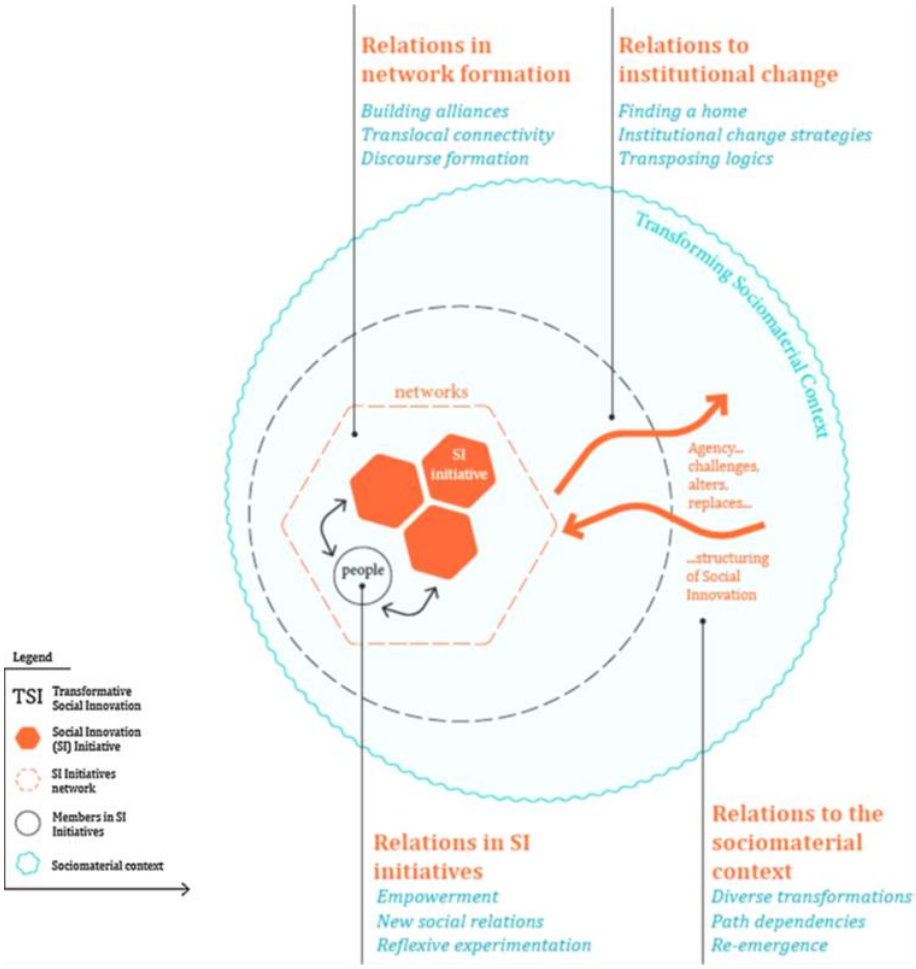
- new ways of doing (practices, technologies, material commitments),
- new ways of organising (rules, decision-making, modes of governance),
- new ways of framing (meaning, visions, imaginaries, discursive commitments), and
- new ways of knowing (cognitive resources, competence, learning, appraisal).

This is a rather broad definition of SI but is in line with the distributed character of SI underpinning TSI thinking, but contrary to several other definitions it does not mention any specific social purpose or need that shall be addressed. What makes TSI particularly interesting from the perspective of our study is the interest in how different types of relations transform core networks and contexts in which SIs are embedded, interpreted as mutually reinforcing processes. Four types of these "transformative" relations are distinguished (Figure 2.8):

- Relations within SI initiatives: how SI initiatives and their members seek to develop empowering collectives
- Relations in network formation: how they seek to form broader networks
- Relations to institutional change: how they seek to challenge, alter, or replace dominant institutions whilst also being shaped by those
- Relations to the socio-material context: how these attempts at transformation are being shaped by broader changes in the socio-material context.

Based on extensive case-study work, for each of the four types of relations, twelve more specific propositions or hypotheses have been suggested how the transformative impact of SIs could be enhanced (Figure 2.8).

Figure 2.8: Transformative Social Innovation – four types of relations



Source: Pel et al. (2020)

To illustrate the transformative potentials of SI and the processes of transformative change, the TSI framework has been applied to the context of systemic changes in the energy sector and empirically analysed as part of the SONNET project. Energy systems consist of socio-technical arrangements, as well as institutional settings, e.g., between energy suppliers and households. Social innovation in this institutional context is "considered to be transformative to the extent that it challenges, alters or replaces dominant formal or informal institutions" (Wittmayer et al. 2020a, p. 7). Transformative change processes towards the empowerment of certain actors in the energy sector might be described under the concepts of energy democracy or energy justice. However, the transformation of institutional structures might also come along with maintaining parts of existing institutional structures or resistance towards change.

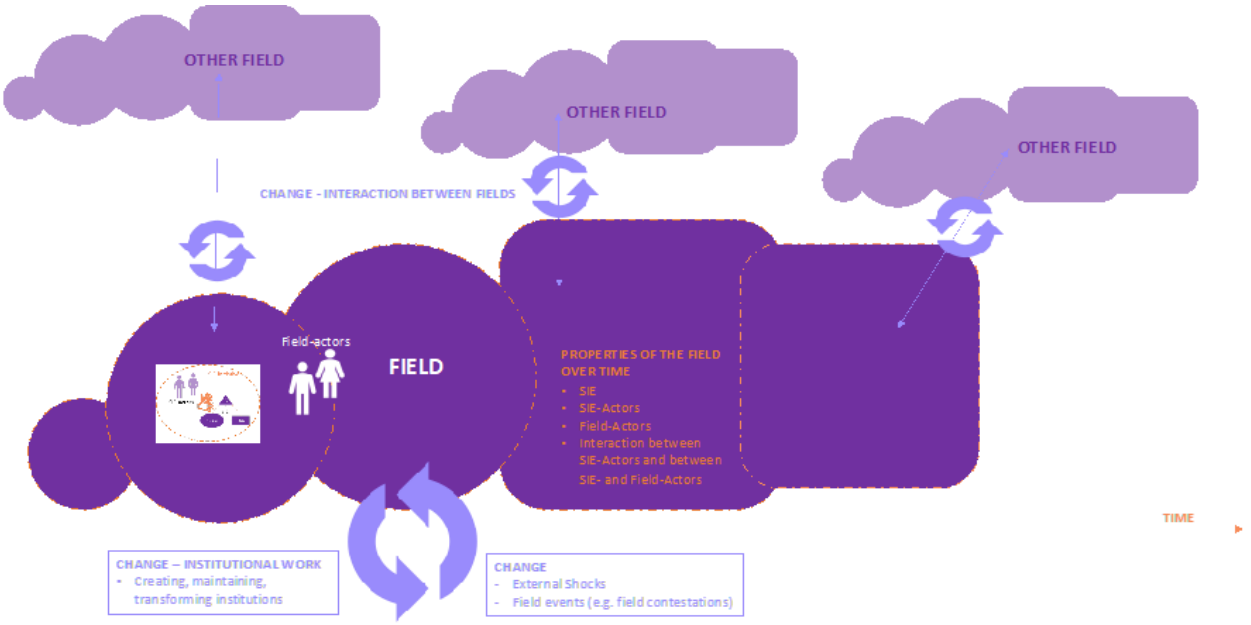
Focusing on meso-level social order, the SONNET project applied the TSI 'field' approach to understand the processes of institutionalisation and how institutions are being transformed in the course of social innovation activities. Following (Scott 2014), institutions are made up of regulative, normative, and cultural-cognitive elements. They are based on tacitly or explicitly formulated rules that enable or hinder certain activities. The field-approach (Fligstein and McAdam 2011) puts a focus on the actors, activities that evolve around different types of social innovations and traces changes in institutional structures, e.g., through institutional work of social innovation actors.

Questions that guided the empirical analysis of different fields of social innovations in energy (SIE) were formulated as follows:

- How do SIEs and SIE fields emerge, develop, and institutionalise over time?
- How do SIE field-actors and other field-actors interact with the 'outside' institutional environment and thereby co-shape the SIE field over time?
- What are the enabling and impeding factors for SIE field-actors and other field-actors to conduct institutional work and change the 'outside' institutional environment? (Hielscher et al. 2020)

The field approach shows how social innovations are influenced by different actors and processes. For example, while the interaction between different social innovation initiatives is crucial, for the field of cooperative energy production other fields such as the SIE fields of participatory experimentation formats or the SIE field of local electricity exchange might be more influenced by policy actors than by other SIE initiatives. Furthermore, there are differences in the history of the SIE field that influences the transformative potentials that social innovations might unfold in the energy sector (e.g., with cooperative energy production building on a longer history and gamified energy apps as a more recent phenomenon). Social innovation initiatives might change established actor roles in the energy sector – like in the case of prosuming that changes the roles of private households from consuming also towards producing energy – or establish novel roles, such as it is the case for organising local peer-to-peer electricity exchange (Hielscher et al. 2021). The field approach acknowledges the complexity of actor constellations, organisational and institutional structures, and power relations. Therefore, social innovation cannot be reduced to a niche phenomenon and described as a "David vs. Goliath narrative" (Avelino et al. 2023) but transformative change unfolds across different actor groups on different scales.

Figure 2.9: Relationship between concepts for thinking about processes of SIE



Source: Wittmayer et al. 2020b

Complementary to the relational perspective on TSI, Sengers et al. (2021) distinguish four central 'generalisation mechanisms' that indicate how socio-technical innovations diffuse more widely and get institutionalised. While specific local solutions make up a large part of social innovations, they can have a broad impact through (adapted from Sengers et al. 2021):

- Replication, adaptation and proliferation to other local contexts.
- **Expansion, scaling and consolidation** of social innovations is a possible form of generalisation that has been successful in many cases, for example, in the case of car-sharing concepts.
- Challenging, reframing and adapting institutional frameworks, social innovations can become established practices.
- **Circulation and anchoring of new knowledge,** so that the knowledge and experience gained in social innovations can be used for social innovations in other application areas.

Unlike for profit-oriented (business) innovations, the broad impact of social innovations is not necessarily achieved through commercial success on competitive markets but is often based on the widespread practice of willingly sharing knowledge about new solutions with other users. Exploring these non-market mechanisms will be one of the key questions to be addressed.

6 TOWARDS A CONCEPTUAL MODEL OF SOCIAL INNOVATION FOR SOCIETAL TRANSFORMATION

The review of the social innovation literature has shown the diversity of concepts that are used in this field of research. Over the past ten to fifteen years, research on social innovation has intensified, not least driven by the funding of large projects by the EU, and has delivered a multitude of definitions, typologies, and process models that help better understand the dynamics of social innovation and the roles that various types of actors play.

What is currently still missing are approaches that connect social innovation to transformative change for addressing societal challenges. The promising approaches identified, such as Transformative Social Innovation or the Comprehensive Theory of Social Innovation and Social Change (SI-DRIVE) deliver important conceptual building blocks, but they tend to be too narrowly focused on social innovation, and thus do not fulfil an important requirement, namely, not to see social innovation in isolation, but in interaction with innovations that pursue different purposes and are of a different nature. This is, we argue, essential for understanding the potential role of social innovation in relation to societal transformation.

More specifically, we propose to draw on the following building blocks for our research: i) a definition of social innovation based on a typology of various forms of innovation, ii) a typology of social innovations geared to our research needs, iii) a process model of how social innovations emerge and contribute to broader processes of socio-technical transformation, including considerations regarding the role of different types of actors, iv) a positioning and differentiated interpretation of the process model in relation to the three contexts of societal challenges introduced at the beginning of this chapter.

6.1 Definition

Our definition of social innovation (adapted and amended from BEPA 2010) states that:

- Social innovations are innovations that are social in their intended overarching purposes or ends, but they can be implemented based on non-profit-oriented as well as profit-oriented business models.
- They employ social (i.e., behavioural, organisational) means or combinations of social with other (e.g., technological) means to achieve these ends.
- Specifically, we define social innovations as new initiatives (ideas, products, services and processes) or new combinations of existing initiatives (solutions) applied in practice in order to address social needs and create new types of social behaviour and relationships.
- They are thus innovations that are not only intended to be beneficial for society (1st order benefits), but also aim to enhance society's capacity to act (2nd order benefits).
- For reasons of uncertainty and complexity, it needs to be assessed on a case-by-case basis whether a social innovation is indeed beneficial (i.e., has positive social effects), and for whom.

In order to frame and position social innovation in relation to other types of innovation, we distinguish two main dimensions (see Table 7): the **purpose** of an innovation, and its **nature**. The first dimension relates to the balance of profit-orientation vs. the pursuit of social purposes, and the second one related to the technological vs. non-technological/ social nature of innovations. It is important to stress that the social purpose pursued by a social innovation does pre-empt any assessment whether a social innovation will actually lead to beneficial social outcomes and impacts, or not. Social innovations are as ambivalent as any other kind of innovation, and it needs to be left to ex-post judgement whether the desired effects have been achieved (and for whom), or whether they are over-shadowed by undesirable ones.

The **(primary) purpose** of an innovation needs to be further distinguished from the business model through which it is implemented, which can be non-profit as well as profit-oriented. In other words, according to our definition, social innovations can be based on profit-oriented business models, as long as their overarching purpose remains predominantly social.

Transformative change (e.g., to address societal challenges) usually requires combinations of different types of innovation captured by this typology and their aligned uptake, and the balance between the different dimensions may change in the course of a transformation process (e.g. a growing degree of profit-orientation of an initially non-profit oriented business model, or a technological enhancement of an innovation that was initially purely social in nature).

Table 7 also shows that we also consider innovations that are technologically led in nature as – (partial) social innovations, as long as they pursue a social purpose. This is because the social innovation potential of a technology-led innovation can become apparent at a later development stage only and evolve into hybrid innovations.

Table 2.7: The purpose and nature of innovations – a conceptual framework (source: AIT/ISI)

(Primary) Purpose Nature	Social (social purpose, non-profit business model)	Hybrid (social purpose, but profit-oriented business model)	Profit (both purpose and business model)
Non-technological (or: social nature)	"Pure" SI: focus on social need, changing social practices, social networks, cognitive frames, institutions	Social entrepreneurship – not technology-based	New organisational, managerial, and financial solutions introduced by firms
Socio-technical (or: hybrid)	Socio-technical social innovations (e.g., social housing, potable water, fully digital education during COVID-19 lockdown)	Social entrepreneurship with a crucial technological component and intended changes in social behaviour (e.g., digitally enabled social innovations)	New production processes significantly changing intra-firm relations (inside groups and among different groups of employees), or inter-firm relations (e.g., organising supply chains, etc.)
Technology-led	Primarily technological innovations with a social benefit, without significant integrated (intended) changes in social practices, but possibly entailing new social practices but (e.g., open-source software)	Social entrepreneurship based on "hidden" technologies not intending changes in social practices, but possibly entailing them. Social purpose is combined with for-profit (business model (e.g., sensors for clean water supply systems, clean engines)	New consumer goods, services, and production equipment for gaining market share and/or enhancing competitiveness, productivity, profits, and growth
	„FULL" SI: BOTH pursue social purpose AND use non-technological/social means		PARTIAL" SI Pursue social purpose but employ technology-led innovations, possibly entailing new social practices

6.2 Typology of social innovations

As reflected in the scientific literature, social innovations are highly diverse. In fact, there are several dimensions in the scientific literature according to which social innovations are differentiated:

- Social relations that lead to the creation of SI (Wittmayer et al. 2022),
- Manifestations of social innovation (Wittmayer et al. 2022),
- The level and structure of social innovations (Schartinger et al. 2020),
- Domain of origin of social innovations (Schartinger et al. 2020),
- Degree of (directional) change or the level of innovativeness a social innovation aims at (Jaeger-Erben et al. 2015),
- Degree of formality (Jaeger-Erben et al. 2015).

Our proposed typology of social innovation is based largely on Schartinger et al. (2020), but relaxes the focus on 'green' social innovation, and thus focuses on the following two dimensions:

- Societal domains of origin of SI (economy, civil society, government)
- Scope of interaction from niche to wider uptake at societal or even global scale.

Table 2.8: A typology of social innovations (source: adapted from Schartinger et al. 2020)

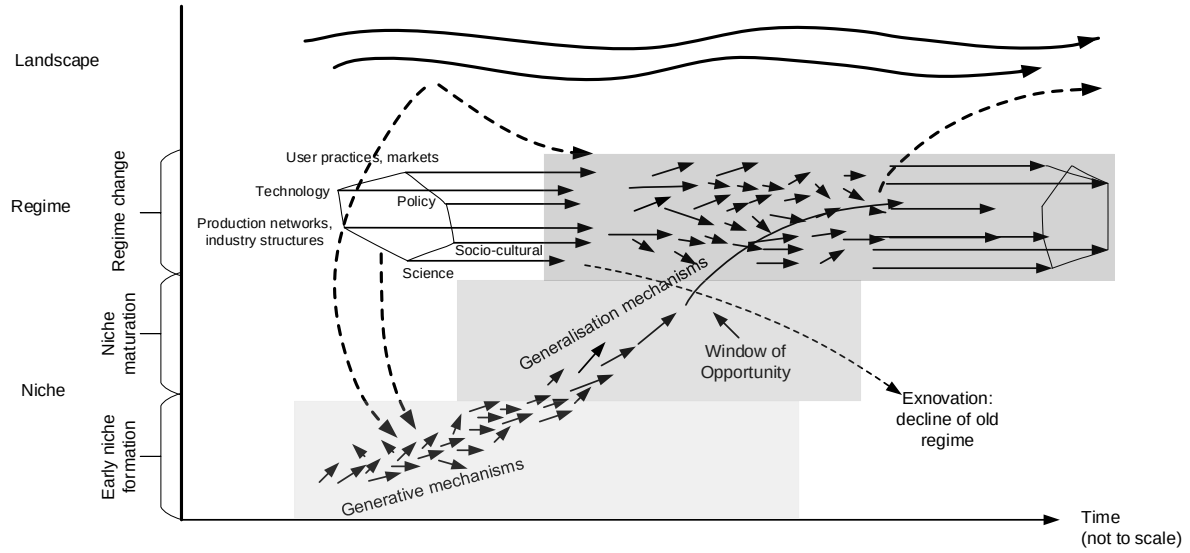
Societal domain / Degree of interaction	Economy	Civil Society	Government
Fragmented / Niche	(1) Company-based	(4) Temporary niche	(7) Experimental
Partially framed	(2) Entrepreneurial	(5) Community-based	(8) Embedded
Societal / Global	(3) Disruptive	(6) Global movement based	(9) Top down

Whereas Table 7 focuses on the positioning of what we consider as social innovations in relation to other types of innovation (i.e., distinguished according to categories such as purpose, nature, business model), Table 8 looks inside the black box of social innovation. It promises to be a useful and productive typology for purposes of policy analysis, because it distinguishes i) the areas of origin of social innovations as potential target groups of policy interventions, and ii) the characterisation of the 'embeddedness' of social innovations in networks of interaction of different scales and intensity, which is important to take into account when designing suitable policy measures. The nine types of social innovations distinguished could thus serve as blueprint for systematising policy interventions to help foster social innovation (while taking into account appropriate rationales for intervention in the first place; see Chapter 4).

6.3 Process Model: A Multi-Level Perspective on Social Innovations (MLP-SI)

While an overarching descriptive phase model may still be useful to structure the social innovation process, it needs to build on a more sophisticated systemic and co-evolutionary understanding of the underlying interaction and reinforcement processes. This type of understanding has been developed in great detail in the scholarship surrounding the MLP and its application to sustainability transitions. Work has been extensive on this topic with a view to a large variety of different countries, institutional settings, industry sectors, actors, and more. Rather than starting from scratch, we therefore consider the MLP to be a very useful foundation for our SI process model, which we expand upon with SI-specific insights from the previous chapters, in order to arrive at a process model for this project, i.e. the **Multi-Level Perspective on Social Innovations (MLP-SI)**, shown in Figure 2.10. On this basis, the interactions between social and profit-oriented purposes of – as well as between technological and non-technological – innovations, but also those between micro-level of actors and interactions, meso-level of institutional and incumbent conditions and wider contextual forces can be addressed.

Figure 2.10: Multi-Level Perspective on Social Innovations (MLP-SI)



Source: authors, adapted from Bodenheimer (2019) and Geels and Schot (2007)

The three levels in the MLP-SI are largely the same as in the traditional MLP, as it was already described in Section 5.2. One possible specification is that the regime here is governed or influenced by the three social forces identified in the ESGM (i.e., institutions, social networks, and cognitive frames); another option – which is represented here - is to slightly adapt the categories used in the established MLP framework (i.e., technology, production networks/industry structures, science, socio-cultural conditions, policy, spaces of interaction). While the ESGM sees the interaction of these social forces as the causal factor for reproducing a societal problem, from an MLP perspective, we see these three social forces as part of a slightly wider set of factors that characterise and keep the regime stable, along with the other interlocking elements.

In applying the MLP to SI, we mostly want to focus on the mechanisms that drive the creation and maturation of social innovations in the niche as well as their (potential) expansion into the regime, i.e., systemic change or transformation processes. For this we draw not only on prior MLP scholarship but enrich it in particular with insights from the ESGM and TSI concepts, as well as the SIMPACT project (on actor roles), and prior work on generation processes, especially in (Howaldt and Schwarz 2016; Anderson et al. 2018), and on generalisation processes, especially in Sengers et al. (2021), as being the most relevant approaches for this project.

It is important to note that the following describes an **ideal-type and successful transition**, in which an SI manages to spread past the niche and change or replace the original regime. This is anything but the norm; as with any innovation, most SIs eventually fail or remain a small phenomenon at the margins. Failure can happen at just about any point in time during the transition process, though it is of course most likely in the early stages and becomes progressively less likely as the SI matures and expands. Those SIs that do eventually succeed at leading to regime change, often require decades for their maturation and expansion into the regime.

In the MLP-SI we subdivide the developments at the niche level into two stages, namely early niche formation and niche maturation. **Early niche formation** takes place via first effects of generative mechanisms. At the beginning of any social innovation stands the identification of a social need that is not being met (adequately) and the development and operationalisation of initial ideas to better address this need. This initiation, development and early operative work is done by the SI developers, who go through early and reflexive experimentation in the form of trial and error, variation of approaches and consequent learning and unlearning to find solutions that work to address the identified social need. This often starts a process of empowerment, as a previously unmet social need is increasingly being met. As part of this process, new social relations develop within SI initiatives, both among SI developers and, with further progression of the SI, potentially also with more external knowledge providers who provide specialised knowledge to the process. At this early stage, other actors like supporters and promoters are likely to be involved, too. Insofar as multiple innovations or SI initiatives develop around the same social need, these niches will likely begin to interact with each other. This may either happen very early on, during the early niche formation stage, or somewhat later, as the SI moves from early niche formation to niche maturation. Interactions between SI initiatives can be cooperative,

in the form of building networks and alliances, exchanging knowledge and learning from one another (adaptation). Depending on their similarity, some initiatives may decide to consolidate their efforts. In other instances, SI initiatives can also be in competition to one another, with each initiative seeking to highlight its own unique merits and sharpening its profile in contrast to the others. Throughout this process, a discourse begins to develop around how the social need is framed and its possible solutions.

If there were many different early approaches to addressing the social need in question, in the **niche maturation** stage, they usually begin to consolidate to some degree over time. Through a process of replication, adaptation and proliferation, SI experiments are spread across different settings, often with the help of promoters who provide the necessary infrastructure, funding, and connections to policy programmes. More successful approaches become dominant and expand or spread, while less successful ones either disappear or remain very small and localised.

This is also the stage in which SI initiatives begin to have more interactions with the regime and enter the phase of **generalisation** (see Box 4). With the help of supporters, SI developers raise broader awareness for their SI and the social need it seeks to address and engage in agenda-setting and coalition-building beyond the niche. Through their very existence as well as their discourse, SI initiatives challenge and dispute the status quo, which can lead to conflict with, and resistance by, incumbent regime actors seeking to prevent or at least slow down changes that threaten their established status and power. Depending on its outcome, this conflict can either lead to the failure and decline of the SI or to improving and strengthening it if it manages to persist. In the case of success, a process of reframing and adapting institutional frameworks, policies, and practices begins that opens up institutional space in the regime for the new SI to inhabit and leads to the circulation and anchoring of the new knowledge associated with it.

As was elaborated in Ch. 5.2, multiple different **pathways** have previously been identified that ultimately lead to some form of **regime change**. Geels and Schot (2007) already identify three different forms of external triggers that can lead to change, based on different combinations of speed and scope: specific shock (high speed, narrow scope); disruptive change (low speed, low scope); and avalanche change (high speed, broad scope). With a view to the long-term systemic changes needed for sustainability transformations, however, we find there to be one case missing: low speed, broad scope. Changes involving the transformation of an entire system (such as the energy, mobility or agrifood systems) take decades to unfold (low speed) but lead to very changes (broad scope). In our view, this is the type of change involved in a “system transition”, which leads, correspondingly, to a “system transition pathway”. Because of its significant scope, interactions in this pathway are always to some degree competitive, as there will always be (at last some) incumbents seeking to prevent this level of change, but the ambition of transition policies is often to turn the interactions into more symbiotic ones. In contrast to the pathways previously identified by Geels and Schot (2010), the status of the niche innovation is neither immature nor mature, but rather maturing, as the system transition pathway covers an extensive period of time.

Table 2.9: Extended framework of pathways for regime change

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Nature of Interaction</td></tr>
<tr><td>Symbiotic</td><td>Competitive</td></tr>
<tr><td rowspan="3">Status of nice innovation</td><td>Immature</td><td>Transformation pathway (disruptive change)</td><td>De-alignement and realignment pathway (avalanche change)</td></tr>
<tr><td>Maturing</td><td colspan="2">System transition pathway (system transition change)</td></tr>
<tr><td>Mature</td><td>Reconfiguration pathway</td><td>Thechnological substitution pathway (spechific shock, avalance, disruptive change)</td></tr>
</table>

Source: authors, based on Bodenheimer (2019) and Geels and Schot (2007).

In the case of the two symbiotic transition pathways, the regime merely adapts, a process that is likely to happen without significant resistance. However, in the case of the competitive pathways and especially for systems level changes, the niche may not be able to overcome the stability and active resistance of the co-evolved and dynamically stable regime on its own, even with a timely window of opportunity. In the case of the system transition pathway, the balance between symbiotic and competitive relationships, is particularly sensitive to policy interventions. Sustainability transitions, in particular, will increasingly be motivated by a level of political intentionality that does not align immendiately with the regime's path dependences, especially dominant market forces. In order to overcome this barrier, system transitions usually need to be accompanied by policy-driven **exnovation** processes that begin at the latest during the niche maturation stage. These serve to intentionally destabilise the incumbent regime through a combination of direct and indirect instruments such as financial incentives, regulatory bans, or standard setting. In some cases, SIs may also act as enablers for the phase-out process of certain technology-based systems by triggering behavioural changes that open up new avenues for socio-technical transitions (see e.g. the enabling role of social innovation in the case study on autonomous driving; Chapter 3).

Box 4: Why generalisation is more suitable as a concept than diffusion when analysing the role of (social) innovation for system transformation

Background

- Sengers et al. (2021) proposed the notion of "generalisation" to better understand how a novel socio-technical configuration emerging from a bottom-up process of niche formation leads to system innovation and transformation.
- The concept has been criticised for not being sufficiently distinct from recent notions of diffusion. However, we argue that there is a distinct difference between generalisation and diffusion that is worth being highlighted explicitly.

Key aspects of diffusion processes

- Initially, the notion of diffusion was strongly focused on the adoption and uptake of *product, process, or service innovations.*
- As innovations do not just diffuse unaltered but are subject to continuous processes of learning by interaction with users, the understanding of diffusion started to address matters of interaction.
- Building on an evolutionary understanding of innovation, there are key mechanisms at play, such as relative advantages, complexity, compatibility, observability, trialability (Rogers 1962), informational returns, network externalities, learning by using, technological interrelatedness (Arthur 1988).
- According to Sengers et al. (2021: 1155–1156) diffusion is a follow-up to the experimental phase that „generates a mature, internally consistent and stabilised configuration (...) which is then widely adopted wholesale (...) through processes of demonstration and imitation".
- Recent work on diffusion tends to move beyond an object-focused understanding of diffusion and takes the co-evolution between object and context, between niche and regime into account. Some speak also of societal embedding as being associated with diffusion processes.
- While this is all correct, and diffusion has indeed become a more open concept embracing interactions between the objects of diffusion and their societal and organisational context, it is misleading when it comes to system innovations, which – in terms of scope – are much wider and precisely make the "systems" the object of change, not the innovation within a system. This implies that the experimentation and learning is not just focused on the innovation, but on the entire systemic configuration, which is why – for instance – living labs have become more common in recent years to provide learning environments for such systemic configurations.

Key aspects of generalisation processes

- Diffusion does not capture the architectural dimension of system innovations, which is at the core of Sengers et al. (2021) intentions of better understanding system transformation.
- Generalisation represents a broader perspective on *systemic change*, which goes beyond single products, production processes or services, as it addresses system innovation.

- It includes, in addition, processes of (dis-)empowerment as well as institutional, regulatory, cognitive, and behavioural changes.
- Four key mechanisms of generalisation have been identified by Sengers et al. (2021):
  - Challenging, reframing, and adapting institutional frameworks
  - Replication, adaptation, and proliferation
  - Expansion, scaling, and consolidation
  - Circulation and anchoring of new knowledge
- For generalisation processes to be successful, a combination of all four mechanisms is often needed due to the inertia of and complex interdependencies within prevailing systems as well as the fragility of new experimental configurations, as expressed by Sengers et al. (2021): "in the case of systemic change (...) **novel configurations** are likely to be radically different and **incompatible with governance and market arrangements**, so that they will encounter **profound resistance from incumbent** actors, as well as market and institutional obstacles. (...) Experiments may (...) exemplify an entirely new possible future, but their specific legacies **may come to be embedded** in the world **in a more partial and evolutionary way** as well. This is partly due to the inertia of existing systems, or their ability to absorb change, as well as the fragility of experimental configurations and the challenge of **creating entirely new institutional and economic relations** and contexts for novel configurations." (Sengers 2021: 1156)

6.4 Social innovations and their roles with regard to societal challenges

The bulk of SI definitions postulates a success, that is, social innovation contributes to tackling societal challenges *by definition*. Such definitions are not helpful either from a theoretical (methodological) angle or from a practical point of view, including policy-making, monitoring, and evaluation. First, the impacts of any social innovation should be assessed ex post, on a case-by-case basis, that is, must not be included in the definition of social innovation. Second, these definitions exclude the existence of unsuccessful social innovations. Clearly, there are 'millions' of partially successful or failed social innovations, just as in the case of business innovations.

In brief, a meaningful ('useful') definition of social innovation should stipulate the *purpose* of social innovation, not the outcome(s). This insight provides a link with the three societal challenge contexts, on which we focus in our empirical work, and with regard to which we argue that social innovations fulfil different purposes:

- As for **type 1 societal challenges (SI and system change),** the change processes are relatively slow and require overcoming path-dependences in entrenched socio-technical systems. In these cases, the main driving force is a societal need, e.g., to introduce (more sustainable) mobility solutions, energy production and distribution systems, or food supply systems at different levels (for a community, a city, a region, a country, or a macro-region [supra-national region]. To respond to this type of societal needs, social, profit-oriented, and hybrid innovations are all needed. These are devised and implemented by many different types of actors and discussed, 'approved' and from time to time 're-negotiated' by different types of stakeholders. All these three types of innovations would rely on both technological and non-technological innovations. A number of social innovations – not all, though – are transformative in this context: certain actors will be empowered by SI, while others will be disempowered, otherwise there would be no system change. Disempowerment of actors and renunciation of structures involved in harmful activities to the environment is important factor in achieving transformation (Avelino et al. 2019). Certain types of SI ecosystems facilitate empowerment (Pel et al. 2020). SI is understood by these authors as the introduction of new social relations which affect the distributed nature of SI agency in SI ecosystems.

  Given the relatively slow pace of changes, there is a room for experimenting with different types of social, profit-oriented (business), and hybrid innovations. An important role for policies is to facilitate these experiments, e.g., in the forms of social labs (for "ideation") and pilot projects.
- As for **type 2 societal challenges (SI and disruptive technologies),** the change processes are likely to be faster, more uncertain, and less predictable, compared to type 1 challenges. In these cases, the main driving force is the disruptive technology itself. Social innovations would play a role in "taming" these disruptive technologies, as well as improving the capabilities of various social groups to prepare for

meaningfully using some of these disruptive technologies, and 'protecting' themselves against their potentially harmful consequences. In other words, the roles of social, hybrid profit-oriented innovations are less 'balanced' than in the case of type 1 challenges: often a disruptive technology initially motivates the pursuit of profit-oriented innovations – most likely having several important non-technological components as well, especially organisational, managerial, and business model innovations –, while social purposes tend to be 'subordinated' to this profit-oriented framing of these technology-driven innovations. Several complementary elements promise to be useful in this context: (i) prospective (forward-looking) analyses – when time allows, preferably participatory ones – to better understand and if possible 'tame' disruptive technologies (slow down and redirect unfavourable, 'threating' technological changes and strengthen and speed up favourable ones); (ii) promote business innovations that 'transform' ('translate') disruptive technologies into goods, services, and processes bringing economic benefits, with neutral or beneficial societal and environmental impacts; and (iii) foster social and hybrid innovations that support a faster diffusion (social acceptance) of economically, socially, and environmentally favourable business innovations, contribute to tackling the negative impacts of business innovations stemming from certain disruptive technological changes and develop the capabilities of various social groups to prepare for accepting and meaningfully using some disruptive technologies, and 'defending' themselves against harmful disruptive technological changes.

- In **type 3 societal challenges (SI and crisis phenomena),** societies face – mostly – harmful changes of significant magnitude, severely affecting very large social groups, if not a whole country, or the entire mankind. It is important to distinguish crises of an abrupt nature (e.g., a pandemic) from those that are progressing slowly (e.g. related to social inequality). Given the abrupt nature of the first type of crises, at least in their early stages, technological solutions are not available in many cases, e.g., vaccines and medicines to stop a deadly virus from spreading and curing people who are infected. Hence, fundamental and fast – immediate – changes in social practices are vital (in the strictest sense). We have witnessed – and 'practiced' – many of these social innovations as a response to the COVID-19 pandemic: suddenly and almost entirely digitalised education, virtual political, business, and private (social) meetings, new ways of shopping, dramatically increased use of safe modes of mobility (walking and cycling), social distancing supported by warning apps, etc. (Gegenhuber 2020; Scheidgen et al. 2021). In these cases, social innovations were, indeed, social both in terms of their objectives and means. Yet, quite a few of them were also supported by technological innovations, as well as by public sector innovations – some simply would have not been possible without digital technologies, new business models and practices, or new regulations. The supportive technological innovations were mainly based on previously available technologies, 'enhanced', amended and adapted for new purposes fast and significantly, tailored to the new needs, as well as to the requirements and available skills of a much wider, much more diverse user group. With these social – and the related, 'supportive' technological and hybrid innovations – we 'bought the time' needed to develop radical medical (technological) innovations. The crisis has also forced researchers working in the public and private sectors to fundamentally change their standard practices, especially to co-operate more closely, make available new results much faster and more widely, neglecting some elements of their previous secretive (protective) practices.
  The second type of crises is evolving more slowly but can equally have devastating effects on society. The main difference to the first sub-type of crises is that there is much more time to develop novel systemic solutions, quite similar to type 1 societal challenges. And it equally requires sustained and patient efforts to address them.
  Several complementary elements promise to be useful in this context: (i) conducting prospective (forward-looking) analyses, focussing on 'black swan' type events with the ultimate, practical aim of enhancing capabilities and capacities needed for stronger resilience; (ii) fostering social and hybrid innovations to tackle the crisis situation with prompt, major changes in social practices; and (iii) promoting business innovations that assist the immediately required social and hybrid innovations aimed at tackling the crisis situation, and are aimed at tackling the crisis situation with new technologies and business solutions.

In relation to all three types of societal challenges, it is important to recognise that social innovation may also have a 'dark side' (Nicholls et al. 2015b, pp. 5–6; Pel et al. 2023). Clearly, no society is homogenous, not even those social groups that are marginalised and disempowered: their members still have their own values and

views, and thus might perceive a certain change process and its impacts in different ways. Clearly, members of a certain social group are likely to perceive the improvement for other social groups as a relative worsening of their own situation. For instance, in context 1, social innovations that are aimed at introducing more sustainable mobility solutions or energy production and distribution systems, are likely to require some investment, as well as a certain level of knowledge from citizens to benefit from these innovations. Thus, not all social groups would be able to participate in – and thus benefit from – these social innovations. The gap between various social groups, therefore, would widen and deepen. The same goes for social innovations in the other contexts as well, in particular concerning digitally enabled SIs in relation to crises (one needs equipment, skills, and access to internet to benefit from those).

Moreover, a particular solution that improves the situation of some groups can, in fact, affect other groups negatively in an 'actual', 'neutrally measurable' way, e.g., when their access to certain support schemes or services becomes more limited. Further, inadequate interventions can even further aggravate the position of marginalised groups.[16] For these reasons the measurement of social innovation activities and their impacts is a much more demanding task than measuring business innovations (Havas 2016). Hence, it is not surprising that we do not have even partially satisfactory methods, let alone a widely used set of indicators to measure SI processes (inputs, throughputs, and outputs), their outcomes, and impacts (Cunha and Benneworth 2020; Krasnopolskaya and Korneeva 2020; Lee et al. 2021; Terstriep et al. 2021).

[16] For example, Molnár and Havas (2020) highlight the case of controversial microcredit schemes, drawing on a growing body of literature.

CHAPTER 3: SOCIAL INNOVATION CASE STUDIES

By Susanne Giesecke, Matthias Weber, Doris Schartinger, Andreas Albiez, Sophia Horak, Maria Stadler,

1 INTRODUCTION TO THE CASES

The four cases presented here as examples for social innovations cover a wide range of transformative developments. Not only do they vary in their focus sectors (energy, transport, health, and housing), they also cover different eras and time horizons, starting from the early 1920s to the next 20 years of our future. Besides this range, they are examples that are supposed to exemplify the three different types of social innovations we identified and described in the previous papers. Furthermore, the case descriptions reference where they fit best in the matrix of the purpose and nature of innovations (Chapter 2).

Rationales and criteria for case selection

Defining energy cooperatives as social innovation derives from a longer history of such cooperatives and their role in Germany's energy transition. They are considered the most prominent example of SI in relation to energy in the German context and represent the co-evolution of social and technological innovations. Energy cooperatives allow us to study diffusion and changes over time toward an energy transition. Autonomous driving at first sight might not be considered a typical social innovation and its potential as such lies more in the future as the case study points out. What makes the case of AD also distinct from the others represented here is that its dynamic (so far) is very much driven by the business sector, but its success will ultimately depend on new forms of usage. The Corona Warn App (CWA) stands for a public intervention in a fairly recent crisis situation, in which the national government had to respond immediately. In this respect, the case of the Corona Warn App marks an unusual one, because all other of our examples for social innovation have emerged from civil society or industry or a combination of efforts from both sectors. The case of social housing in Vienna, the only foreign example in this paper, covers a period of over 100 years and is thus an interesting example for continuous transition and incremental change. It is an especially interesting example for its scale and longitude with almost two thirds of dwellings in Vienna today still part of the municipal housing stock.

Positioning of cases within the three types of societal challenges as contexts for SI

The energy cooperatives stand for social innovation that is connected to system change and can be considered front runners in the context of the German "Energiewende": transition of the energy sector toward sustainability. Autonomous driving (AD) stands for a technological disruption with a lot of investment from the industry sector, which could occur in the mid-term future. AD has the potential to respond to the social demand to reduce traffic, congestions and relieve residential as well as commercial city areas from overcrowded parking lots. Furthermore, AD could meet people's need to be mobile at all times, as well as to reach places that are not within their vicinity. This is especially relevant for older people and people with disabilities, but also for younger people who do not have a driver's licence. In contrast, the Corona Warn App was a non-commercial development without any business-related interests. It was financed by the government. The social quality attached to it was the need to protect vulnerable populations from being infected with COVID-19 and to prevent a collapse of the public health system. The Vienna housing case combines two types of contexts for social innovation: a crisis situation and system change. The case shows that a severe crisis that occurs at the landscape level can open up a window of opportunity for system change if the conditions of an innovation ecosystem for a niche to mature to generalisation are favourable. As the only case here not taken from a German context, it is still a valuable example of how different pathways are charted in national settings like Austria and Germany that were and still are similar. Thus, the historical situations of some major German cities were comparable to the one in Vienna after 1919. Yet, the pathways that cities like Berlin, Munich or Hamburg chose to cope with homelessness and poverty were quite different.

Differences in purpose and nature of innovations

In line with our typology, we consider "innovations" in their integrity as being composed of technological, social and other dimensions that are inter-related with one another. As the case of the energy cooperatives will illustrate, social innovation criteria refer to cooperatives' principles and novel actors in the energy transition; whereas the technological aspects refer to new technologies of energy production, distribution etc. The Corona Warn App case, of course, relies to a significant degree on modern information technologies. However, there were no disruptive technological innovations involved that were just developed for that app. Rather, it relied on pre-existing technologies that were merged for the purpose of tracking, informing and warning. Its innovation origin is social in nature, but enabled by digital technology. As already indicated, it is the context

and practice of use that makes autonomous driving a social innovation. Autonomous vehicles as such would not qualify for a social innovation. What also distinguishes this case from the other three in this paper is that the social innovation potential lies in the future and how its potential will unfold very much depends on future policies of the public and private sector. This is why the case of AD makes the policy action especially significant and a relevant issue to observe and discuss publicly. In the case of social housing in Vienna, technical innovation also played a role, but more a supportive one than a paramount one. Innovation in serial production of bricks and prefabricated construction parts are noteworthy for the efficiency and the speed of the diffusion of the social innovation. So, we can say that the technical innovations that accompanied the movement "Neues Bauen" were not a prerequisite but an accelerating success factor.

Positioning of the cases in terms of our innovation typology

We classify the energy cooperatives (EC) as a socio-technical innovation. It is also considered a hybrid type due to the importance of business models for many energy cooperatives. Variations of economic interests vs. environmental interests drive the developments. Autonomous driving also represents the socio-technical case in our typology of social innovations and their interaction with technology. Besides the technological combination of new generations of sensors, data processors and actuators, the social component is represented by the possibilities for people who cannot drive and for whom the "last mile" after public transportation is cumbersome or not accessible. A further socio-ecological aspect lies in the potential to reduce cars, especially private ones, if people share a pool of electric AD vehicles that do not congest parking spots and traffic lanes. Cars in general could be reduced through the provision of public or private AD fleets. If AD is used in the future for such purposes, it would also be considered a hybrid type of social innovation.

The social innovation of municipal housing is a "pure" social innovation in that it is addressing social needs, changing social practices, building social networks, and changing cognitive frames and institutions. Even though some new technologies played a role in the diffusion and fast upscaling of the innovation, they were not congenial. Though rents were and are paid for the dwellings, it is not a for-profit model and does not fall into the same hybrid category as the other two, EC and AD.

The Corona Warn App was not inspired by commercial motivation nor by technological breakthroughs, though state of the art of IT played a crucial role for tracking COVID-19 incidences. It can be considered a socio-technical innovation with genuine social purposes.

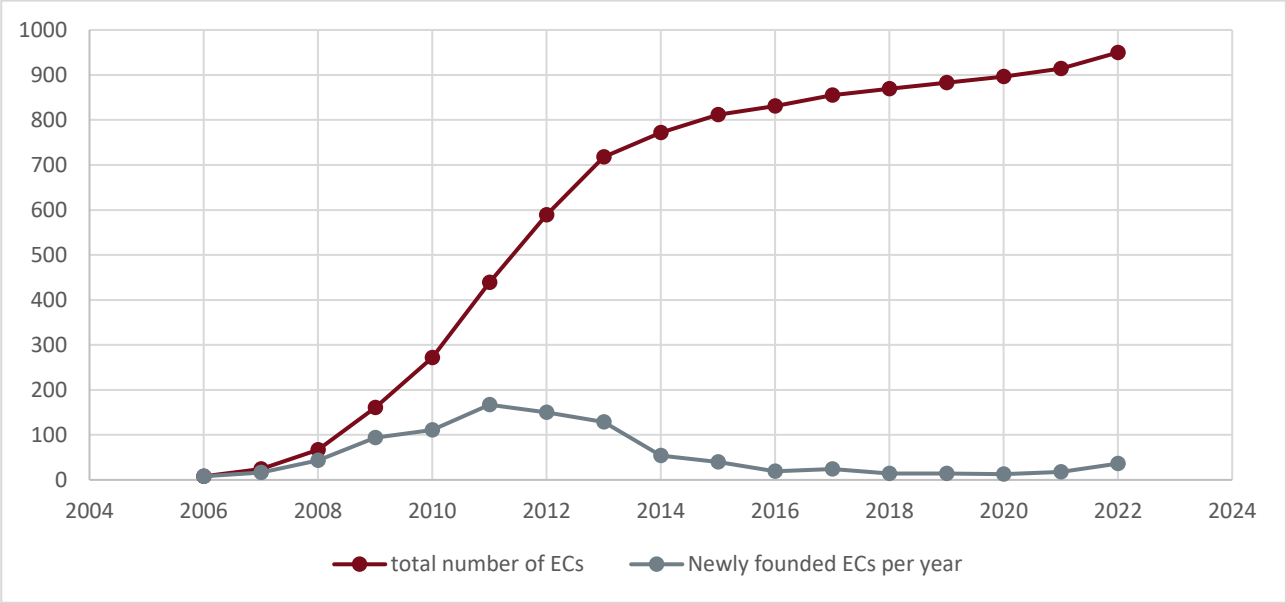
The following section introduces the four case studies one after the other along a similar structure. The first case of the energy cooperatives represents system change. The second case on autonomous driving represents a technological disruption. The third case on the Corona Warn App represents a social innovation that emerged during a crisis situation. And finally, the fourth case on social housing in Vienna combines system change with a long-standing crisis situation. The last chapter compares these cases and draws policy conclusions for initiating and nurturing social innovations.

2 CASE STUDY "ENERGY COOPERATIVES"

2.1 Background

Energy cooperatives (ECs) are not a 'new' phenomenon in Germany. In fact, these types of cooperatives build upon a longer history that goes back to the beginning of the 20th century, when ECs were "playing a fundamental role in electrifying the rural regions of Germany" (Debor 2018, p. 15). In the context of Germany's 'Energiewende', however, energy cooperatives gained new momentum due to the availability of renewable energy technologies that allowed citizens to participate in energy production as well as policy incentives that made investments in renewable energy production more attractive. Therefore, ECs were associated with novel forms of social meaning insofar as they started contributing to sustainable energy transitions on the local level (see section 2.2). In the context of this re-emergence of energy cooperatives, four aspects can be distinguished that shaped the development of ECs over time.

Figure 3.11: Development of number of ECs in Germany over time



Source: DGRV 2023

First, **policy changes** on the EU level as well as the national level in Germany played a crucial role for the re-emergence of ECs by introducing favourable conditions for investments in renewable energies. The foundation was laid with the liberalisation of the energy market in 1998 (Agora Energiewende 2019). Energy distribution and grid operation was unbundled and next to the previous regional monopolies also smaller market players were able to enter the energy market in Germany. On the national level, especially the introduction of the Renewable Energy Source Act (EEG) in 2000 paved the way for the emergence of ECs (Bundestag 2000). It introduced technology specific feed-in tariffs and thus laid the foundation for a secure business model for ECs. Over time, however, the EEG was amended several times e.g. in 2012, 2014, 2021, 2023 (Leiren and Reimer 2018). Each of these amendments directly impacted the development of ECs. Especially the EEG amendments in 2012 and 2014 introduced new barriers for ECs by reducing feed-in tariffs for solar PV, which until then had been the central business model for ECs (Klagge and Meister 2018). Next to the EEG, further policy changes can be described as influential for the development of ECs. Changes in the cooperative law in 2006 lowered barriers for the establishment of ECs by reducing formal requirements (Klagge and Meister 2018; Herbes et al. 2021). Also, the decision about the nuclear phase out in Germany after the nuclear accident in Fukushima in 2011 gave renewable energy technologies in general a big push (Heidary et al. 2021, p. 33).
Second, also **technological developments** were crucial for the re-emergence of cooperatives in the field of energy. This especially relates to technologies of solar PV. According to Herbes et al. (2021), electricity production with solar PV is the most successful business model for ECs because PV installations are simpler to install and require lower investments than other technologies. "But third and key, PV installations, like other forms of renewable electricity, profit from the Feed-in Tariff (FIT) schemes that support the RECs" (Herbes

et al. 2021, p. 2). With falling prices of solar PV models but at the same time, fixed feed-in tariffs guaranteed for a time of 20 years, this made citizen energy production an financially secure investment. As Holstenkamp and Kahla (2016) describe it: "[W]hen feed-in tariffs were relatively high and prices for photovoltaics modules were dropping […] photovoltaics projects were economically very attractive" (Holstenkamp and Kahla 2016, p. 120). However, this changed when feed-in tariffs were reduced. Heidary et al (2021) quote one member of an EC as follows: "*The price shock of the photovoltaic sector… you can say that the module prices for photovoltaics did not get lowered as much as the feed-in tariff got reduced… there was a miscalculation for a time…"* (Heidary et al. 2021, p. 38, Interview DE_EC_06). ECs therefore had to adapt their business models and started e.g. investing in other technologies such as wind power or biomass (Herbes et al. 2021).

Third, **intermediary structures** gained importance. With an increasing number of energy cooperatives in Germany combined with challenging policy conditions after amendments of the EEG, networking and professionalization of actors was getting more and more relevant (see section 2.5 on generalisation mechanism). On the regional level, networks were formed, often in the form of associations e.g. LaNEG Hesse e.V. since 2013, LaNEG Rheinland-Pfalz e.V. since 2012, Bürgerenergie Bayern e.V. since 2014, BürgerEnergy Thüringen e.V. since 2013 etc.). On the national level, an important milestone was the introduction of a new section for citizen's energy cooperatives at the German Cooperative and Raiffeisen Confederation (DGRV) in 2013. This allowed to have a joined representation of ECs interests on the national level. Furthermore, the DGRV section provides data from yearly surveys on the development of ECs. From a more bottom-up perspective, ECs joined interests on the national level and formed intermediary structures such as the 'Bündnis Bürgerenergie e.V.' founded in 2014 to represent ECs interests and increase political influence. The foundation of 'Bürgerwerke e.G.' in 2014 furthermore allowed joint energy marketing on the national level (see section 2.4 chapter).

Finally, members of energy cooperatives find **external events and societal trends** to be influential for the development over time. First, developments on the financial market played a role, often supporting ECs e.g. during the financial crisis in 2006 or the longer period of low interest rate policy (Heidary et al. 2021). "Second, the Fukushima nuclear catastrophe in 2011 and the decision for the nuclear phase out in Germany in reaction to this catastrophe contributed to increasing the acceptance for renewable energy technologies as well as policy support (Heidary et al. 2021). Third, members of ECs described the Fridays for Future movement as an important influential factor that increased the awareness for the climate as well as the interest of younger people to get engaged in renewable energy production. This is in line with the broader observation, that social movements and energy activism – rooted in the anti-nuclear movement – play an supportive role for energy transitions in Germany (Becker et al. 2016; Punt et al. 2022). However, this might also be interpreted as 'ideational support (Heidary et al. 2021, p. 50, Interview DE_EC_04)', which is less clearly backed-up with policy support.

2.2 The 'innovation' in question

2.2.1 What is the social need addressed? What is the societal challenge behind?

In order to find answers to the climate crisis, targets and measures have been formulated at different governance levels. Internationally, the Paris Agreement formulated the joint target of the United Nations to keep global warming below 2°C, with further efforts to limit it to 1.5°C (United Nations 2015). On the EU level, the European Green Deal aims to transform Europe's economy (European Commission 2019), making it 'fit for 55' and reducing 55% of net greenhouse gas emissions by 2030 (European Commission 2021a). Energy policies thereby play a central role. In Germany, the energy concept outlined measures to transform the energy system towards the use of renewable energies (BMWi 2010) Subsequently, the German *Energiewende* has gained international recognition due to its speed and scope (Agora Energiewende 2015).

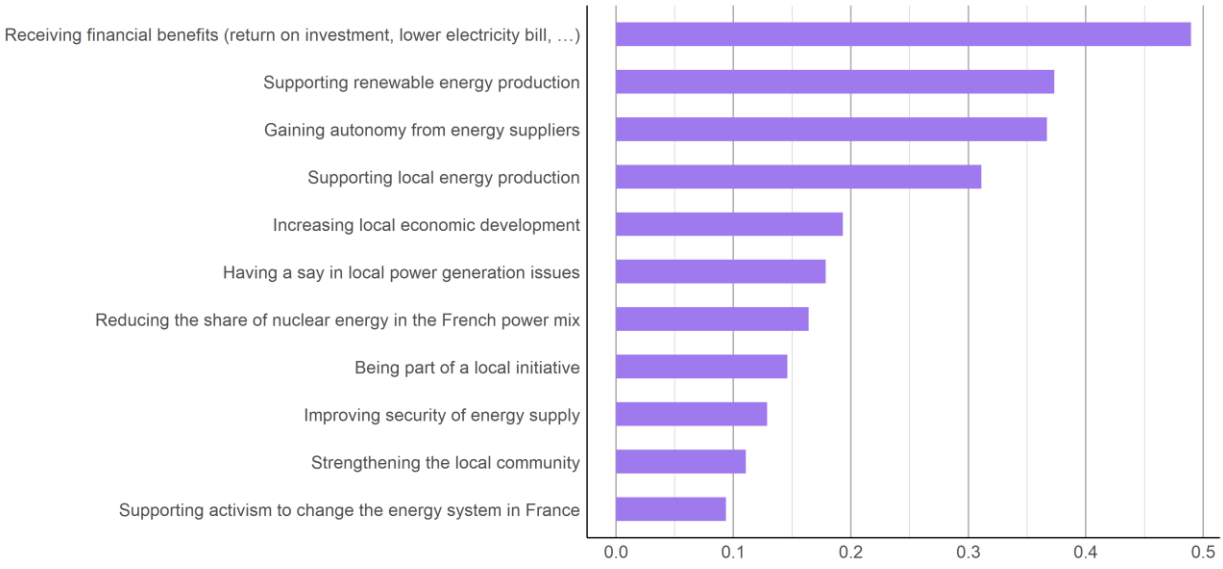
Due to the urgency and comprehensiveness of the necessary changes, there is an increasing awareness that successful energy transitions require systemic changes that include both technological as well as social innovation (Wittmayer et al. 2020a; Rogge and Stadler 2023). The German Energiewende has to be understood as a systemic shift with the aim to change the main pattern of the energy sector, for example the actor constellations of major incumbent utilities in relation to public energy policies (Kemfert et al. 2018). On the one hand, this requires changes in energy technologies and infrastructural system. For example, renewable energy production happens more decentral and depending on weather conditions. Therefore, grid structures need to be adjusted that e.g. allows to distribute wind energy from the north of Germany to the south. On the

other hand, controversial debates around the construction of wind power plants and power lines show the importance of acknowledging aspects of social acceptance (Ohlhorst 2018). In order to transform the energy system in a socially just and democratic way (Jenkins et al. 2016), social innovation might allow to empower citizens as 'energy citizens' (Schlindwein and Montalvo 2023) to actively participate in this process. The boom of ECs is the most prominent example of changing actor constellations in the German energy sector and describes a novel role that non-profit oriented forms of citizen energy can play in the Energiewende.

As described above, ECs are not a 'new' phenomenon, but gained novel momentum and novel forms of social meaning in the context of the German 'Energiewende'. The societal challenges addressed by ECs and the motivation that drives engagement is well described in the literature (Hackbarth and Löbbe 2022; Holstenkamp and Kahla 2016; Ahlemeyer et al. 2022; Poppen 2015; Guetlein and Schleich 2022). For example, Hackbarth and Löbbe (2022) review the literature on the factors that motivation individuals to engage in ECs and find key drivers in form of economic benefits, autonomy, self-sufficiency or energy autarky, environmental benefits, community spirit, regionality convenience and the simplicity of participation (Hackbarth and Löbbe 2022).

In a survey study with more than 6.000 participants from Germany, France and Poland, Guetlein and Schleich (2022) observe a high potential of future investments of citizens in renewable energy production. According to their findings, around 90% of participants in Germany, France and Poland indicate that they would choose to invest in decentralized renewable electricity generation if the conditions were right (Guetlein and Schleich 2022, p. 51). For the German sample, 21.4 % of participants indicated that they were actually planning to invest in sustainable crowdfunding projects. Furthermore, for the case of France, Guetlein and Schleich analysed the most important factors that influence future investments decisions in cooperate renewable energy production and find that financial benefits are mentioned most often, followed by the motivation to support renewable energy production.

Figure 3.12: Factors which would motivate participants (in France) to invest in a renewable energy cooperative as shares of participants selecting a particular factor (participants could select up to three factors)



Source: Guetlein and Schleich 2022

In line with these findings, Heidary et al. (2021) as well as Kantel et al. (2022) interviewed ECs about their motivations and find different types of motivations that drives the engagement in renewable energy production. The interpretation of the societal challenge addressed may vary depending on the motivation and the focus of the EC - between economic interests, independence from other market actors or environmental benefits.

2.2.2 What is the "Innovation"? How can it be characterised?

New social practices: On the individual level, novel roles and practices of citizens to participate in the energy transition can be identified. Instead of only acting as consumers, citizens might engage as prosumers, change lifestyles towards sufficiency or engage in social movements.

The active engagement of citizens in the energy transitions can be summarized under the term of energy citizenship (Schlindwein and Montalvo 2023). This can refer to different types of practices such as investments in renewable energy production, prosmuning or participation in social movements. But also practices of saving energy on the individual level and sufficient lifestyles (Pagliano and Erba 2022) can be understood as novel practices of energy citizenship. Citizens engagement in energy transitions can be driven by different motivations and address different aims such as independence, democratic influence, environmental benefits but also economic benefits as an important factor mentioned by different actors (Hackbarth and Löbbe 2022).

Organisational innovation: Cooperatives are one possible and successful format to organise citizen's participation in the energy transition. Although this is not a new format, it gained novel meaning in the context of the *Energiewende*.

Cooperatives organisational structures are not new and frequently used in different societal domains such as for shared ownership in housing or in relation to agricultural goods and services (Blome-Drees 2012). However, in the context of energy, the energy market in Germany for a long time has been mainly shaped by 4 regional monopolies (Agora Energiewende 2019). After the liberalisation of the energy market in 1998, the emergence of 'new players' in the field can be seen as a new development with ECs as innovative types of actors that allows the direct participation of citizens in renewable energy production (Smith et al. 2016). We define ECs in line with their legal cooperative status, regulated by the German cooperative law (Bundestag 2022). Furthermore, the European federation of renewable energy cooperatives (REScoop) defines cooperative principles for ECs. These principles include 1) voluntary and open membership, 2) democratic member control, 3) members' economic participation, 4) autonomy and independence, 5) education, training, and information, 6) cooperation among cooperatives and 7) concern for community (REScoop.eu 2019). Insofar, the social innovation under study is directly linked to organisational forms.

Institutional innovation: The emergence of ECs as actors in the energy transitions required changes in institutional structures such as the liberalisation of the electricity sector. Insofar, institutional innovations opened a window of opportunities that was crucial for the development of ECs as social innovation.

Several innovative changes in institutional structures were key to open a window of opportunity that allowed ECs to emerge and scale. First, the liberalisation of the electricity sector allowed for a greater diversity of actors in the electricity market (Agora Energiewende 2019). Second, technology specific feed-in tariffs made investments in renewable energy production economically attractive and feasible for citizens. Third, one precondition for the establishment of a larger number of ECs was linked to changes in the cooperative law in 2006 that facilitated the establishment of new cooperatives (Klagge and Meister 2018). Institutional changes are further represented by e.g. introducing a new section for energy cooperatives in the DGRV in 2013[17].

Technological innovation: Technological developments around solar PV but also wind turbines and biomass can be understood as another precondition for the development of ECs.

To describe ECs as social innovation involves both social as well as technological elements. Especially the availability of solar PV modules in Germany (together with technology specific feed-in tariffs) can be describes a window of opportunity for smaller actors like ECs to contribute to energy production (Holstenkamp and Kahla 2016). As Holstenkamp and Kahla (2016) describe it: "one could speak of a "gold rush" in the period 2009–2011 even within the community energy sector" (Holstenkamp and Kahla 2016, p. 120). With the price shock of solar PV modules and changes in the EEG, other technologies are gaining importance and the technological element changes with novel business models of ECs.

Business model innovation: With changes in technological elements and policy changes over time, also novel business models of ECs emerge. Business model innovations therefore refer to processes of professionalization and adaption of ECs over time.

ECs business models might be based on different types of technologies such as solar PV, investments into wind energy projects, into local heat production, e-mobility or other types of business models (Herbes et al. 2021). However, as Herbes et al (2021) find, changes in business models also require social elements such as new types of knowledge and processes of professionalization, which can be a challenge for implementing these

[17] DGRV, section for energy cooperatives – see: https://www.dgrv.de/bundesgeschaftsstelle-energiegenossenschaften/

business models (Herbes et al. 2021). Furthermore, due to very detailed regulations of the EEG, several technological-related barriers emerge for ECs. For example, the EEG especially incentivises the self-consumption of electricity. Overall, business model innovations also describe an innovation journey of ECs. At a point of an increasing success of EC's business model, policy conditions changed that created novel institutional barriers and required adapting business models and professionalizing activities, e.g. in intermediary networks.

2.2.3 How are the different dimensions of innovation related to each other?

With reference to the two key dimensions (i.e., purpose and nature of innovation) identified in Section 2 to characterise and position different kinds of innovation, the purpose of ECs can mostly be described as 'hybrid', addressing business interests at least in terms of self-financing. However, the motivation of ECs might differ with some of them identifying more as non-profit interested while others clearly aim for regional value creation through their business models. A differentiation can be made between ECs with a social purpose and energy providers with a main focus on profit that make use of cooperative organisational formats in order to benefit from advantages created for ECs. For example, Lundberg (2019) finds evidence of larger project developer collaborating with citizens in order to benefit from the exemption clause for ECs in wind power auctions. This profit-oriented approach formally builds on citizen's participation but if mainly driven by profit purposes would not be understood as SI.

2.3 Process perspective

2.3.1 The early triggers of change

Historically, Germany's energy system has been understood as an top-down organized public infrastructure and as a 'natural monopoly' (Agora Energiewende 2019, p. 8). This system evolved from a centralized structure, dominated by large energy trusts, that focused on the use of coal (von Hirschhausen 2018, p. 20). German coal regions such as the Rhine-Ruhr region contributed to a stronger focus on centralized structure based on one source of energy production. While these structures emerged throughout the 19th century, also in the second half of the 20th century, after the second world war, the idea of a centralized energy system remained: "After the war, one of the founding principles on which the European Community was built was the idea that a cartelized energy and heavy industry would maintain jobs and supply security" (von Hirschhausen 2018, p. 24). However, this started to change during the 1970s and 1980s with an increasing movement aimed at a greater independence from fossil fuels and nuclear energy. According to Kemfert et al. (2018), "the Energiewende is a long-term project, and it is a political and societal revolution as much as it is a technological revolution" (Kemfert et al. 2018, p. 380).
Because of its ambitious program, Germany's *Energiewende* has received international attention. Especially the 'speed and scope' of the *Energiewende* has been described as 'exceptional' (Agora Energiewende 2015, p. 1). From the perspective of socio-technical system change, Geels (2020) has described different phases of Germany's electricity transition between 1986 until 2016. First, after the oil crisis of the 1970s, technological niche developments such as wind turbines and solar PV was supported by R&D programs. The Chernobyl nuclear accident in 1986 can be described as an external shock that increased environmental awareness of citizens and for example also motivated the foundation of EWS Schönau[18] as a counter reaction - today one of the bigger ECs in Germany. Second, after the introduction of the EEG in 2000, renewable energy technologies diffusion quickly and "[s]olar PV became an industrial success story" (Geels 2020, p. 16) in Germany. Third, the prices for renewable energy technologies declined (also influenced by cheaper products from Chinese technology providers) and, during this phase, guaranteed a stable business model for ECs (Holstenkamp and Kahla 2016).

2.3.2 Main phases of development

While Geels (2020) focuses more on technological niche creation around renewable energy technologies, the process perspective on Germany's *Energiewende* provides a slightly different picture from the perspective of social innovation. While ECs are clearly based on the development of renewable energy technologies, only the introduction of the EEG in 2000 together with changes in the cooperative law in 2006 created the conditions

[18] EWS Schönau – see: https://www.ews-schoenau.de/ews/genossenschaft/wir-ueber-uns/

for joint energy production by citizens in the form of ECs, We distinguish three phases of this development between 1998 and 2023:

1. **Window of opportunity for prosumption practices and ECs:** An early phase can be described for the time between 1998 and 2006. During this time, the policy changed in favour for ECs to emerge and opened a window of opportunity. Important milestones were first, the liberalisation of the energy market in 1998 (Bundestag 1998) that allowed greater diversity of actors contributing to the energy market (Agora Energiewende 2015). Second, the introduction of the EEG with technology specific feed-in tariffs in 2000 (Bundestag 2000). The EEG is described as "the key policy instrument for the *Energiewende*" (Leiren and Reimer 2018) that provided stable conditions for investments in renewable energy projects with fixed rates of return over 20 years. Third, changes in the cooperative law in 2006 (Bundesjustizministerium 2006) facilitated the establishment of new ECs (Klagge and Meister 2018). In this sense, niche creation happened more indirectly: not by direct support for ECs as organisational form but by lowering barriers for cooperatives and by creating financially attractive conditions for the use of renewable energy technologies.
2. **Diffusion of energy citizenship and organisation in form of ECs:** The time after 2006 until 2014 can be described as the boom-phase of ECs. The number of newly founded ECs increased during this time from only 8 ECs that existed in Germany in 2006 to a total number of 772 ECs in 2014 according to the yearly statistics of the German Cooperative and Raiffeisen Confederation (DGRV 2015)[19]. This boom-phase was further influenced by external factors such as the financial crisis in 2006 that made investments in ECs comparable more attractive (Heidary et al. 2021, p. 28). Furthermore, the Fukushima nuclear accident in 2011 gave ECs further importance. The accident led to the immediate shut down of the oldest nuclear power plants in Germany and the decision for the nuclear phase out in Germany until 2022. Heidary et al. (2021) find increased environmental awareness and interest in renewable energy production as a reaction to the Fukushima nuclear accident as a support factor for their development. However, in contrast to ECs, the financial crisis and nuclear phase out decision negatively impacted the four big energy providers in Germany: "With these developments, in addition to the phase-out of eight nuclear reactors, the Big Four were now faced with a crisis" (Leiren and Reimer 2018, p. 36). Policy conditions in the following years shifted towards more competition-oriented approaches in favour of bigger companies.
3. **Competition and crowding out of EC initiatives**: From the boom-phase of newly founded ECs between 2006 and 2014 one could imagine a stronger focus on diffusion as the next step for the development of ECs. However, due to changing policy conditions with several amendments of the EEG (Leiren and Reimer 2018), ECs faced novel challenges. As a consequence, the number of newly founded ECs decreased from 167 newly founded ECs in 2011 to only 13 newly founded ECs in 2020 (DGRV 2023). Two parallel developments contributed to these policy changes and the amendment of the EEG: first, increasing pressure from the European Commission towards more competition-oriented approaches and second changes in political priorities and responsibilities within different legislative periods (Leiren and Reimer 2018). Instead of the further diffusion of ECs, the policy changes led to a diversification of business models such as investments in wind energy and e-mobility (Herbes et al. 2021). As one reaction to changing policy conditions, ECs increased their efforts in joint networking activities on the regional and national level to improve their possibilities for political influence.

In 2022, according to the statistics of the DGRV, 220.000 members of ECs jointly produced 8 Twh of renewable electricity. This corresponds to 3% of the total renewable electricity generation in Germany (DGRV 2023). Of course, with 3% of the total share of renewable electricity in Germany, this cannot be interpreted as a completed system change that successfully exnovated dominant forms of centralized and fossil-based energy production. There might have been further potential for ECs to contribute to a regime change in the energy system but due to changing political priorities this potential was not fully exploited. However, ECs were successful in continuing their activities and in finding answers to constantly changing policy conditions.

[19] In 2022, according the DGRV, 950 ECs exist in Germany that produce 3% of the total renewable electricity generation in Germany (DGRV 2023.

2.3.3 Barriers faced by energy cooperatives

From the development over time as described above, key barriers for ECs can be identified especially in relation to legal and administrative barriers, economic and financial barriers and competition-oriented barriers. Next to external challenges, also organisational barriers within ECs or between ECs and other actors exist:

- **Legal and administrative barriers**: The EEG with its several amendments over time forms a very complex policy landscape. ECs are very directly affected by changes in legal frameworks. While all types of investments in the energy sector depend on secure and stable conditions for investments, ECs are smaller actors that often rely on one specific business model (e.g. energy production from solar PV). Furthermore, because ECs are less professionalized, there might be a lack of knowledge about policy frameworks and a lower readiness to take risks (Herbes et al. 2021). In addition, administrative barriers such as approval procedures on the local level can be a main barrier because the projects developed by ECs are sometimes too small to be of big interest for local authorities (Kantel et al. 2022).
- **Economic and financial barriers:** Economic barriers impact ECs in terms of planning security and a high dependency on favourable policy conditions. For example, the EEG strongly incentives self-consumption of energy. In practice, this might mean that solar PV plants are installed where most energy is consumed, not where most energy could be produced. Interestingly, however, it is often not the main problem to allocate the necessary financial resources but to develop projects and find suitable sites for these projects. As Heidary et al. (2021) quote one member of an EC: "*I see that with nearly every cooperative, that their members would like to invest, the money is there, but there are no projects which would be worthwhile to invest in.*" (Heidary et al. 2021, p. 53, Interview DE_EC_05).
- **Competition-related barriers:** With the amendment of the EEG in 2017 an auction model was implemented that replaced the previous feed-in tariffs. This followed a more competition oriented approach as favoured by the European Commission and by changing national policy priorities (Leiren and Reimer 2018). According to Anfinson et al. (2023), "many scholars agree that the auction model represents a barrier for actor diversity in general and community energy in particular […]" (Anfinson et al. 2023, p. 3). The auction model included an exemption clause that gave advantages for citizens ECs. However, Lundberg (2019) finds for the case of wind power auctions that "larger project developers collaborated with citizens to be eligible for the exemptions" (Lundberg 2019, pp. 456–457) and thereby increased their advantages.
- **Social and organisational or user-related barriers:** Next to external factors influencing ECs also internal organisational barriers hinder the development of ECs. This is especially due to a relatively lower level of professionalization among members of ECs and readiness to take risks (Herbes et al. 2021; Ametowobla et al. 2021). ECs are mostly driven by a few active voluntary members. Therefore, a lack of time of members in terms of developing projects can be a barrier for their development (Heidary et al. 2021, p. 53). As a consequence, ECs might benefit from close cooperation with other local actors, e.g. in form of support from municipalities (Meister et al. 2020).

2.4 Actors' roles in the process

2.4.1 Main types of actors and stakeholders

First level: energy citizens

On the individual level, citizens participate in different ways in local energy transitions. This can refer to different practices such as changing lifestyles towards more energy efficient or sufficient practices (Pagliano and Erba 2022), participating in local movements and protests (Becker et al. 2016) or prosuming (Ouanes et al. 2022). These types of individual engagement in energy transitions can be summarized under the term 'energy citizenship' which empathizes 'both the duties and rights of citizens' (Schlindwein and Montalvo 2023, p. 3) to contribute to energy transitions. This might also include joining forces for joint investments in renewable energy technologies in forms of ECs.

Concerning the motivation of individuals to engage in ECs, Hackbarth and Löbbe (2022) find differences in terms of socio-economic characteristics that influence individuals' motivation to engage in ECs. According to their findings, younger or middle-aged and better educated individuals are more likely to get engaged (Hackbarth and Löbbe 2022). In contrast, Heidary et al. (Heidary et al. 2021, p. 53) find that ECs suffer from an aging member structure with a lack of younger people taking over active parts in the EC. Furthermore,

members of EC describe that members often lack diversity in terms of gender structures (Heidary et al. 2021, p. 37).

Second level: joint energy production by ECs

At the core of ECs are their members that jointly engage in the cooperation. According to the section for citizen's energy cooperatives at the German Cooperative and Raiffeisen Confederation at total of 220.000 people in Germany engaged in ECs in 2022 (DGRV 2023). The majority of the members are individuals (95%). Furthermore, the member structure also includes farmers (2%), companies or banks (2%) or municipalities and public institutions or churches (1%) (DGRV 2023). As described above (see section 2.2), ECs are defined by their legal status, regulated by the German cooperative law (Bundestag 2022) and cooperative principles (REScoop.eu 2019). As part of the cooperative organisational model, ECs rely on the financial capital provided by their members. Unlike some other forms of cooperatives, revenues are not returned in form of material economic advantages (such as housing for housing cooperatives) but in form of financial revenues (Heidary et al. 2021, p. 12).

Third level: Networks of ECs and intermediary institutions

Since about 2012, several networks on the regional level emerged that support regional coordination of ECs. The aim of these networks is to encourage learning, coordinate activities on the regional level but also to increase political influence. As Heidary et al. (2021) quote one member of an EC: "[…] *we asserted that a single cooperative does not really have a voice concerning politics. That was the starting point where we said, we want an umbrella organisation which represents the voices of energy cooperatives in our federal-state*" (Heidary et al. 2021, p. 39, Interview DE_EC_07). Regional networks often take to legal status as an association but there are differences in terms of the status and organisation of these networks. Some of the federal states in which regional networks emerged are:

- Rhineland-Palatinate (LaNEG Rheinland-Pfalz e.V., founded in 2012)
- Thuringia (BürgerEnergie Thüringen e.V., founded in 2013)
- Hesse (LaNEG Hessen e.V., founded in 2013)
- Bavaria (Bürgerenergie Bayern e.V., founded in 2014)

Further networks formed on the national level with different goals. One motivation for national level intermediaries is the professionalization of ECs, knowledge exchange or increased political influence as a reaction to policy changes that created challenges for ECs. Furthermore, national cooperation also allowed joint energy marketing or project development. Some of the national networks are:

- Section for citizen's energy cooperatives at the DGRV (founded in 2013): represents EC's interests on the national levels, collects data in yearly statistics, professionalized structure with permanent funding (in contrast to regional level intermediaries that are based on voluntary work)
- Bürgerwerke e.G. (founded in 2013): joint energy marketing, ECs sell energy to Bürgerwerke e.G. and Bürgerwerke e.G. resell energy to end users; remaining profits (after taxes, administration costs, EEG-surcharge and grid charges) are distributed among the member ECs
- Bündnis Bürgerenergie e.V. (BBne, founded in 2014): emerged out of cooperation of regional networks; political representation of citizen energy beyond the organisational form of ECs;

While ECs are mainly funded by their members, some of the intermediary actors might also receive public funding, e.g. for specific projects or to increase the professionalization of ECs.

2.4.2 Cooperation and competition

Because ECs are driven by voluntary work of their members, they often lack professional knowledge and personnel capacities. Cooperation is therefore crucial for many ECs to increase knowledge sharing e.g. with other ECs in regional or national networks (see section 2.5 on dynamics). Also, cooperation with municipalities can be important (Meister 2020; Meister et al. 2020). This is especially because local land use and planning in the German federal system is based on municipal decisions. Therefore, "municipal approval is indispensable" (Meister et al. 2020, p. 8). Schmid et al. (2020) find that municipalities cooperate with ECs in terms of providing roof spaces for solar PV installations (Schmid et al. 2020). However, ECs also describe differences in terms of cooperation with local authorities or utilities. Cooperation can bother be interpreted as an enabling factor ("*Municipal utilities are always a good partner*", Heidary et al. 2021, p. 17, Interview DE_EC_08) or

an impeding factor ("*Municipalities can be an impeding as well as an enabling factor for energy cooperatives*", Heidary et al. 2021, p. 17, Interview DE_EC_05). Others describe the lack of cooperation with the municipality as an impeding factors (Kantel et al. 2022).
The feed-in tariffs provided a stable business model for ECs. However, with the amendment of the EEG in 2017 and the introduction of the auction model as a more competition-oriented approach, competition with other actors emerged as a new problem for ECs. As described above (see section 2.3 on competition-related barriers), some larger project developers found ways to benefit from the exemption clause developed for ECs to participate in auction and thus gained advantages (Lundberg 2019). As a consequence of these policy changes and a stronger focus on competition-oriented approaches, ECs developed novel forms of networking and cooperation among each other, e.g. in the form of regional and national networks.

2.4.3 Main roles of actor types and how they have changed

In the process of EC's development over time, different actors take different roles. Starting point are citizens as members of early ECs that function as **developers**. For example, one of the oldest ECs in Germany is EWS Schönau that has its roots in the anti-nuclear movement and was funded as a reaction to the Chernobyl nuclear accident in 1986[20]. Also other renewable energy producers can be a source of inspiration, even if they don't operate as an EC. One example is Naturstrom AG that was founded in 1998 by members of environmental associations[21]. The examples also show that members of ECs engage in joint networking activities to function as **knowledge providers**.
The most important sources of knowledge for many ECs is the exchange with other ECs in form of regional or national networks (Heidary et al. 2021). For example, the association Energiewende Jetzt e.V. offers coaching for ECs[22].. Networks also function as **promoters** of the ideas and needs of ECs e.g. by coordinating political statements to communicate ECs interests. Heidary et al. (2021) find that important forms of cooperation happen on the local level, e.g. by cooperating with municipalities that provide spaces for solar PV or by investing in energy cooperatives. Insofar, municipalities can function as **supporters**. However, some members of ECs also describe an impeding role of municipalities, e.g. due to complex bureaucratic processes or due to different political ambitions on the local level (Kantel et al. 2022). During the earlier years of the development of ECs, also national level policy makers can be understood as supports by creating favourable policy conditions for the emergence of ECs.

2.5 Dynamics

2.5.1 Generative mechanisms

For the case of ECs, the most important generative mechanism at play are cooperation (with other ECs, local businesses or municipalities), learning (in networks that allow for professionalization). Furthermore, also conflict (with big players in the energy market) plays a more indirect role insofar as ECs, not in form of a direct conflictual interaction but in form of competing interests.
While ECs in their early phase could rely on stable policy conditions that allowed their fast diffusion (see figure 1), cooperation and learning are both especially relevant for a later phase when the policy conditions changed. ECs cooperate with other cooperatives in joint projects or with municipalities that provide spaces for renewable energy plants e.g. roof space for solar PV (Meister 2020; Schmid et al. 2020). Cooperation and learning are strongly related insofar as cooperation helps to compensate a lack of professionalization (Meister 2020). Network activities are an important aspect of learning and professionalization. According to a member of an EC quoted by Heidary et al. (2021): "*The desperation of energy cooperatives and the rising question whether there would be still an economic market for them led to the idea to found an umbrella company, independent from third parties where existing competencies could be bundled*" (Heidary et al. 2021, p. 43, Interview DE_EC_03). A crucial step towards a stronger professionalization was the foundation of the section for energy cooperatives at the German Cooperative and Raiffeisen Confederation in 2013. In contrast to other networking activities, the section at the DGRV is not based on voluntary work but based on permanent personal funded by the contributions of their member federations (Heidary et al. 2021). Furthermore, the foundation of

[20] See: https://www.ews-schoenau.de/ews/geschichte/
[21] See: https://25-jahre.naturstrom.de/rueckblick/
[22] See: https://www.energiegenossenschaften-gruenden.de/coaching.html

the Bürgerwerke eG (2013) marks another crucial step for professionalization of energy cooperatives since it allows joint energy marketing.
Conflict is more indirectly described. ECs compete with bigger market players, which are often more successful in lobbying activities and promoting their activities. Overall, the energy in Germany for a longer time "was regarded as a natural monopoly" (Agora Energiewende 2019, p. 8). Therefore, institutional structures were built to support the four main market players. Conflicts emerge in form of broader social movements, like it was the case for the anti-nuclear movement or the Fridays for Future movement.

2.5.2 Generalisation mechanisms

While the diffusion of ECs can be described based on the increase in the numbers of ECs over time (see figure 1), generalisation for the case of ECs rather refers to more complex processes that allow to adapt institutional structures towards a more decentralized energy system based on citizens participation in the energy transition. First of all, policy changes that **adapted the institutional framework** (liberalisation of the electricity market, introduction of technology specific feed-in tariffs, change of the cooperative law) were crucial for opening a window of opportunity for ECs to emerge. This allowed a fast **expansion and scaling** of ECs, described as boom-phase of ECs in Germany. After changes in the policy framework, however, the most important generalisation mechanism for ECs was **learning and professionalization**. This happened in regional or national networks that allowed to bundle competences (Heidary et al. 2021). ECs actively conduct institutional work by forming network structures and representing their needs and interests in different council. One EC quoted by Heidary et al. (2021) describes this as follows: "[…] *that wouldn't be possible for a single cooperative. It enables us to introduce aspects of citizen participation and cooperatives into those councils as well*" (Heidary et al. 2021, p. 50, Interview DE_EC_05). Associations such as Energiewende Jetzt e.V. offer coaching for ECs as a form of knowledge sharing among ECs. Furthermore, national networks coordinate statements in reaction to novel laws and policy changes, publish press releases, collect data for yearly statistics and try to influence political processes through lobbying. Heidary et al. (2021) quote one interviewee according to whom, network structures allow to have be better heard in political contexts: "[…] *they don't listen to me because I'm Mr… they listen to me because I am the board member of the federal state network for energy cooperatives*." (Heidary et al. 2021, p. 37, Interview DE_EC_08). On the local level, ECs conduct intuitional work by cooperating with local business and municipalities (Meister 2020) and by representing a successful way of local engagement in energy transitions that aims to encourage other actors to get engaged as well. Finally, another strategy of ECs that faced challenging policy conditions was the **adaptation** of their business models (Herbes et al. 2021).
***Path-dependencies** & inertia, and how to overcome them (→ socio-material context)*
As described above (see section 2.3), ECs were successful in establishing novel types of joint energy production but due to their smaller size compared to still dominating energy utilities in Germany, the innovation process cannot be understood as successful in destabilizing the existing regime. This is especially the case due to changes in political agendas that set different incentives for cooperative of competition-oriented forms of energy production. More stable policy frameworks would allow ECs to better plan their activities in the future. Furthermore, infrastructural barriers exist that still represent a challenge for a more decentralized energy system. For example, while most ECs build their business models on energy production based on solar PV plants, this creates challenges for the stable operation of the grid. Self-consumption of the produced energy is therefore stronger incentivized. However, this mean that ECs have to install solar PV plants where more energy is consumed, not where most energy could be produced. Therefore, also technological innovations related to energy storage or grid operation are needed to balance differences in energy production.
*What **social relations** are built?*
Overall, ECs contributed to changing the roles of citizens in energy transitions by actively producing, selling and distributing energy instead of taking the role of passive consumers. This also brings about a greater diversity of actors in the energy market and contributes to a more decentralized energy system. While energy in Germany for a long time was understood as a "natural monopoly" (Agora Energiewende 2019, p. 8), ECs represent novel types of actors in the energy system. Most importantly, ECs represent a more democratic approach to energy production that is less interested in profit orientation but in environmental benefits, regional development and empowerment of citizens. Novel social relations are built among citizens that jointly engage in local energy production as well as between citizens and policy makers on the local level (e.g. municipalities supporting ECs) and on the national level (EC intermediaries interacting with policy makers).

2.6 Rationales and options for policy intervention

2.6.1 Types policy interventions observed

The window of opportunities that allowed ECs to emerge can be described as a successful policy intervention. Even after the liberalisation of the electricity market in 1998 (Bundestag 1998), ECs only emerged after two more policy changes: first, the creation of financial incentives ins form of a feed-in tariff model that allowed the development of a stable business model for ECs (Bundestag 2000) and second, the reduction of barriers after the amendment of the Germany cooperative law in 2006 (Bundesjustizministerium 2006). However, with changing political priorities and several amendments of the EEG, ECs faced novel barriers that hindered their potential to contribute to systemic change in the German energy transition (see section 2.3).

2.6.2 Failures to justify policy interventions

Overall, the role of institutions is central to understand the case of the ECs in Germany. After favourable conditions created by the cooperative law and the EEG, regulation turned out to be a barrier. From the perspective of a failures concept to justify policy intervention (part 2 of this study), institutional failures were the most important.

Institutional failures refer to regulations, standards, legislation, political as well as to socioeconomic cultures, social norms and values (Weber and Rohracher 2012). For the case of ECs, institutional failures especially refer to the EEG that first fostered and – after several amendments and changing political priorities towards more competition-oriented approaches – finally hindered the development of ECs (see section 2.3).

A second type **of institutional failure** can be seen in the fact that overall, ECs are associated with positive social norms such as democratic values. However, integrating smaller actors and decentralized forms of energy production in established institutional contexts often creates challenges that are so far less addressed by policy interventions (e.g. interventions on the local level in urban planning frameworks etc.). This failure is closely linked to policy coordination failures.

On a broader picture, also **transformational system failures** need to be better addressed by policy interventions. In relation to social innovation and their role in the energy sector Rogge et al. (2023) for example suggest better coordination across policy domains that would enable social innovation in the energy sectors, such as a coordination between innovation policies, energy policies and climate policies. Furthermore, better coordination is needed across policy levels (Rogge et al. 2023). This also refers to ECs that often face different barriers on different policy levels, such as bureaucratic barriers related to urban planning law and barriers on the national and European level related to energy market mechanism.

Finally, **capability failures** play a role for the generalisation of ECs as SI insofar as ECs often lack professional knowledge when interacting with institutional actors. On the other side of institutional actors, might lack knowledge about the specific requirements and barriers that ECs are confronted with.

2.6.3 Suggestions and recommendation for action

- Renewable and just forms of energy production need to be made financially more attractive with better market conditions for ECs to encourage socially just and renewable forms of energy production. This requires **long term strategies** that allow to build stable business models.
- ECs have a lower level of professionalized knowledge and due to their small number in terms of the overall energy production, less influence in shaping conditions for cooperative renewable energy production. This should be addressed by **reducing bureaucratic barriers** and shaping niches for ECs to further develop and scale.
- The development of ECs as one example for SI is impacted by policies from different policy domains, such as energy and climate policies but also policies related to cooperative laws, tax systems etc. Furthermore, different policy levels influence the development of ECs over time – from EU directives to local level urban planning policies. There is a need for a **closer dialogue** with EC representatives across policy domains and policy levels

3 CASE STUDY "AUTONOMOUS DRIVING"

3.1 Background

Autonomous driving (AD) is a disruptive innovation with the potential to transform traffic in several regards. Despite unrealistic initial promises made by entrepreneurs about the imminent arrival of autonomous vehicles (AVs), the technology has advanced significantly and is progressing towards technical feasibility for mass adoption. Estimates vary, but public transportation carriers (PTCs) in Germany hope to incorporate AD into their repertoire within the next 10 years. These 10 years are therefore a crucial time to understand and anticipate the advancement of this innovation and its adoption scenarios in order to identify windows of opportunity that would allow steering along desirable trajectories. How soon AD will become a reality, and more importantly, in what shape it will be realized, depends largely on policy action taken in this time window. AVs are malleable and can be inserted into different sociotechnical systems, resulting in various sociotechnical configurations of AD. It is these configurations on which the benefits, downsides and challenges of this innovation depend, more so than on the technology itself. Before getting to these systems however, it is important to recapitulate the history and development of AD, as well as the current moment in time.

The last few years have seen a wave of pilot projects, with somewhat mixed results. Throughout Germany and the rest of Europe, PTCs have offered autonomous shuttles that operate on fixed routes, akin to a regular bus (Interviews 4, 5). Although these shuttles already operate mostly autonomously, they have been accompanied by a person to serve as the "technical operator" for legal reasons. What these trials have shown is that there is enormous potential and demand for autonomous shuttles operating on-demand as part of public transportation. What they have also shown, however, is that there remain important barriers on the way towards mass adoption. Besides legal, institutional, financial and social barriers, there are also still significant technical hurdles to overcome. Despite the technology having come a long way, shuttles require a reliable 5G connection for navigation and coordination that is difficult to assure in rural areas, they struggle with sensing their surroundings on country roads where they lack orientation points in the environment, and their speed is often limited to below 20 km/h for safety reasons (Interview 4, 5). The progress on the limitations pertaining to the vehicle itself is difficult to predict, making it difficult to estimate when AVs will be satisfying from a technical standpoint. As it stands, the technology of AVs is not ready for mass adoption, not to mention financially viable.

Box 1 – Definition of Autonomous Driving

Autonomous vehicles can be defined as those vehicles "*in which operation of the vehicle occurs without direct driver input to control the steering, acceleration, and braking and are designed so that the driver is not expected to constantly monitor the roadway while operating in self-driving mode*" (NHTSA 2013, as cited in Thomopoulos und Givoni 2015). More precisely, five levels of autonomy can be distinguished (Marletto 2019, S. 225):

"0 – No automation
1 - Driver assistance: some driving functions being automated
2 - Partial automation: several driving functions being automated, but the driver must perform the remaining driving tasks
3 – Conditional automation: the human driver must intervene when requested by the AD system
4 – High automation: full driving automation but only in some contexts
5 – Full automation: Full driving automation, in all contexts."

Level 4 and Level 5 are what is commonly imagined as AD, with no driver being required. Some argue that technically, Level 5 cannot be reached because no system is ever truly autonomous. For our purposes however, the difference between Level 4 and Level 5 concerns merely the number of contexts in which AD works since its implementation differs for instance between rural and urban spaces. In the following, *AD* refers to Levels 4 or 5.

What makes this point in time critical from the perspective of social desirability of AD? Currently, AD technology is still malleable, and there is a window of opportunity for industry, government and society to shape and steer AD in the direction we want. We are advanced enough in the development process to foresee

realistically the possible models of adoption and their levers for action, while also being early enough to prevent undesirable lock-ins and path-dependencies. This window of opportunity could close unused, however, especially if a paradigm of individual mobility is maintained through inadequate action by policymakers.
The grand challenge of sustainability/climate change and the trend towards mobility as a service (MaaS) lend further context to the evolution of AD. Mobility is a significant contributor to greenhouse gas emissions, which cannot be fixed through electrification alone. Producing electric vehicles (EV) is resource-intensive and emits GHGs, regardless of whether the vehicle is autonomous or not. To meet sustainability targets in the long run, a reduction of the number of vehicles used is required. This coincides with a trend towards Mobility as a service, where users access "a platform that integrates access to information about and payment for multiple combinations of transport services" (Pangbourne et al. 2018). AVs could become an extension of such intermodal MaaS offers and thus make them more accessible and attractive, which in turn makes car ownership unnecessary for an increasing number of people. The window of opportunity currently presenting itself lies in steering the development of AD towards MaaS and away from individual car ownership to make mobility more sustainable (Kivimaa and Rogge 2022).

3.2 The 'innovation' in question

A traditional, purely technical understanding of innovation obscures the transformative potential of AD. Such a conventional view would frame AVs as a novel, highly advanced technology that is a superior version of conventional cars on a purely technological level. What makes AD a potential "gamechanger", however, is its interaction with infrastructures and mobility practices. Depending on its implementation, AD could revolutionise public transportation and drastically reduce the number of cars needed for the same level of mobility (Canzler and Knie 2016; Internation Transport Forum 2015). Consequently, much of the street and parking infrastructure in cities could be repurposed and redesigned, which would constitute a dual transformation of mobility and infrastructures at the same time. In fact, AD makes possible the exnovation of burdensome car infrastructures. To understand AD as a social innovation, then, a multi-dimensional understanding of innovation is required.
This section first discusses four possible models of adoption for AD. Then, the social needs addressed by AD depending on the adoption models will be elaborated upon. Lastly, the institutional, legal, technical and social dimensions of AD as well as their interactions and interdependences will be characterised.

3.2.1 Four models of adoption

For our purposes, we can distinguish four models of adoption. In the first model, AVs can be bought and owned by individuals, replacing conventional vehicles without changing the underlying structures of mobility. The second model is carsharing, where AVs are bought and offered for rent by non-profit organizations, municipalities or communities. The third model sees AVs functioning as robotaxis operated by a for-profit company like Uber. Lastly, the fourth model sees autonomous shuttles integrated into public transport, covering the "first and last mile", such that AVs funnel users in and out of established public transportation modes. If the fourth model is implemented such that AVs are one of multiple modalities accessible to users through a unified platform provided by PTCs, we can speak of MaaS (Kivimaa and Rogge 2022). Notably, these are not so much adoption scenarios as adoption models since they can co-exist and compete. The question is therefore one of balance or weighting, rather than of a binary choice between them.

Model 1: Privately owned AVs

The first model of privately owned AVs is mostly a technological substitution of conventional cars, leaving out a systemic transformation of mobility. In this model, individuals would own AVs that take them where they need to go and then park them somewhere nearby, a function called valet parking (Interview 1). The car would then move on demand and autonomously to its owner to take her to the next destination. While this scenario would be convenient, it overlooks the main problems of traffic within cities. The issues with cars are that many of them in one place will inevitably lead to a traffic jam, and that they take up space while unused, which is about 96% of the time (Thomopoulos and Givoni 2015). The traffic problem is expected to improve through vehicle-to-vehicle communication (V2V), that facilitates smoother traffic (Fagnant and Kockelman 2015). However, this effect only becomes sizeable with higher AV market penetration, as mixed traffic between AVs and conventional cars are estimated to improve lane efficiency by 21% at 50% market penetration, and by 80% at 90% market penetration respectively (Shladover et al. 2012). The parking problem

is somewhat alleviated, since AVs can at least be ordered to park in large lots outside the city centre. These lots still need to be somewhere, however, and especially in metropolitan areas they cannot be located outside the city entirely since the distance for calling them back would be too great. This may not be an issue in rural areas, but in cities, space is a precious good and parking spaces are a rather inefficient use of it. Since AVs are estimated to be $10,000 more expensive than a conventional car at the beginning of their commercial availability, they will also be out of reach for most consumers (Fagnant and Kockelman 2015). To reap the transformative potential of AD, it is necessary to split the costs between consumers and to cut down on the time vehicles stand idly – which the other models can better achieve (Interview 2, 5).

Model 2: AV sharing

The second model of non-profit carsharing foresees AVs being bought by communities to provide non-profit mobility. Rather than owning a car, users would call an AV functioning as a robotaxi via an app or telephone and be picked up and dropped off at their destination. The decisive advantage over the first model is that instead of being unused for 96% of the time, AVs can be under near-constant usage by different users. This drastically cuts down on the number of vehicles needed to fulfil mobility needs, while at the same time spreading the costs of the AV across many users, even if the number of vehicles needs to be large enough to cover peak times. This innovation also brings two significant advantages over conventional carsharing, which might suffice to make it a viable option for a larger share of the population. First, robotaxis can move people who cannot drive, such as people without driver's licenses, with certain disabilities, or of advanced age (Milakis et al. 2017). Secondly, the sum of AVs can function as a mobile fleet that is constantly under high usage. The unpredictability of demand would be counteracted by the flexibility of AVs going where they are needed by themselves. This improves coverage and efficiency, as carsharing otherwise requires more vehicles placed around a city to reach the same coverage. It furthermore relieves users from having to pick up and drop the vehicle off at a designated spot (Firnkorn and Müller 2012). Such shared fleets could be created and operated by different actors, including municipalities, PTCs or grassroots communities.

Model 3: AVs for commercial mobility services

A very similar and third model is that of carsharing offered by for-profit companies. Companies like Uber are contenders for this scenario, but traditional car manufacturers like Mercedes Benz also have experience and interest in carsharing (Firnkorn and Müller 2012). This scenario would work similarly to the second model from the perspective of a user, with the difference being the for-profit operation and differently distributed agency between users, regulators and carsharing companies. Numerous typologies of shared mobility exist, with some distinguishing up to 8 types of vehicle sharing, resulting from combinations of for-proft and non-profit orientation, crossed with peer-to-peer, business-to-consumer and government-to-consumer ownership models (Castellanos et al. 2022). For our purpose of characterising AD as an innovation, however, it suffices to mention both non-profit and for-profit carsharing (model 2 and 3, respectively) as relevant models, although we will henceforth refer to them together as *shared mobility*.

Model 4: AVs as part of public transport

The fourth and final model sees AVs integrated into public transportation and operated by public transportation providers. AVs would close the current gap of the "first and last mile", that is, the distance between a private home and a train station or bus stop (Interview 1,2,5). Similar to the second and third scenario, a vehicle would be called on demand to pick up and drop off a user at their destination. The crucial difference to the previous models is that the reach and efficiency of public transport rides is enhanced by multi-modal rides that combine AV usage with the use of more efficient vehicles like trains, trams, subways or buses. These can not only be faster, but also more space- and resource efficient. This model is therefore the one that reduces overall traffic the most.

The main factor underlying the balance between these models is their relative attractiveness in comparison with each other and with conventional driving. Presently, public transport is the least popular mode of mobility in Germany (Interview 2). Private vehicles provide comfort, reliability and flexibility that trains and buses currently do not, besides enabling mobility in places where there is no public transportation coverage at all. However, to make traffic more sustainable and to meet the grand challenge of climate change, public transportation and shared mobility should increasingly outweigh private mobility since they are inherently more efficient. From a societal perspective, it would thus be preferable to realize AV models that are based on sharing or multi-modal concepts, rather than on individual car ownership. Before we can get to these concrete

measures, however, a clearer understanding is needed of the institutional, social and technological dimensions of autonomous driving as an innovation.
Finally, the four models are not mutually exclusive but can co-exist. Of particular interest would be a MaaS approach in which the three models AV sharing (Model 2), AV for commercial vehicle services (Model 3) and AV-based public transport (Model 4) are integrated within a common intermodal, multi-service pricing, ticketing and accounting system, similar to the model that was pioneered in Finland and has been introduced in several other countries since then (Kivimaa and Rogge 2022).

3.2.2 Typology

Seen from the perspective of the innovation typology proposed in Chapter 2 (which distinguishes purpose and nature of an innovation as the two key dimensions), the *nature* of AD as an innovation is sociotechnical. If just considered as a variant of autonomous systems, one might call AVs a technological innovation, i.e. it had its origins in the combination of sensor, data processor and actuator technology. However, there is a difference between AVs and the phenomenon of autonomous driving, which adds social, infrastructural and institutional layers to the technological components. AD is certainly a socio-technical innovation in nature, as it requires a novel technology as basis as well as a reconfiguration of users and their mobility behaviours to make it work. A world changed by AD will feature as many technological transformations as infrastructural, behavioural, legal and institutional ones.
The *purpose* of the innovation on the other hand is less clear, as it depends on the adoption model. Mobility companies like Uber and car manufacturers pursue a profit-oriented purpose, whereas PTCs aim at a hybrid or social purpose. Likewise, a municipality offering a fleet of vehicles for its citizens would pursue a social purpose. Consequently, AVs serve a different purpose depending on the socio-technical regime they are embedded in. AD as an innovation is thus of a hybrid nature, with its purpose depending on the model of realisation, with Models 2-4 addressing predominantly social needs. In terms of its nature, it is not a "pure" social innovation, but socio-technical in all four models, with Model 1 showing only very limited socially innovative features.

3.2.3 Social needs addressed by AD

Numerous overviews of the benefits potentially provided by AD have been created (Milakis et al. 2017; Fagnant and Kockelman 2015). For the purposes of characterising AD as an innovation, we will focus on those most relevant for our conceptualization. Furthermore, we will distinguish the social needs addressed by AD depending on its adoption model. Technologies never exist in a vacuum, and few of their qualities are inherent to their materiality. Rather, what they are, what they do and what benefits they bring depends on the sociotechnical regime they are embedded in. We therefore again have to distinguish between the adoption models, with one exception. Regardless of the model of adoption, AVs promise to make traffic safer. Roughly 90% of car accidents are due to driver errors, which AVs could reduce drastically even if they never become perfect, although the crashes that may still occur pose unique legal challenges (Fagnant & Kockelman 2015). Apart from safety, however, scenario-based differentiation is needed.
Privately owned AVs, AV sharing and commercial AV-based mobility services could provide comfort and increased mobility for those that cannot drive (Grunwald 2015, p. 671). Driving a car can be hard or impossible for people with certain disabilities, or elderly people. Not being able to drive can be devastating for them, depending on the quality of public transportation in their area. Owning an AV would alleviate this problem. AVs would also relieve drivers of having to search for parking spaces, as they could use valet-parking to have their car park itself.
Although some imaginaries of AD foresee traffic jams as eliminated through coordination between AVs and reduced crashes, this is unlikely to come to pass. This requires high levels of automation, which are unlikely to be widely available for several years to come. Moreover, simply because of the prohibitive price of advanced AV systems, they will be unaffordable for most people, at least for another ten or even fifteen years, when their additional costs as compared to conventional vehicles are expected to drop from $10.000 to $3000 (Fagnant and Kockelman 2015). However, according to simulations, an AV market penetration of 50% would yield a mere 21% increase in per-lane effectiveness, while 10% adoption yields just 1% improvement (Shladover et al. 2012). Given the high price tag, even a 50% market penetration is unlikely to come to pass, barring extreme subsidy programs. Consequently, the critical mass of AVs needed to alleviate congestion will

not be reached for a long time since car traffic will remain for many years a mix of conventional and autonomous vehicles.
In the Models 2-4, several further benefits are reaped. These can be classified as benefits of a first and second order. First-order benefits relate to the direct impact of AD, whereas second-order benefits relate to the larger transformation of traffic and the redesign of infrastructure and urban spaces it enables.
First-order benefits of AVs for public transport (Model 4) include improved *intermodality, flexibility* and *alleviated worker shortages*. Intermodality refers to a seamless switching between different modes of mobility, such as biking, taking trains, trams or busses, walking and driving (Canzler and Knie 2016). A successful intermodal transportation network facilitates the same kind of flexibility that a privately owned car provides – which is one of the main advantages of a privately owned car. The key factor here is seamlessness. Public transportation should ideally be smooth, uncomplicated, pleasant and efficient. Delays, poor coordination and a variety of other factors can and often do disturb the smoothness of public transport. Furthermore, getting into the transportation network can be difficult in areas with poor coverage, where the next bus stop is too far away for comfort. Precisely this gap can be addressed by AVs. If AVs can be called on demand, arrive quickly and drive to a flexible location, some of these issues are alleviated, making public transportation more attractive relative to private vehicles.
Another big selling point of AD is the worsening worker shortage. Germany is going through a demographic transition which decreases the younger working population relative to the older retired one. Consequently, the present "Fachkräftemangel" should not be understood as a temporary problem, but a structural issue that requires long-term solutions. Public transportation carriers and the Deutsche Bahn have been affected strongly by worker shortages in a wide range of sectors, including vehicle operators (Interview 5). PTCs therefore hope that AVs can alleviate this issue. Since AVs will be driverless, the only workers still required would be coordinators in a centralised hub, as well as mechanics for maintenance. Alleviating the worker shortage is also promising for long-distance freight hauling via train or truck, but the impacts on these sectors are beyond the scope of this report and merit their own discussion.
Second-order benefits are those that *enhance society's capacity to act*, which in our case concerns above all municipalities who benefit from a lower total number of cars existing in their city. Owning a car is both mandatory for and wanted by many people. Public transportation as of right now is often simply too slow, inflexible or unavailable at all to make cars obsolete. However, models 2-4 would enable more citizens to forego car ownership. Up to 90% of cars could be eliminated while enabling the same level of mobility, if autonomous vehicles were used at a large scale, according to estimates (Internation Transport Forum 2015). Other studies have shown that for each shared car the number of individually owned vehicles is reduced by between 9 to 13 vehicles (Martin et al. 2010).
The space liberated from cars can be repurposed creatively, empowering citizens and granting municipalities flexibility (Interview 1, 2). On-street parking spaces can be repurposed to make neighbourhoods more liveable by adding trees and greenery, benches, urban gardening patches, wider pedestrian walkways, cycling paths, outdoor spaces for businesses like restaurants or cafes (Laurent 2019). These measures also contribute to making public spaces safer and help reduce the number of accidents. Larger parking lots could be repurposed to add more housing, or parks. Furthermore, these spaces can also be used to adapt cities to our changing climate by transforming them to combat urban heat. Added green spaces improve flood resistance while improving air quality and lowering temperatures – providing a multitude of benefits to improve public health and quality of life (Interview 1, 2, 5).
Regardless of which purpose parking spaces would be redesigned, the overarching benefit is *granting flexibility* to municipalities and *empowering citizens*. It is hard to overstate the constraints car infrastructures put on urban planning with the amount of space they require. Municipalities would gain enormous flexibility with the removal of this constraint, a flexibility they could share with their citizens. For any given space, a participatory project can be launched to include citizens of a neighbourhood in its design, granting them unprecedented agency (Laurent 2019). This is in itself a kind of second-order social innovation, as new practices and structures can emerge. In sum, autonomous vehicles can help public transportation to improve to the point of making car ownership obsolete, which brings enormous benefits and flexibility to citizens and municipalities.
Notably, in rural areas the implementation is more difficult. Since space is not a scarce good in the countryside, repurposing parking spaces is less of a factor (even if it could be an issue in tourist destinations). Furthermore, for most people in rural areas, cars are and will remain indispensable for a long time simply due to the

flexibility they offer. Overall, the alignment of AD with the existing structures and future possibilities is worse in rural than urban areas, making AD implementation more difficult (Schippl and Truffer 2020). Nevertheless, there are also people who cannot drive in the countryside, and the worker shortage also affects drivers of school buses there. It goes without saying that rural and urban are not binary distinctions, but that there is a spectrum of population density with which the efficiency and ease of implementation of AD scales (Schippl and Truffer 2020). Nevertheless, we focus primarily on urban spaces for this report because of the increased benefits.

3.2.4 Dimensions of AD as an innovation

There is a *behavioural and cultural* component to this transformation. Citizens are accustomed to certain habits of mobility which will change with the advent of autonomous driving, regardless of the model. There are of course smaller changes, like being able to use the time in the vehicle instead of having to focus on the road. Larger changes, however, can be expected with the frequency, length and types of trips citizens take. These changes are hard to predict as they depend on many factors, but it is safe to say that in Models 2 to 4, rebound effects could lead to an overall increase in the frequency of trips, as well as to trips taken by AVs instead of by bike or on foot. Furthermore, alongside the behavioural dimension, cultural identities will transform. Driving and owning a car, or a specific model of a car, has long been a marker of status. Acquiring a license to drive is a rite of passage, owning a car a status symbol and being interested and invested in car mechanics and modification a hobby to many people. Autonomous vehicles disrupt this tradition. Its users need not be able to drive, need not know their city's layout, need not navigate or know anything about their car. They would, in a MaaS model, also no longer own the car. Relinquishing car ownership therefore also means changing existing identities. This process of divestment from individual car ownership is met from the opposite direction by emerging identities, especially among young people (Interview 3). Young people are more open to, or have optimistic expectations with regard to MaaS, and do not have to go through a process of divestment. One should not forget that owning a car and learning to drive are significant investments. Drivers must buy, fuel, insure and park their cars, as well as clean, maintain and occasionally repair them. This costs money as well as time. Younger people, especially, are increasingly unable to afford the expense and unwilling to invest the time. The meaning of cars and mobility as a marker of status will likely shift, with car ownership potentially even becoming an anti-status symbol (Canzler and Knie 2016).

AVs are dependent on new physical, digital and legal *infrastructures*. New infrastructures must be created, such as EV charging stations and reliable 5G networks. AV shuttles will require a reliable 5G connection to operate, which is especially challenging in rural areas. In a recent trial, an AV shuttle slowed down or stopped entirely every time it lost its signal (Interview 5). Additionally, requesting an AV on demand will also require an internet, or at least a telephone connection. Availability and reliable operation of AVs therefore depends on successful digitization, particularly in the countryside. Furthermore, legal infrastructures need to be updated continuously to facilitate the implementation of AD as well as regulating liability.

In terms of the *economic dimensions,* AD is expected to have strong impacts on labour markets (in particular for freight transportation, which is not considered in detail here). Overall, we can observe that Models 2-4 exhibit several interesting economic opportunities. Autonomous vehicles drive down operating costs (i.e. reduced labour costs) yet increase the price of initial acquisition compared to a conventional vehicle. Models 2-4 can leverage this price structure advantageously, because the high upfront costs are split across many users while eliminating the largest share of operating costs in form of a driver. This affinity does not make it impossible to sell AVs to individuals, or even to prevent mass adoption. It does, however, encumber such a scenario, giving more time for Models 2-4 to establish themselves and compete with individual ownership before car prices drop due to expected learning rates. Given the head-start for model 2-4 providers, it seems likely that only the wealthiest early adopters will own AVs, while others will use them as a service. The intensity of these dynamics, however, also depends on policy decisions.

For the operation of Models 2-4, several pricing schemes are conceivable. Robotaxis could be integrated into existing flat rate tickets for public transportation, they could require a small fee per ride, a taxi fare-like fee per kilometre driven, or a combination of the latter two. The more users utilize this service, the cheaper it would get, as the upfront costs of buying an AV as well as the operating costs are split between more customers. On top of that, users will likely be willing to pay more for public transportation fees, if the services improve and especially if they become so good that owning a car becomes obsolete. Regardless of the specific monetization model, the underlying calculation is that AVs will pay off since they require much lower operating costs by not needing a driver, which is by far the highest component of operating costs.

The above dimensions are interrelated in various ways. Some components like the legal, physical, and digital infrastructures represent *necessary* conditions for the implementation of AD. Others, like the economic dynamics will strongly affect the balance between the adoption models and thus provide leverage for policy to steer the trajectory of this innovation. Social, behavioural and cultural aspects not only influence the (non-)adoption of AD overall, but also the specific adoption models. More importantly, however, the readiness of citizens to partake in this mobility transition as well as the overhaul of urban infrastructures will largely influence the shape of cities to come. With these aspects laid out, we can now turn to the overall *system innovation* that is aimed at.

3.3 Process perspective

3.3.1 What 'system innovation' is aimed at?

Autonomous Driving enables the exnovation from individualized automobility[23] and thus a sweeping transformation of urban spaces. As automobility has become increasingly interwoven with our economies, infrastructures, and identities, it has also become increasingly difficult to disentangle ourselves from cars. Even if we were unanimously committed to this aim, simply creating a satisfactory alternative for those reliant on their individually owned cars is a large task. Such is the case with every exnovation, as sociotechnical regimes are deeply inscribed in various subsystems. Occasionally, however, a disruption occurs that de-stabilizes the dominant regime and enables the emergence of a different one. Precisely this is on the horizon with autonomous driving, which opens a window of opportunity to phase out individual automobility.

The process of exnovation from individual automobility, generalization of MaaS extended by AD, and transformation of infrastructures is a co-evolutionary process. As the three latter adoption models become more attractive, more people will opt for them either in addition to their privately owned vehicle or as a full replacement. It is important to note that one does not have to forego car ownership to use AD, but depending on the costs and downsides of owning a car, citizens will gladly do so if their alternatives are good enough. Consequently, the reduction of car ownership can be accelerated by increasing the relative attractiveness of MaaS over owning a vehicle. Furthermore, it is crucial to reap the benefits of lowered car ownership by repurposing parking spaces and obsolete streets in desirable ways.

Notably, it is also possible that the advent of AD makes traffic worse. Thomopoulos and Givoni (2015) have argued that we could currently find ourselves at a "peak car" moment in time, after which car ownership and the total number of cars in existence declines permanently. However, as they point out, AD as in the first adoption model could make individual traffic easier and more comfortable, while also relieving users of needing to find parking spaces themselves. If 90% market penetration is reached, traffic jams should also become significantly less common (Shladover et al. 2012). It is therefore important to say that AD makes the exnovation of conventional car infrastructures and car culture *possible*, not that it automatically leads to it.

3.3.2 What phases can be distinguished?

AD as an innovation is in the stage of niche formation, with the switching point towards niche maturation on the horizon. Niches are being formed and experimented with throughout Germany and the rest of Europe, mostly in pilot projects by PTCs, supported by federal or state funding. In the US, these developments are also strongly driven by commercial actors such as Uber. These pilot projects are inherently limited in terms of their scope and duration since they are intended as trials to learn and build upon later. By themselves, they are not designed to promote scaling-up or generalisation. They do, however, function as proofs of concept and beacons for others to consider and imitate. The success of pilot projects has been limited so far, simply because a few barriers remain to making AD an economically and technically viable product for mass adoption. Once the first pilot projects clear these barriers, however, we can expect a rapid proliferation of AD offers by companies and PTCs. This will be the switching point between niche formation and niche maturation. Given the affinity of AD for densely populated spaces, they will likely generalize from urban to rural areas through processes of replication-adaptation; processes that will require overcoming hurdles that are specific to rural areas.

The speed and extent to which AD leads to a regime change from individual automobility towards MaaS will depend highly on policy action. Contrary to purely technical innovation, one cannot rely on an automatic diffusion of AD through economics of scale only. While these apply to the production costs of AVs and to the

[23] *Individual automobility* refers to the prevailing model of automobility based on individual car ownership, in contrast to models 2-4 where ownership but not necessarily rides are shared.

coverage of MaaS offers, the direction in which AVs transform mobility is malleable. Furthermore, the regime change in question consists not in the offer of AD as a supplement to conventional traffic. Rather, the regime change lies in the departure from individual automobility based on car ownership (which is tied to a reduction of parking space and number of driving lanes), which makes room for the adaptation of cities to our changing climate and citizen's needs. Political (non-)intervention is likely to play an important role in the direction and likelihood of such a regime shift. If a rather passive stance is taken, this will not only slow down the proliferation of AD offers, but also favour individual ownership of AVs on a large scale, leaving the transformative potential of this innovation squandered. Seeing AD as a social and systemic innovation, as proposed in this report, offers the possibility to broaden the room to manoeuvre to fully exploit the transformative potential that AD offers, whereas a traditional and overly technological understanding of innovation would narrow down the perspective for AD to a rather narrow range of AD models.

3.3.3 What barriers are in the way of autonomous vehicles?

Numerous barriers remain. These include technological, infrastructural, legal, social and institutional barriers. First, technological barriers are not to be underestimated. They are not the focus of our investigation, but it is important to note that they currently limit the contexts in which AD can be employed, the speed at which vehicles drive autonomously and the efficiency of the operation. For instance, AVs sometimes struggle on country roads where there are few points of orientation in the environment (Interview 4), they come to a stop or slow down if they lose their 5G connection (Interview 5) and they can be easily sabotaged with minimal interventions (Standard.at 2023). However, it seems that these problems can be resolved with more research and appropriate policy action.

Second, there remain several bureaucratic and legal challenges. An often-discussed point with no clear resolution yet is the legal liability in case of an accident (Grunwald 2015). Solving this is not an easy task and requires extensive public debate at the intersection of ethics and law. Another issue that is often overlooked is the technical approval of the AVs themselves (Interview 4,5). As of now, every vehicle must pass an individual approval procedure, which places a burden on municipalities and those conducting pilot projects, but it will remain a problem beyond trials. Standards are needed to streamline these approval procedures.

Third, financial factors matter greatly in the ability to expand offers quickly and to make them attractive. As stated previously, there are lock-in phenomena with each of the models. The ability to offer users an easy, reliable and overall attractive service is therefore crucial in gaining purchase in the market, which in turn matters for the ability to scale up the services. Increased government funding for PTCs, for instance, could be decisive in tipping the balance in favour of model 4 (AV for public transport), whereas inaction could give car companies enough time to sell so many cars to individual customers that restrictive measures become too unpopular. For PTCs, having enough funding to pay the substantial upfront cost of AVs might be difficult, but should pay off in the long run.

Lastly, the exnovation from individual automobility is required for the proliferation of AD and MaaS offers. Individual car ownership and traffic is deeply embedded culturally, meaning that a process of divestment must take place for citizens to relinquish their car willingly. Cultural processes are hard to predict or govern, but the creation of attractive alternatives is not. We can assume the speed of exnovation to be proportional to the attractiveness of public transportation and MaaS, which means that policymakers can support PTCs through financial and institutional means in order to reform traffic. Nevertheless, Germany is not a uniform place and cultural processes are inherently fragmented. Consequently, one must understand the generalisation of AD to be hindered by identities invested in individual automobility, which vary in intensity by region. The generalisation of AD will therefore also not happen uniformly, but rather first in those areas where this exnovation is easier.

3.4 Actors' roles in the process

When it comes to the role of different actors in the innovation process, AD follows a more traditional structure of innovation due to its high degree of technicality. In linearly conceptualized innovation processes, the innovation is developed and driven by scientists or experts, and subsequently disseminated as a finished product to end-customers. Most innovation processes including AD are more complex than that, but the role of distribution is more traditional than with other socio-technical innovations. Simply due to the technicality of car manufacturing and algorithm development, the main drivers of the innovation are highly professionalized companies and organizations. Citizens mostly enter the picture after the fact, as users of a

finished product. This is markedly different to more "pure" social innovations (according to our typology of innovations), like practices developed by bottom-up initiatives driven by citizens. Nevertheless, AD is a hybrid innovation that still involves citizens and governments in more substantial ways than it may appear at first glance. To get a more fine-grained picture, we can distinguish *developers*, *supporters*, *promoters* and *knowledge providers*.

Public transportation carriers, acting as developers of integrated mobility services, but at the same time also as supporters, promoters and knowledge providers, are a key actor group for AD. They can be considered the prime driver of the fourth model of adoption. PTCs throughout Germany are excited about AD and think that it could be a "gamechanger", hoping that within 10 years from now, it will be financially and technically viable on a large scale. In fact, AD has been referred to as a "penalty shot" for PTCs. They have been conducting numerous trials with various different vehicles and modes of operation, to test out the present possibilities and scope out the needed institutional changes. To implement AD, PTCs must develop several new institutional arrangements as well as retraining some of their staff. For instance, all autonomous shuttles would be driverless but connected to a central coordination hub. This hub would help to troubleshoot arising issues, send out mechanics or replacement vehicles in case of technical issues, as well as help users with any issues that occur. Additionally, mechanics will have to receive new training to troubleshoot and repair the new vehicles. New models of subscription or payment must also be implemented, with options being a flatrate for all AVs, a taxi-fare like fee per kilometre driven, or a flat fee per ride, to name just a few. All of these challenges, however, are surmountable. For PTCs, the prospect of getting more users for their services and alleviating the worker shortage are extremely appealing.

Next to PTCs, car companies are another type of *developer* of AD, but also citizens and governments can play developer roles. Crucially, we must distinguish the developers of autonomous *vehicles* from developers of autonomous *driving*, the latter being a social phenomenon and model of mobility. AVs are indeed developed by traditional car companies as well as manufacturers of autonomous shuttles, which follows the familiar picture of technological innovation. AD on the other hand is a complex mesh of AVs and infrastructures, regulations and user behaviour. Consequently, the configuration of AD involves the creation of guidelines and regulations, the re-designing of infrastructures and neighbourhoods, as well as the establishment of new mobility practices by the users. Both citizens and governments have, or at least should have, a significant say in how these configurations are developed. In this sense, the role of citizens may be passive in regard to the development of AVs, but not so for the implementation of AD where their involvement is required for the fine-tuning of offers to fulfil their needs. Furthermore, citizens should play a central role in the redesign of urban spaces as part of the second-order benefits of AD through car stock reduction. In the same vein, national governments, states and municipalities are developers in that they shape AD.

The role of governments is complex, however, and they can act as *developers*, *supporters* and *promoters* of AD. Depending on which scenario a given government finds desirable, it can help to clear barriers, adapt regulations or make direct financial contributions. Municipalities especially fall into this category, as they are in charge of their infrastructure and can thus decide to take action by adapting it to one or the other adoption model. For instance, municipalities can decide how or whether to allocate parking space and how to price it (Interview 2). Cheap parking in centralized lots outside of the city centre would encourage AV usage, as would high prices for or even the elimination of on-street parking (Interview 1). Furthermore, governments can also act as promoters of AD through information campaigns if they deem it desirable. However, given that governments have significant leverage over the shape of AD through their role as developers and supporters, having them retreat into merely being promoters would be a disappointing foregoing of their agency. Most likely, however, governments on multiple levels will take all three roles depending on varying stages of the innovation process.

Citizens will fulfil diverse roles, with some being *promoters* by serving as lead or pilot users who help improve AD. As with every innovation, some will try the technology earlier than others. If the services are satisfying, and especially if they visibly feed into a desirable transformation of overall traffic, then citizens might become promoters who encourage others to try it out as well. However, it should be mentioned that AD is not apolitical and that it already has opponents willing to contest it through direct action. For instance, protesters in San Francisco have recently begun to place traffic cones on the hoods of empty AVs in order to make them stop, which disrupts their operation without damaging the car (Standard.at 2023). Currently, AVs are susceptible to such sabotage, as it is easy to make them stop due to their many safety protocols. Citizens are therefore not just involved in the development and adoption of AD, but potentially also a barrier to if a movement against

the proliferation of AVs forms. By and large, however, citizen's perceptions of AD are positive (Interview 1,4,5). Many citizens are not just passively waiting for AD but actively anticipating and expecting policy guidance for it (Cohen et al. 2018).
In sum, citizens will play diverse roles and their engagement is also contingent on the roles they are granted. Crucially, however, *citizens* should not be merely thought of as *consumers*, the difference being that citizens "*(a) may be users of the new mobility technologies or not, (b) are sufficiently informed about societal benefits and adverse effects of AVs, and (c) are not narrowly self-interested rational agents but can act for the common good"* (Milakis and Müller 2021, p. 107). If governments make an active effort to involve citizens in the transformation of traffic and infrastructure, they will fall more in the role of *developers*, but if citizens are seen and enacted as passive end-consumers, then they at best fall into the role of *promoters*. Engaging citizens successfully and getting them onboard with a substantial transformation of traffic and infrastructures can thus be an opportunity to empower citizens, especially when involving them in the redesign of urban spaces (Laurent 2019, p. 271).

3.5 Dynamics

3.5.1 Generative mechanisms

The most important generative mechanisms at play are *learning*, *variation*, *conflict* and *planning & institutionalisation of change*. These mechanisms affect at various points the creation and development of early niches, pushing them towards maturation. Other mechanisms apply as well, but to lesser degrees. For instance, *selection* will govern competing AD offers and competition between adoption models but is not all too relevant yet.
Learning is especially important for PTCs who are new to providing AD. The learning moments here range from large-scale protocols and infrastructures for the operation of on-demand AD all the way to training mechanics to maintain and repair the novel vehicles (Interview 5). For instance, it has become clear through trials that improved 5G coverage will be necessary in rural areas to operate AVs (Interview 5). Such learnings co-evolve with innovative pilot projects, as the learning is a natural by-product of experimentation while also being required to progress AD offers towards maturity. Learning is therefore a driver of iterative experimentation, as PTCs tinker to learn the ropes of operating autonomous shuttles. Because these kinds of learning include not only explicit knowledge, but also tacitly acquired capacities of involved actors, it is important to create a stable long-term funding infrastructure for projects to persist and iterate, rather than ending abruptly, which would disrupt this capacity building (Interview 5).
Variation describes the entire emergence of AD and MaaS as a new mobility concept. The novelty herein lies less in AD itself, which has been around as an idea for quite some time. Rather, the novelty consists of emerging mobility concepts, habits and the associated roles and identities of its users. PTCs experiment with various concepts and iterate upon them, usually in cooperation with municipalities who support or even initiate these projects. Similarly, new mobility companies like Uber have disrupted mobility patterns throughout the world and might do so again with the inclusion of AVs. Citizens, too, vary and adapt their behaviour, as they try out these offers and incorporate them into their everyday life. Over time, and as AVs become more commonplace, citizen's identities may reconstitute themselves around the new modes of mobility, such that car-owning becomes less and less important or even frowned upon (Interview 2,3).
Conflict is a crucial driver of AD niches. Central actors like PTCs, car manufacturers and mobility companies align their activities with their respective preferred adoption models and thus seek to make these preferred models dominant. Consequently, car manufacturers will likely contest restrictive measures on car ownership, mobility companies will fight regulation against their business models, and PTCs will ask for subsidies and support to AV in public transport. While their preferred adoption models can co-exist, there is a certain amount of lock-in at play once AVs have been sold to individuals, or cities have been remodelled around a lower number of cars. Conflict therefore drives the different actors to be the first ones to reach the market in order to change the infrastructural regime in their favour.
Lastly, *planning and institutionalisation of change* are essential determinants of the future course of AD. As AVs enter the market in various adoption models, infrastructures and institutions will provide massive gravitational pull for the models, depending on their setup. Policymakers thus face a window of opportunity where goal-oriented policies can facilitate and hinder those adoption models deemed more and less desirable. The relationship between innovation and institutions is again co-evolutionary, since institutions embed and

enable AD while successful AD implementations at the same time call for and legitimate the restructuring of institutions around them.

3.5.2 Generalisation mechanisms

We will possibly witness in the near future a push to generalize the existing AD niches into common and institutionally embedded practices, most likely within the next 10 years. Generalisation in this context means the proliferation of AD offers and a corresponding transformation of mobility practices and cultures. The different adoption models function through different generalisation mechanisms that should be distinguished. However, since AD is a technology that has not yet proven its technical and financial viability on a mass scale, the *replication* of the first successful implementations are an especially important generalisation mechanism. Once a single PTC successfully implements AD, their model is likely to be *replicated*, *adapted* and *proliferated* by other PTCs. Pilot projects can function as proofs of concept, which eventually demonstrate financial and technical viability. Since PTCs are trying to learn from each other, they are fairly well networked (Interview 5). Consequently, a successful project can be replicated rather quickly in other places. The rural-urban divide will matter here, as models will vary across this spectrum, with a successful urban model not necessarily working in rural areas.

Expansion, scaling and *consolidation* on the other hand is more relevant for mobility companies. The carsharing and robotaxi markets will likely tend towards oligopoly, as companies will be quick to merge, take over and outcompete others to attain a larger market share in this emerging sector, as observed when Germany opened the market for intercity buses like Flixbus. Therefore, the generalisation of AD offers from the private sector is likely to follow the known market strategies of tech companies with their focus on rapid expansion and scaling. PTCs will of course also expand their offers once initial trials are successful, aiming to capture more of the market share or to expand their services into more remote areas.

At the same time, the *challenging, reframing* and *adapting of institutional frameworks* will matter greatly in shaping AD. *Citizens* play a crucial role here, as their acceptance and demand for institutional change will push AD onto one or the other trajectory (Interview 1). Due to the uncertainty and complexity associated with these behavioural and institutional aspects, experimental approaches are used to test these new configurations (e.g. regulatory experimentation). AD as part of public transport could fundamentally challenge car ownership as a normality, which could result in a critical mass of citizens pushing for institutional restrictions thereof. The question is thus which coalitions form because citizens can align with either PTCs, car manufacturers or mobility companies. The citizens are also transformed in this interaction, as their mobility habits co-evolve with AD. It is thus likely that some citizens will act as defenders of individual automobility, whereas others prefer models two to four (Interview 1). This results in self-reinforcing mechanisms, as attractive MaaS offers change users' mobility habits, which in turn fuels institutional change to facilitate this mode of transportation.

The *circulation and anchoring of new knowledge* matters in the creation of technical standards as well as the improvement of vehicle-to-vehicle (V2V) technology. Standards are important to streamline regulatory procedures, especially in overcoming the current hurdle of AD developers needing to apply for individual approvals for every vehicle. Furthermore, V2V technology needs to be improved, regulated and standardized to ensure the interoperability between vehicles from different manufacturers.

3.6 Rationales and options for policy intervention

3.6.1 Justifying Policy Intervention

In this section, we discuss the justifications for policy intervention in line with an extended framework of market failures, structural system failures, and transformational system failures as outlined in this study (Chapter 4). In the case of AD, system failures are prevalent, both structural and transformative ones.

A so-called *directionality failure* (transformative system failure) would occur in the case of AD if insufficient efforts were made to attain a desirable trajectory. This presupposes that a (political) decision is taken on the ambition to pursue a transformation of the mobility system, based on which more specific steps are made to influence the direction of AD uptake and generalisation. In line with overarching sustainability and particularly climate policies, the AD usage in connection with public transportation or MaaS seems to be the most desirable trajectory. However, as market dynamics only partly support this direction, this could result in a case of directionality failure. It could be addressed, for instance, by increasing the attractiveness of public transport and hence the potential of business models connecting AD services to public transportation to cover the first

and last miles. Complementary to this, the introduction of mobility-as-a-service models could offer an alternative to individual mobility based on privately owned cars and contribute to changes in mobility behaviour.

We would speak of a *demand articulation failure* (transformative system failure) if citizens needs are not adequately understood and addressed. The case of AD underlines that it will be very important to involve citizens in order to realise the desired trajectory. Their perspectives as users of public transportation, as car drivers and as citizens living in either urban or rural areas should at minimum be heard. In fact, their perspectives constitute viable needs, which can and should be integrated in co-design processes to shape future public transportation, individual car ownership, and the usage of space, especially in urban areas. The case further touches upon the enduring challenge for the car manufacturing industry to adapt their business models to the goal of climate-neutral economies, as well as the challenge of regions economically dependent on the car manufacturing industry to adapt structurally. In order to avoid a persisting demand articulation failure, there is a need to develop policy responses to bring those needs to the foreground, to use them constructively in implementing the transition, and to consider compensation measures, where needed ("exnovation policies").

An *infrastructural failure* (structural system failure) would occur if necessary new infrastructures are not created. Among other things, autonomous shuttles for public transport require digitalization and reliable 5G coverage, especially in rural areas. For AD to be successfully integrated into public transport systems, a general strengthening of public transport is recommended. It should not be forgotten that automobility as we know it would have never been possible without a state that creates, maintains and regulates the infrastructures it requires (Dangschat 2017). Creating new infrastructures for emerging technologies is an important task for governments and not doing so constitutes infrastructural failure.

Our framework would call a lack of a legal redefinition of liability for AVs as well as exnovation policies for individual car ownership *institutional failures* (structural system failure). The former is a necessary condition for all models of AD without which it cannot be implemented. Without legal clarity, investing into and using AVs is unfeasible. The latter would constitute not just a failure to reap potential benefits, but a failure to react to ongoing developments and citizens' needs. Once MaaS offers, including AD, proliferate and become more attractive, an increasing proportion of their users will desire to forego car ownership entirely. Enabling them to do so would not just support a sustainable development but constitute an adequate institutional response to their needs (Cohen et al. 2018).

Given the path-dependency of the still dominant mobility system that is based on individual ownership of cars, it would be insufficient to address one or some of the failures only. Instead, they need to be addressed simultaneously to enable a system transformation. AD is thus just an additional and potentially very useful element in furthering this transformation.

3.6.2 Policy Options

An approach solely consisting of traditional innovation policies will miss the mark for autonomous driving. AD is a socio-technical innovation that has the potential – under certain conditions – to contribute to a transformation of the system of individual mobility. This transformation could be supported by a mix of policies. However, such a policy mix would require seeing AD as more than a purely technological innovation, because this would suggest a too narrow range of policy options, and thus entail the risk of not reaping the full potential of AD. If indeed the ambition of realising an integrated MaaS-based mobility system is pursued, then a combination of policies would be needed, ranging from urban planning, climate protection, traffic and labour policy to proactively guide the transition into the direction of MaaS. The policy mix can draw on enabling measures for AVs in general, enabling measures for specific models of AD, and disincentives for conventional automobility that should be utilized in concert. Only if governments steer this transition will its potential benefits be reaped, or, in other words: "Whether the AV locks us further in or out of the 'car based society' depends on the choices we make as a society, not solely on a specific technological development" (Thomopoulos and Givoni 2015, p. 14).

Enabling measures for AVs in general include *funding* for research, pilot projects, new infrastructures as well as the timely adaptation of legal infrastructures. Although the overall experiences with recent AD pilot projects have been mixed, continued funding is needed to facilitate the ongoing learning process PTCs need to implement AD (Interview 1, 3, 5). *Investment* in necessary infrastructures is also needed, for instance for widened 5G coverage and a sufficiently dense network of EV charging stations (assuming that AD will be largely based on electric vehicles), both of which are useful regardless of the adoption model. *Legal*

infrastructures are also important, since autonomous shuttles for pilot projects currently have to go through a lengthy bureaucratic process of approval for every individual vehicle that could be streamlined (Interview 2, 4, 5). Legal liability remains a complex problem that will require intensive societal debate about ethical principles and responsibility.

Furthermore, enabling measures specifically for shared mobility can be taken. Municipal transport operators could provide shared fleets of robotaxis based on innovation-oriented procurement procedures. Similarly, public transport can be strengthened through investing, for instance, in autonomous microbuses. PTCs have also asked for a stable funding landscape for pilot projects to enable continuous iteration and learning (Interview 5). It is also recommended to involve citizens as substantially as possible in pilot projects to fine-tune the offers to their needs. Citizens can also be involved in co-creative redesign processes of their neighbourhoods, further increasing their agency over the transformation of mobility.

Lastly, disincentives on car ownership, driving and parking could be considered *(exnovation measures)*. These would focus on internalizing costs of these processes. For instance, one inner-city parking space costs the municipality between $1400-$5600, according to estimates and without factoring in opportunity costs for alternative space usage (Fagnant and Kockelman 2015). Parking against payment is already normal in inner cities but could be expanded in scope and intensity. The same intensification could be done for other measures, such as car taxes.

Crucially, disincentives and restrictive measures should not be understood as arbitrary prohibitions, but as an internalization of negative externalities produced by cars. Cars produce a number of externalities: Accidents with other drivers, but also with pedestrians and cyclists, greenhouse gas emissions, noise, air pollution and the often-underestimated space occupation. These externalities inflict costs that are often borne by people other than those who caused them. Air pollution affects every urban dweller and is paid for by them and the healthcare system, space occupation produces opportunity costs paid in higher housing prices, sealed surfaces for roads and parking space worsen the micro-climate of cities, and GHG emissions are paid for by the entire planet. Internalizing these costs creates an incentive to divest from established mobility patterns and seek alternatives. As one scholar puts it: “Networks of innovators can benefit from positive feedback between their (existing or gradually created) legitimation and their ability to gain support from ad-hoc policies. As a consequence, policies for AD should be considered as a partially endogenous constituent of the transition pathway towards AD, and not just as an exogenous (hampering or facilitating) factor” (Marletto 2019, p. 229). It is characteristic of many sociotechnical regimes that negative externalities are not borne by their originators. As a society, we have decided to facilitate automobility for everyone, with states and municipalities providing toll-free roads and often free or cheap parking spaces. At this point in time, however, the car-centric consensus is breaking down and alternatives in the form of MaaS and AD are becoming increasingly viable. Consequently, one can rightfully ask why the externalities should still be borne by society at large and demand that their costs instead be internalized to the price of owning, driving and parking a car. Since the market fails to properly price some externalities, especially environmental ones, the state can step in using policies that internalize these costs to create a more accurate reflection of the true costs of automobility as a regime. When consumers weigh the benefits and drawbacks of the present versus an alternative regime, then, they gain a more precise comparison. When it comes to governing such sociotechnical transitions, invisible externalities should generally be internalized, such that they become palpable to the inflicting consumers.

Furthermore, inaction should not be mistaken for neutrality. Some argue that the state should not intervene in such sociotechnical transitions and rather leave the decisions to consumers and markets. This view overlooks the myriad path-dependencies in this case. The existing infrastructures are enmeshed with conventional automobility, and if left unchanged, will continue to privilege this model. It has been forgotten what it took to build this infrastructure in the first place, and its upkeep costs have become normalized. In contrast, the new infrastructures required for the various AD adoption models may appear disproportionately expensive. Refraining from transforming infrastructures is thus not a commitment to neutrality, but rather one to the established regime.

Overview of Interviews on the Autonomous Driving case

Interviewee number	Date	Role / Occupation
1	16.5.2023	Mobility researcher
2	2.6.2023	Mobility Researcher
3	7.06.2023	Innovation & Transitions Researcher
4	13.6.2023	Pilot project coordinator
5	30.06.2023	Public transportation carrier Representative

4 CASE STUDY "CORONA-WARN APP"

4.1 Background and introduction

The COVID-19 pandemic has accelerated decision processes of the German federal government that were beneficial for the digitalization in the health sector, as digital tools were quickly needed to improve crisis management processes and support systems. One of the most prominent examples for a technological innovation during that time is the Corona-Warn-App (CWA). However, apart from the technological aspects and innovations behind the CWA, it is important to investigate the discourse around the app. From a social innovation perspective, the introduction of the CWA meant a shift toward more responsibility for infection control from local health authorities to citizens. Therefore, the analysis and interpretation of the CWA case should help to understand how social and technological innovation could interact in the context of crises and whether the potential of social innovation was brought to bear in the case of the COVID-19 pandemic. The CWA in Germany represents a special case that helps us to understand how the interaction of social demand and technological capabilities interact in a crisis to shape an innovation as a solution approach.

One of the many digital outcomes of the pandemic is the implementation of contact tracing apps as solutions to the urgent need to prevent the spread of the viral disease COVID-19. In Germany, the official app for this purpose was the so-called Corona-Warn App (CWA), whose main goal was to disrupt infection chains. Beginning in April 2020, the federal government was in the position to decide on a concept for the app, which lead to the introduction of a decentral app architecture, anticipating the storage of data only locally on users' phones. This solution was to enable trust and respond to data privacy concerns by potential users (Coronawarn.app 2023). Digital solutions to stem pandemics have been facilitated in East Asian states like South Korea and Singapore and can be seen as extreme examples (Partheymüller et al. 2020)because data privacy were neglected.

The German Robert-Koch-Institute (RKI), a public health research institution, was selected to develop the CWA, together with the technological companies Telekom and SAP. The first version of the app was launched on June 13th, 2020 and the architecture of the app was made publicly available as open source (Bundesregierung 2023).

Thereafter, the app was continuously updated and new functions were added through the end of May 2023, when the necessity subsided due to the growing immunity of the public and the slower spread of the disease. Since June 1st, 2023, the app is no longer under development (Coronawarn.app 2023).

4.2 The 'innovation' in question

An investigation of the CWA can only be regarded in the context of the pandemic as a major crisis. As local health authorities and hospitals increasingly reached their limits beginning in February of 2020, citizens as well as policymakers asked increasingly for a solution that could help to stop the spread of the disease. This major societal challenge led to the development of socio-technical innovations like the CWA, which was intended to serve different social, physical as well as communal needs. Although the app was a public-private partnership, it was not profit-oriented (Bundesregierung 2023).

In a 2020 report by the Staatsministerium Baden-Württemberg the results of a survey among more than 1000 citizens are displayed, of which 36% had answered that they have installed the CWA, 58% did not and 6% did not have a smart phone (Staatsministerium Baden-Württemberg 2020).

4.2.1 Personal responsibility

The purpose of the CWA was clearly intended to be beneficial for society as it should help to save human lives, which points to a first-order benefit. Moreover, it also served as a digital tool which enhanced society's capacity to act, also representing a second-order benefit. This resulted from the fact that the government's responsibility for society's welfare was shifted in part to people's personal responsibility.

This institutional paradigm shift regarding contact tracing can be explained with the data architecture of the CWA, which was intentionally planned to follow principles of data parsimony (to do justice to the high standards of data protection and to not use or produce more data than needed), anonymity and decentral data storage. Following these principles, the top-down approach of the federal government research sector (through

RKI) resulted in a technology that demands of its users to be more personally responsible and proactive by voluntarily using the CWA.
The decisions surrounding the app's architecture had many different consequences. First, the app caused a change of institutional structures. The local health authorities were skeptical of the CWA as they did not get access to relevant data (e.g., time and place of possible infection), due to the app's decentralized approach ^. At the same time, this anonymization made it possible for infected users to communicate their infection to other users they did not know personally. It did, however, again shift responsibility strongly to the personal realm, as it required users to regularly test themselves and enter their positive test results into the app. One important measure in any epidemiologic situation, contact tracing, was digitally transformed and its possibilities were extended using the app (Interviewee 1,2,3) (WHO 2022).

4.2.2 Technological Innovations behind the CWA

The use of "Low Energy Bluetooth" to measure only short distances to other users of the CWA enabled the detection of close encounters that could potentially lead to the transmission of the virus if one person was infected. The data between contact users was locally stored on each device in encrypted form to ensure privacy and data protection and prevent unauthorized access. The use of this technology for a contact tracing app was a new asset and showed many benefits like low energy consumption, as "Low Energy Bluetooth" is an energy-saving technology. As the app architecture was open source, individuals, independent experts and organisations could assess the functions and security of the app, as was done by the Chaos Computer Club (Chaos Computer Club 2020).

4.3 Actors' roles in the process

Looking at the network of actors in the CWA case shows the RKI can be considered as *developer* and promoters, according to our actor. typology. According to the developers at RKI, the Corona-Warn App project benefited from the cooperation between the RKI and the IT partners like SAP and Telekom, who were also developers as a public-private partnership (Interviewee 1).
Since the app was in a spotlight position as it was powered by the federal government and open source, different actors were asked to critically examine the use, function and ethics of the app. Politicians, the Chaos Computer Club (a consumer oriented NGO), as well as many universities took a closer look at the app, scrutinising data protection issues as well as the potential of the app to prevent further lockdowns if enough people would use it.
When one wants to examine the critical feedback of various actors, there is a lot to find, as it represents a net of entanglement with many different opinions (Behne et al. 2021; Häring et al. 2021; Beierle et al. 2021). This comes from the fact that the risk assessment of the data architecture as well as the efficiency evaluation were not easy parameters to agree upon. Users did not play a significant role in the development of CWA.

4.4 Process perspective

Prior to the existence of Covid-19, questions of public health were institutionalized in certain public authorities, which prepared rules and regulations in the form of pandemic plans to react to any outbreak of infectious disease. They were based on experiences from earlier (historic) pandemics and showed non-digital solutions like manual contact tracing (Robert Koch-Institut 2017). The development of the COVID-19 virus had a high impact on this existing regime (in the sense of the MLP terminology introduced by Geels and Schot (2007)), which needed to react under high time pressure. The vehemence of the pandemic can be seen as a sudden shock, as well as a catalyst for top-down decision making by the government. This provided a window of opportunity and increased the pace for the development of innovations. However, due to the speed of decision making, bottom-up processes like co-creation and public participation were neglected.

4.4.1 Different phases

Niche formation
Before the COVID-19 pandemic, there were undeveloped concepts for contact tracing apps. The ideas of contact tracing apps showed limited adoption and less sophistication at that time and focused merely on assistance for treatment of the patients. Mostly, contact tracing apps showed simpler technologies (manual data storage, messaging systems) and were mainly used for specific infectious diseases like tuberculosis, HIV and other sexually transmitted infections (Navin et al. 2018; Safely 2019).

Niche maturation

The CWA represents a special case for a social innovation, developed during the COVID-19 pandemic, not as a classical niche innovation but as a top-down solution rolled out in the country of Germany. The further development of contact tracing apps cannot be viewed isolated from this specific shock. As the motivation for the development of the app was big, actors from the federal government, public research sector and IT decided to cooperate with each other. In the moment of maturation, the social need was clear and well-articulated, as the main purpose of the app was the protection of people's health, especially for vulnerable groups, and the protection of the national health system. Although there were other COVID-19-contact tracing apps, they were not significant competition to the CWA. An example would be the Luca-App, which was a contact tracing app developed by actors outside of the government in Germany. It was criticized for various issues, like lack of anonymity and data protection, and was not as successful as the CWA (TAZ 2022).

Regime change

The development of COVID-19 was a landscape change leading to a rapid transformation in the shape of pandemic response. As the status of apps for contact tracing was immature and during the breakout of the pandemic, the development of contact tracing apps like the Corona-Warn App was a technological substitution initialized by the federal government that had to react to a lot of landscape pressure (Geels and Schot 2007). The nature of interaction between the CWA and other contact tracing apps was never meant to be competitive as the CWA was the official app by the government and commercial players like Google and Apple only facilitated the support for their operating system for one App per country and for the CWA in Germany Interviewee 1). This was meant to prevent false information about the COVID-19 pandemic (Sherr 2020).

The outbreak of the pandemic led to a shift in governance and policy approaches and provided a window of opportunity for new social and technological solutions in various fields. Decision making on contact tracing apps was accelerated, because a quick response to higher incidences and mortality rates from COVID-19 was needed, acting as a catalyst. The usage of the app was advertised by the federal government to contribute to citizens' public health. Public health was emphasized as being the most important common good.

4.4.2 What are the kinds of barriers the innovation was confronted with?

On the one hand, people were asked to follow public health recommendations in order to support the continued functioning of the public healthcare system (a common good) and thus save human lives (Vyaznikov 2018). On the other hand, the use of the CWA meant sharing personal data, which encroaches on an individual's right to privacy, that requires protection (Taylor 2016), and enjoys a particularly high standing in Germany. People raised the ethical question of whether "the infringement of civil liberties through invasive tracking was justifiable given the circumstances" (Simon and Rieder 2021).

Despite efforts to ensure data protection, people showed concerns about the app's level of data protection and privacy issues. The ethics of data as a public good became more and more relevant as its value increased for various actors(Zuboff 2019). Data sharing is a delicate subject and requires proper guidelines and frameworks still under development to avoid unauthorised surveillance and privacy breaches (Taylor 2016).

The promotion of the CWA showed that citizens had limited trust and belief in the technology development, data policies and the developing actors overall, i.e., the German federal government, SAP or Telekom. From the beginning of the COVID-19 pandemic, questions about whom or what to trust have been ubiquitous, as individual experts and political actors were asked to respond how to manage the crisis. The introduction of the CWA led to the discussion on whether technologies can truly be trusted or merely relied upon. In fact, if the CWA is regarded as a socio-technical system, it becomes clear that people's trust in the artefact is tightly intertwined with the trust in the actors that developed the app. Users had demands for trustworthy technology development as well as for public debates about such technologies, which ultimately requires attributing epistemic and moral duties to all actors involved (Simon and Rieder 2021).

The effort to ensure the data privacy of users was evaluated by several universities and the Chaos Computer Club (CCC). This was possible because the app architecture of the CWA was released as open source code. A detailed report by the CCC favoured the decentral data storage and evaluated the data protection measures as decent (Chaos Computer Club 2020). However, a definite recommendation was not given as every user needed to decide on the use for themselves (Höb 2020). Also, there remained a small risk that user data could be abused or app users tracked with tools like Bluetooth sniffers (Chip 2021). This possible loss of technological sovereignty combined with the increasing dependence on Apple and Google led to many doubts and a lower adoption of the Corona-Warn App.

There were also many other barriers identified that prevented people from using the CWA. First, to use the app, a suitable smartphone was needed that also supported "Low Energy Bluetooth". In Germany, 40 percent of the people did not have a phone that would let them download the app, most of them over 65 years old, which means that especially those vulnerable groups most strongly affected by the pandemic could not make use of the CWA (Scheuer 2020). Therefore, one can say that digital equity, the accessibility for everyone, was not granted.
People's reluctance of using the CWA also reflected doubts about the necessity as well as the accuracy of the app. In their evaluation of the CWA, Judith Simon and Gernot Rieder (University of Hamburg) state that "epistemically, the technical feasibility of the approach was questioned, challenging the assumption that location data could be used to effectively track the disease." (Simon and Rieder 2021). How far the spread of misinformation and conspiracy theories during the COVID-19 pandemic affected the number of users has not been analysed.
For local health authorities and traditional public services, the app was not useful as they were not provided with any data about time or place of a possible infection. However, this was anticipated by the developers. The CWA was aimed to compensate the work of the local health authorities because their capacities were overly exhausted and instead put the responsibility to a large extend in the hands of the users (Opitz et al. 2021).

4.5 Dynamics

4.5.1 Generative mechanisms

As already mentioned, the development of digital tools was accelerated at the time of the pandemic as the generation of new digital platforms, apps and technologies could help to overcome the social isolation that people were forced into.
The CWA was designed by the RKI to be the official contact tracing app of Germany. However, the developers themselves point out that the cooperation with private partners like the IT companies (SAP, Telekom) and the support of Google and Apple had a positive impact on the app's performance (Interviewee 1). This partial shift of the research and design part to the private sector has been criticized by various entities, as many people do not see Google and Apple as trustworthy entities when it comes to data safety and integrity (Kutschera 2020). As Marhold and Fell state:

> "Ultimately, the involvement of governments was not substantial in the setting of a common standard, as they were constrained by technical limitations and outpaced by Apple and Google entering the process. Their role on both national and supra-national levels became crucial only once a standard had been set by platform owners Apple and Google." (Marhold and Fell 2021).

In terms of generative mechanisms, a social need for a tracing technique able to identify and handle infections in large number was identified very soon, as the traditional way of tracing infected persons turned out to be slow and unreliable. Empowerment of end-users certainly played an important role even if there was also a great deal of scepticism against the CWA, which could at least partly be overcome in the course of a collective learning process. New social relations were built, not only between developers and public authorities, but – when considering digital relationships as social – also be exchanging anonymised information among the actors in the CWA social innovation ecosystem. Overall, this is to be considered as a large-scale experiment, though with limited time and resources only for reflexive experimentation

4.5.2 Generalisation mechanisms

A consequence of the regime change during the COVID-19 pandemic was the emphasis on the exchange of knowledge and the centralization of power. This is also true for the CWA – as the app was integrated in the operational systems of Google and Apple, this enabled the interoperability in different countries and enhanced the performance of the app (Interviewee 3). Moreover, only one official contact tracing app in each country was accepted by Google and Apple, which protected the CWA from competition in Germany (Sherr 2020). These premises led to the development and promotion of the app. Further functionalities were added to the app to enhance its usability and benefit to user (e.g., vaccination appointments, check-in functions, contact statistics), which facilitated the uptake and diffusion of CWA in the German population (Interviewee 1).
In other words, the main generalisation mechanisms at work in the CWA case were i) the circulation and anchoring of new knowledge to end users, ii) the (digital) replication and proliferation of the CWA app across countries, but also the adaptation to varying legal and institutional conditions, and iii) the institutionalisation

of CWA as part of the digital ecosystems of Google and Apple. The fourth generalisation mechanism of expansion (of application cases), scaling and consolidation (beyond the COVID-19 pandemic) has – thus far – been less significant.

4.5.3 Diffusion

During the course of the pandemic, more and more people decided to make use of the app. In February 2022, 16 million users donated their data daily (Robert-Koch-Institut 2023). Different factors shaped the diffusion process. For example, the promotion and sponsoring of the government was used to reach more users, because the government ensured that CWA was a prominent topic in the news.
It could also be said that more functions like digital vaccination management and test certificates as well as check-in functions benefitted the diffusion. If and how the infection rates influenced the use of the app cannot be said.
As mentioned above in the discussion of the energy cooperatives, the barriers for the innovation also hampered the diffusion and generalization of the CWA. The developers of the CWA called the app successful by introducing the parameter of 48.63 million downloads. However, it remains open if the app would have been more effective if more trust could have been established in its development and architecture (Interviewee 1, 3, 4).

4.6 Rationales and options for policy intervention

4.6.1 Policy Rationales

In principle, the CWA as such and the related social innovations to shift responsibility for infection tracking from local health authorities to individuals are justified, because they are supposed to address the public good of public health in general, and of lower infection rates and lower mortality due to COVID-19 more specifically. Thus, social innovation in this case was a means to address a market failure.
However, in this case study, a couple of barriers were identified, which hampered the CWA from being a widely used tool. In the logic of the failures framework applied in this study to justify the need for political intervention, these barriers address various deficits, mostly related to functionalities of the innovation system, which provide sufficient reasons to justify policy interventions to support the social innovation for a broader uptake of the CWA. First of all, capabilities failure occurred because the usage of the Corona Warn App could have been higher if more citizens had been digitally literate. In addition, infrastructural failure could be observed because the COVID Warning App (CWA) was not equally available to all. It required a suitable smartphone, which approximately 40 % of the German population did not have.
Finally, it can be argued that there was a reflexivity failure of the government because citizens still had and have concerns and doubts about the app. Conceptually, reflexivity failures belong to the extended failures framework, where they constitute a so-called transformative system failure. However, these transformative system failures were not developed for situations of short-term crisis but with reference to long-term sustainability transitions. The reflexivity failure in the CWA case led to a technology-centric solution, which left several social concerns poorly considered. Scepticism vis-á-vis technological innovation is often interpreted as a lack of ‘qualified’ information, while disregarding that the reasons for scepticism might be due to other concerns. In the case of the CWA this is the importance of data privacy in Germany. In the case of the COVID-19 pandemic, it creates tension with the policy objective of lowering infection rates, and not addressing this tension in a broader discourse might be seen as a reflexivity failure. At the same time, it needs to be recognised that there was simply not enough time to conduct reflexive processes in a situation that requires fast action. This suggests that it would probably have helped to develop pandemic emergency plans well in advance of any potential pandemic, and by way of reflexive processes that are likely to enhance the social robustness and acceptance of app-based tracing processes.

4.6.2 Policy Options

When it comes to the development of policies, the use of the app remained voluntary when it was released. The German authorities did not introduce a corresponding law for the CWA. The federal minister of justice of Germany at that time, Christine Lambrecht, pointed out that „A law is of no use, all data privacy questions are covered by the DSGVO”, (Zeit Online 2020).The European parliament demanded that the use of the app would

never be forced, the data storage needed to be decentralized and there had to be a clear prognosis if the app would help to achieve a smaller number of infected people (Europäisches Parlament 4/17/2020).
Following the assumption that the app was not as effective as it could have been, it remains open whether the proposed policies of the government were enough. A low-threshold communication from the government is needed to address the lack of trust of the people regarding the treatment of the personal data. There should have been more efforts / innovative ideas to deal with the scepticism, although it is important to say that attempts were made in that direction with making the code open source and with increasing transparency by allowing hackers to test the safety of data in the app.
In a meeting report by the WHO, COVID-19 contact tracing experts from 39 countries and territories from the WHO European Region, including 24 European Union (EU)/European Economic Area (EEA) countries concluded that it was important to "raise awareness about the digitalization of the contact tracing services and foster trust among communities" (WHO 2022). To increase the accessibility of this technology, structural system failures were identified that showed that the equity for the use of smartphones and apps was not given. Where the measures of RKI to integrate the public in the generation and distribution of the app enough? Although there were news blogs, forums, and hotlines for people to turn to, the quick development of the app happened without the participation of the people. However, as the pandemic was an exceptional case to which government needed to react quickly and in a top-down manner, this co-creational element was maybe not feasible due to pressure of the fast-growing infection numbers.
As the world is now in a global transition phase (Robert Koch-Institut 2017), meaning that the virus has become less dangerous and measures are lifted, the story of CWA is finished for now. However, it still makes sense to look at future policies that could be useful to deal with sociotechnical innovations in the next crisis. The implication of a digital chapter in the national pandemic plan could facilitate quicker responses to the spread of the next disease, in order to overcome organisational barriers faster. Digital solutions show a high potential to serve as key tools. Such a central policy needs to meet standards of transparency and accountability, which should be respected even in a crisis when introducing compulsory technological solutions: Key issues are: "Who sets the standards? Which parties are invited to provide technological solutions? Whom does the government endorse and by which process?" (Marhold and Fell 2021).
Overall, it can be asserted that contact tracing apps like the CWA are tools to facilitate pandemic management and contributing to the digitalization of the public health sector. They are socio-technological innovation that are introduced top-down approach by government in view of the urgency of reacting to a crisis, but also require citizens to behave citizens in a pro-active, self-responsible and engaged way to help slow down the fast speed of the pandemic. To achieve this kind of pro-active behaviour, preparatory reflexive processes in society are key in order to strengthen the willingness and the capabilities for using contact tracing apps.
Finally, it remains difficult to assess the effectiveness of the CWA as a social innovation as it cannot be deduced from the number of users only. Although the developers argue for the CWA to be successful as the number of downloads was "high enough" with 48.63 million, it is difficult to understand whether the app was used as intended, or not. However, by introducing the app the German government tried to contribute to contain the impact of the pandemic and evoked a discourse on social values of trust, public health, and solidarity, which may be instructive to better prepare for any future pandemic.

Overview of Interviews on the Corona Warn App case

Interviewee number	Date	Role / Occupation
1	30.6.2023	Epidemiologist, medical informatics, RKI
2	30.6.2023	Senior Research Fellow und Software Developer, RKI
3	4.7.2023	Journalist, digital communication
4	12.7.2023	IT, customer service, „Ask the state Germany", RKI

5 CASE STUDY "SOCIAL HOUSING IN VIENNA"

5.1 Background

Social housing – also called municipal or community housing – is a response to the severe social challenges that we are facing still today in the EU (and beyond), even though we have witnessed massive changes and even social transformation in the field of homelessness and in terms of a shortage of adequate housing during the last 100 years. In our case study which is focusing on the special situation in the Austrian capital Vienna, we will show how social innovation was able to economically reintegrate marginalised parts of the population into society and thus attempted to alter the anticipated path of unregulated capitalist development.
Especially in the city of Vienna, social housing provides a good example of a social transformation that, still today, determines the integration policy of the city to a large degree. From a failures analysis framework, the significance of social housing as a case study is to show how to build resilience within its specific social context and against the laws of the market economy – and to fill in for the market failure of not providing affordable housing to all. We have to note that the case study is located at municipal, not at national level. Even though there are also national programmes to enable affordable housing, the efforts are rather small.

5.1.1 Historical context

This case study deals with the development of social housing in the city of Vienna from 1919 to the present, covering more than 100 years. Social housing in Vienna serves as a case for exploring the development of a social innovation that has served to cope with a severe shortage of housing and the precarious situation of homeless people and families. After WWI, Vienna's social democratic local government created a local welfare state that was intended to promote better housing and living conditions as well as better health and education for working-class people. As Reinprecht (2007) points out, among the various programs developed in the Red Vienna period, the construction of municipal housing was the most ambitious and most prestigious undertaking. The Vienna municipality played a key role as both developer and owner. Social housing was built throughout the city and thus had a long-term anti-segregation effect.
The history of municipal housing in Vienna can be categorized into four periods:
The major part of this paper is committed to describing the case during its most interesting transition period from the grassroots movement to the Red Vienna era. This period is also crucial because it provides an illustrative example of how the government became active to cope with the deficiencies of the imperfect self-regulating market of the previous era and the enormous consequences this had for the marginalised. Another noteworthy aspect is the pace of change at which the social innovation of social housing unfolded and which was of central importance for its short-term success (Giesecke 2016).

5.1.2 Period I: Settlers' movement – Grassroots movement gains momentum in a political vacuum

The settlement movement was essentially a grassroots movement that involved deprived people taking action to build their own shelters and engaging in some rudimentary farming. It can be interpreted as an attempt to keep the housing market embedded in society and to re-establish social relations. Yet the efforts were undertaken by the settlers, not by the state. In this early phase, the state took a rather passive role. Only later would the state step in and define the housing market as a field for state intervention. Those people who had a room or an apartment in a tenement house were largely dependent on the private landlord. This resulted in major inadequacies and severe shortcomings. A proletarian family of the time was constantly on the move, from one shelter to another, almost without any rights of belonging.

5.1.3 Period II: Superblocks – Community housing during the Red Vienna period

Among the cities implementing municipal housing in the interwar period, Vienna took an outstanding position. The Austro-Marxism practiced at the time not only comprised social housing and, with it, municipal schools and improvements of hygiene but came with an emancipatory impetus including a cultural mass movement and a new lifestyle as well as a shared sense of 'belonging' on the part of the working class and the marginalised (Reinprecht 2012, p. 209). We have to bear in mind the context of this municipal housing innovation. This period marks a time of extreme political tension between the well-organised working class active in the industrialised towns on the one hand and the – mostly rural and nationally dominant – lower middle class on the other. The city of Vienna developed towards an Austro-Marxist local social state based on a new type of

tax policy and innovative social policies in areas such as health, education and housing. This reformist policy was closely linked with the struggle for cultural and political hegemony. Compared to the first period covered here, we need to point out that the Austro-Marxist city government acted rather paternalistic in many respects and overruled the autonomous settlers' movement (Reinprecht 2012, p. 209). The superblocks were designed to prepare for a new society. Housing was not defined as just giving shelter but as a social practice and new form of culture, a contribution to the constitution and reproduction of the working-class family, its collective resilience and identity. The emerging social class was to be the antipode to conservative-reactionary and catholic social policy and its idealisation of family, class and patriotic territorialism24 (Pirhofer and Sieder 1982, p. 326).

5.1.4 Period III: Reconstruction era and corporatist housing policies after WWII

After World War II, social housing and the Vienna superblocks were confronted with a totally new situation. The framework conditions, especially the welfare state, had changed dramatically. Instead of the Austro-Marxist Red Vienna, the new model was based on a corporatist consensus, arranged and negotiated by the elite of the social partners[25]. It was characterised by a national welfare state – legitimised by its stabilising and paternalistic function – that guaranteed social peace and the improvement of general living conditions in the post-war era. This welfare model also implied full employment, standardised labour relations and a patriarchal model of the nuclear family. Financially, it was based on an employment-centred work society with social insurance and a subsidiary system of social benefits, complemented by social housing (and other community-financed provisions) (Reinprecht 2012, p. 210).

While the Red Vienna housing programmes contributed to the dignity and acknowledged status of the proletariat as citizens, the reconstruction era served to institutionalise the rights of the working class, turning them into "fully-fledged" citizens. Policies in this era targeted not only the proletariat but much more the middle class, securing its path towards social establishment. Included among this clientele were those in standard employment and their families provided that they had Austrian citizenship. Others remained excluded. This pertained to immigrant groups entering the country (and the city) in the mid-1960s until 2006; only thereafter was a change imposed by a new EU directive (Reinprecht 2012, p. 211).

5.1.5 Period IV: From post-corporatist welfare state to neoliberal economisation

The reconstruction era was marked by a general increase in wealth and welfare. Collective economic progress and social advancement was also accompanied by catch-up modernisation. This development came to a slowdown in the late 1970s owing to the energy and economic crisis, the end of full employment, and the progressing flexibilisation of production systems and lifestyles. At the same time, Austrian society witnessed socio-cultural and socio-political diversification. Traditional values as represented by the patriarchal nuclear family were eroding. Social groups found new forms of identification, employment and private life and underwent change toward more pluralisation and individualisation. This was reflected in changes in Vienna's municipal housing policies. The changes that followed in the consecutive years were already ushering in the neoliberal paradigm that culminated in EU competition law and the end of Vienna style municipal housing in the new millennium. Starting in 1981, tenant protection for newly built dwellings was weakened. Higher standards were applied in furnishing new housing, and standardised construction was replaced by housing designs that were more geared to meeting individual needs. The increase in single households and the emergence of patchwork families, paired with increasing demands for more comfort and space, called for more flexible construction approaches. This also entailed higher rents. Thematic, innovative approaches and experiments were attempted, for instance, in the field of energy-efficient housing. Construction of social housing was opened to private contractors to enhance competition and share the burden of financial and technical risks (Reinprecht 2012, p. 213). The share of better-off middle-class families in municipal housing

[24] The Austro-fascist regime that came to power in 1933 deprived the Austrian parliament of its power, inaugurated an authoritarian feudal state and dissolved the municipal constitution of Vienna, thus making the capital dependent on national legislation as was the status before 1923. Under the Nazi regime, the construction of a number of gigantic infrastructure and housing projects in Vienna was planned. Most of them, however, were not realised. With regard to social housing, only some 3,000 units were built during the whole period. Construction activity ceased in 1942, and the incapability of the Nazi regime to address the persisting housing shortage was compensated by its inhumane Aryanation policy, which was responsible for the deportation and killing of Vienna's Jewish inhabitants, thus making room for the migration movement caused by the war (Eigner et al. 1999, p. 16).

[25] Social partners are organisations representing persons in employment, the employers, and the self-employed and other interest groups.

decreased compared to the two previous decades, and such housing became increasingly associated with marginalised citizens. In recent years, some observers have even come to speak of "inner segmentation" as housing has more and more been left to the private sector and the state has partially had to retreat from this traditional field of corporatist politics (Reinprecht 2012, p. 214). All in all, in the post-corporatist era the institution of municipal housing was no longer to realise collective advancement; instead municipal housing policies were reduced to the management of housing and served to the needs of a more and more diversified and fragmented social structure.

5.2 The 'innovation' in question

5.2.1 New networks compensating political vacuum and market failure

Hunger and homelessness were two important factors influencing the upcoming social housing movement of the first period described in this case study. Another factor were the elections in Vienna in May 1919, which were the first democratic municipal elections based on general, equal, direct and secret voting rights. For the first time, women also had the right to vote. In comparison to the rest of Austria, in Vienna the share of workers was especially high. The legal changes with regard to voting rights in fact constituted a break with the old regime.

Municipal housing as a social innovation in the "Red Vienna" period after WWI came to the fore as a development of several crucial changes that happened at that time. One important factor was the organisation of homeless people in the so-called settler movement that put a lot of pressure on the city government to make affordable housing a policy priority.

The municipal government was not prepared for this mass movement ignited by the settlers (see section on actors below). Since there had been no public-housing programmes for a long time and necessary reforms had been blocked by conservatives, there were neither policies in place to meet the housing needs nor a response to the situation by the settlers themselves, marking the absence of key institutions. Cooperative housing in Vienna began during the first republic, and its numbers increased every year (Förster 1979, p. 119).

Settlers organised in cooperatives depended on cooperation with the municipal government. The city government was looking for a solution to the shortage in collective consumption in exchange for public support and the provision of property for settlements. Legally, the principle of not-for-profit and common-benefit housing was introduced in the cooperation between the municipality and the cooperatives (Frei 1991, p. 172; Novy et al. 1991, p. 90). This included the following agreements: The cooperatives were in charge of organising the housing construction and infrastructure, which was usually done by the municipality. The technical and social infrastructure, including road construction and maintenance, streetlights, waste collection, etc., was in the responsibility of the settlers. In the beginning, the municipality lacked the financial means to provide such services. Here, new forms of institutions and networks emerged that complemented each other and created new sustainable structures.

Some commentators regard the weak government and missing state power as reasons for the rapid spread of the illegal settlements and their continuous existence. The old monarchy had been abolished, and Austria was falling apart as a nation and empire. Disillusioned soldiers were returning from the front, and the supply situation in the cities was miserable. In order to control the military potential posed by the discharged soldiers and their diminishing rationales, it was necessary to provide them at least with shelter and employment. In these circumstances, it was difficult to maintain political order, leaving a power vacuum for some time; thus, competing new centres of power emerged, giving more room than usual for action to individuals and interest groups (Stiefel 1983, p. 105). Not only the state but also the market failed to solve this situation.

Eventually, the city of Vienna supported the settlements, for example, by improving the infrastructure for transporting material and people to the construction sites, by providing water to the gardens in the summers through fire brigades, and by connecting remote locations with the municipal supply networks (Auböck 1975, p. 113). In legal terms, many wild settlements were eventually converted into proper settlements and even financially supported through loans (Förster 1980, p. 68) which thus constituted the building of new institutions.

5.2.2 Mass demonstrations and new cultural values as expressions of class identity

The first mass demonstration of the settlers took place on 26 September 1920 and included representatives from across the entire political spectrum; some 50,000 participants were involved, demanding the

expropriation of speculative property and a land reform. At the next mass demonstration on 3 April 1921, more than 80,000 settlers followed the call of the *Hauptverband für Siedlungs- und Kleingartenwesen*. This marked the hegemonisation on behalf of the Social Democrats, on the one hand, and the divide of the settlers' movement, on the other. One part of the settlers could eventually identify with Social-Democratic ideals. Yet another part, the more conservative faction of the settlers' movement, went their own way. Outside of Vienna they joint the sections of the *Siedlungsverband* that represented the other Austrian provinces and regions (*Bundesländer*). (Novy 1981, p. 31)). The third and biggest march took place on 12 March 1922 when settlers, tenants and construction workers demonstrated for the continuation of the tenant-protection laws and for measures against homelessness and unemployment and expressed their support for the settlement movement. The demonstration numbered some 100,000 participants (Frei 1991, p. 136).

The three historic mass demonstrations between 1920 and 1922 had made clear that there was strong support in society for social reforms to improve the housing situation and sufficient political pressure to provoke reactions on the political side. As a result, municipal and national policymakers started supporting the Vienna settlement movement; without this support the movement would not have been successful (Novy et al. 1991, p. 29). While the mass demonstrations and especially the associations that organised them were characteristic of the rise of new recognisable networks in this era, they are also indicative of the class consciousness of the proletariat. The settlers' movement provided the working class with a cultural and legal identity, which contributed to the strong popularity this movement gained (as reflected in the mass demonstrations and in the press) as well as to the movement's strength and the settlers' unprecedented self-esteem.

The settlement movement of this first period – the related associations, that is – seized the opportunity on many occasions to provide the wider public with information on the movement's demands and progress. Among these occasions were garden exhibitions, construction fairs and the like. Technical innovations contributed to the progress of the settlement movement. During the 5th Construction and Building Materials Exhibition in Vienna in September 1923, the most important new types of houses (core houses) were presented by the architects Margarete Schütte-Lihotzky and George Karau on a 1:1 scale. Both architects worked for GESIBA (*Gemeinwirtschaftliche Siedlungs- und Baustoffanstalt* (Cooperative Settlement and Building Materials Association)). Several innovations in construction helped turn the post-war primitive sheds into regular yet affordable houses (Novy et al. 1991, pp. 37; see below). What we see here early on is the beginning of a development in which academics from a more affluent social class supported the interests of the settlers. This was even more pronounced in the next phase in which the social innovation of municipal housing was much more strongly attached to a movement of architects who developed designs and worked on behalf of the working class.

At the municipal level, the city council had decided to establish a general housing programme as early as 1920. The original idea eventually evolved into a master plan to turn 1.215 ha into an area for settlements and 770 ha into allotment gardens. Several famous architects, including Peter Behrens, Josef Frank, Josef Hoffmann, Adolf Loos and Oskar Strnad, were assigned the task of elaborating the master plan in more detail with an appropriate combination of multi- and single-story buildings (Frei 1991, p. 135; Neurath 1922, p. 41). All this is exemplary for the first period.

5.2.3 Institutionalising financial resources

In April 1921, during the first period, 12 days after the second mass demonstration of the settlers and their supporters, the Austrian government, ruled by the Christian Democratic party, implemented a new fund with the votes of the Social Democrats in parliament. The fund supported the settlements set up by the housing cooperatives. It is an example of the creation of new institutions to make the change from one regime to another. This fund was not only crucial for the settlers but marked an important milestone for the continuation of the social innovation in municipal housing. While in this first phase we see the emergence of a new housing model – at the beginning still a niche – in competition with the old model, it can be interpreted as a first step towards the establishment of a new regime.

The general provision for financing the settlers' community housing during the first period was that 85% of the building costs would be covered by a loan and the rest had to be financed in kind by the settlers providing their own labour by working on the construction site (not on their own homes but on other construction sites). However, the municipality ultimately waived repayment of these loans. Together with the cost of the original property and the costs of the principal development and maintenance, the community actually financed the cooperatives more or less 100% (Kampffmeyer 1926, p. 132; Förster 1979, p. 121).

An additional characteristic of the settlers' movement was the settlers' involvement in the construction work. This was also crucial for building a network among the settlers who became construction workers and for the class consciousness of this social class. The municipal council had clearly stated this in a resolution (Kampffmeyer 1926, p. 126). As mentioned above, the settlers were required to contribute their labour in the amount of 15% of the respective construction costs of the respective project. This is the only contribution that the settlers could be expected to make since they were generally too poor to finance housing by means of cash payments or selling valuables was not an option. This provision stood in contrast to the competing practice of co-operative housing, common also in many cities abroad, where the cooperatives required that the settlers make a significant financial contribution for membership and provided living space with low rents or leases in return. In Vienna, the post-war solution of contributing labour for social housing was regarded as a much more just approach that made housing affordable, even for the unemployed. This approach was called 'muscle mortgage'. In fact, the overall majority of the houses were constructed by the settlers themselves, and only a small part by professional construction workers. The settlers also contributed to the infrastructure by digging ditches for sewage and electricity lines; they also worked in quarries. 15% of the construction costs amounted to 1,600 working hours. The hourly rate equalled that of an unskilled worker paid according to a collectively bargained standard payment agreement. Higher hourly rates were credited to skilled labourers and lower ones to women and young adults. For reasons of efficiency and solidarity, the settlers did not work on their own future houses. Only after the settlers had completed their working assignment were they evaluated according to their neediness and entered a draw for their homes (Brahmas 1987, p. 24; Kampffmeyer 1926, p. 132).

5.2.4 Organisational innovation for self-help and technological innovations for cutting construction costs

An additional institutionalisation emerged during the first period of the settlers' movement as guilds were founded for constructing settlements, apartments and infrastructure. Some observers called this 'guild socialism', a combination of state socialism and syndicalism and an important basis of the corporatism that was established at that time. It was an attempt to subject part of the economy to the control of the proletariat. The principle of local community government was transferred to parts of the economy (Novy 1981, p. 34; Hoffmann 1982, p. 145).

In order to reduce the costs of the settlements, it was necessary to reform several provisions of the Vienna building code. This was also a field of further institutionalisation based on changed construction norms and rules, made possible through the increased – direct or indirect – political influence of the Social Democrats. For example, a provision requiring fire-proof partition walls was eliminated from the code after the reform of 1920. Furthermore, the minimum height of a story of a building was reduced to 2.6 metres and the minimum width of the stairs to 90 cm. It was permitted to use hollow masonry, wooden ceilings without filling, wooden stairs without flush-mounting and outdoor peat latrines (Posch 1981, p. 63).

Scarcity of materials and the need to reduce costs led to the use of alternative construction materials such as clay bricks or slag masonry. They were produced by the settlers themselves. Most of the new settlements were located not far from such production sites, which saved transportation costs. One important innovation concerning substitute materials was the 'pax brick'. It was a masonry brick made of cement, slag, sand, and water and pressed by hand. Pax bricks were filled with clay. They served as a major construction material until 1923 when the economic situation improved and conventional bricks were used (Baaser 1980; Koch 1987, p. 5; Novy et al. 1991, p. 155). This alternative and cheaper construction method was estimated to save up to 50% of the building costs (Schacherl 1926, pp. 21–25).

Most settlement construction sites also included carpentry, locksmithery, tinsmithery and glass workshops, where the building elements were produced in small series. Building a home was not understood as an individual effort or undertaking but as standardised work to serve the masses where efficiency was needed. These workshops were community-owned; some became cooperatives. This form of cooperative work was interpreted as a milestone in creating alternatives to private enterprise and an alternative path for large-scale mass production (Schacherl 1926, p. 21). The cheap production method can be considered a technological innovation, although it had not necessarily been a result of technological progress but rather of scarcity and need.

An additional important innovation was Adolf Loos' 'house with one wall'. This idea, also born out of the necessity, was to build enormous amounts of houses in an efficient and effective way using scarce resources. The house with one wall also gave its builders and occupants more flexibility. It was an invention to build row

houses in a system with only one load-bearing wall. Several accompanying inventions helped not only to save building material but also labour because the houses could be constructed mainly by unskilled workers.
The core house was another technical innovation of the time. The idea emerged in the early 1920s. With this type of innovation, one part of the house was immediately habitable and was constructed with simple means and materials. Later on, the settlers could use their own means to extend this core house to a complete settlement house (Förster 1980, p. 68; Novy et al. 1991, p. 76). The first larger settlement of core houses was implemented by means of a loan of one million schillings granted to GESIBA by the city of Vienna. All in all, 198 core houses were built in several Vienna locations.
With the settlers' movement of the first period came a few other social innovations that expanded the functions provided by the networks of the rising working class and also catalysed the constitution of a proud class identity: kindergartens, playgrounds, sports activities, day care, youth clubs, theatres and music groups etc. emerged, financially supported by the settlers, sometimes with additional support from the city of Vienna. In some cases, the Social Democratic party had its own sections in the settlements (Novy et al. 1991, p. 90).
Further innovations occurred on the organisational level. The settlers' notion that their joint undertaking could only work out if they formed a functioning community led to several initiatives and artefacts, for instance, the community house (*Genossenschaftshaus*). Every larger settlement owned one of those houses; they were either built by the settlers themselves or the settlers remodelled existing larger buildings. They were usually located at the centre of the settlement. These community houses included a *Vereinszimmer* (meeting room), the cooperative's administrative offices, a cooperative store, a library, and a restaurant or cafeteria (Novy et al. 1991, p. 92). The supporters of the settlers' movement regarded the community houses as the heart and brains of the settlements; they were places of cultural activities, which were also occasionally used for secondary education for adults and for festivities. This was interpreted as an expression of genuine community life (Max Ermers in his *Festschrift der Siedlung auf dem Rosenhügel* (Novy 1981, p. 134).
There were economic innovations as well. High unemployment made settlers dependent on collective self-subsistence. They set up their own workshops, nurseries, provisions for health care etc. in a collective/cooperative manner to generate economies of scale, work more efficiently and thus cut prices. The entire food supply and retail was organised through the cooperative (*Konsumgenossenschaft*) that ran the stores in the settlements (Novy et al. 1991, p. 90; Kampffmeyer 1926, p. 135).
The settlements were run and administered by their own members; occasional experts for bookkeeping were consulted, who [then] worked on a voluntary basis. Conflicts within a settlement were usually solved by *Siedlungsschiedsstellen* (an ombudsperson) unless they involved issues of a larger magnitude (Novy et al. 1991, 56; 91). All settlements developed intense passion for gardening and for breeding and herding small animals. The German pioneer and garden ecologist Leberecht Migge had a substantial influence on such developments.

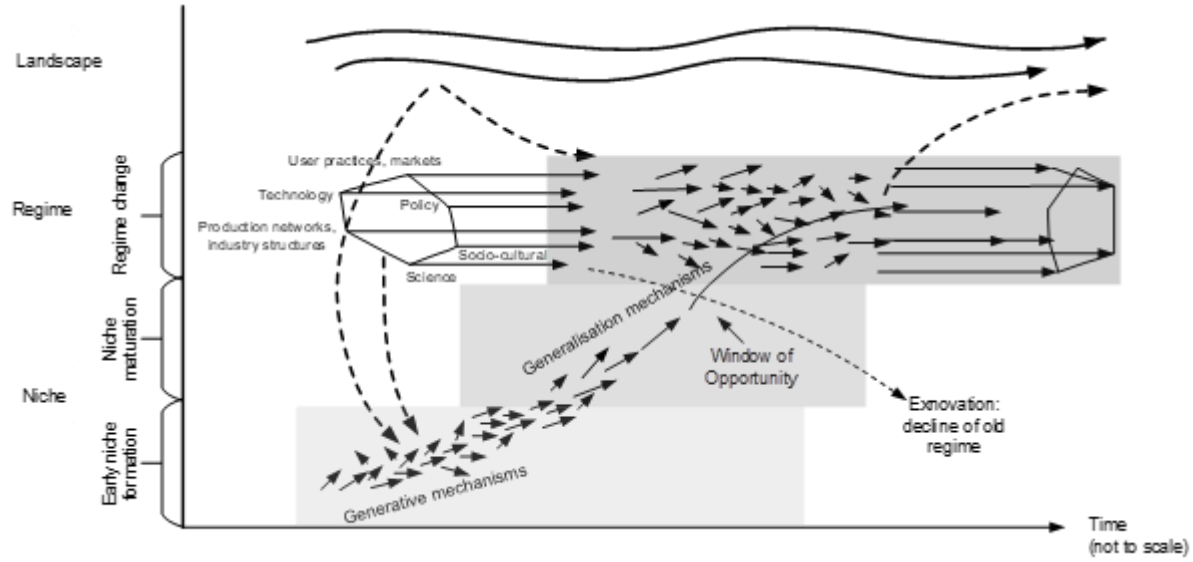
5.3 Process perspective

5.3.1 Distinguish the different phases

The debate on the transition to holistic sustainability at the turn of the millennium gave rise to an understanding of innovation as a lifecycle, as developed by Geels and Schot. In the context of this case study, the efforts of social innovation in housing can be interpreted as attempts to re-embed major parts of the housing market into a social system by means of necessary governmental intervention to restore the delicate balance between economy and society and introduce reforms that affect how individuals relate to one another.
The lifecycle model in innovation studies is connected with a "multi-level perspective", which means that transitions are seen as an "outcome of alignments between developments at multiple levels" (Geels and Schot 2007). The MLP (multilevel perspective) approach is a heuristic concept that distinguishes between the three levels of niche, regime and landscape as opposed to the more common understanding in terms of the policy levels of heuristic approach describes the scope of an innovation: Is it restricted to a niche market? Is the scope of the innovation at the level of a socio-technical regime? And how do innovation activities react to transformative pressure from the socio-technical landscape? (Giesecke 2016)
The differentiation of three levels puts the regime in a sandwich position between niche (or niches) and landscape. The technological niche thus signifies the micro level where new developments occur. The niche is a room for experimentation; some experiments are more successful than others; some disappear, and some prevail in the market and can be classified as innovations. Interestingly, as Geels and Schot point out, niches

are “carried and developed by small networks of dedicated actors” (Geels and Schot 2007, p. 400). Social innovations develop along similar lines. In general, they start as a niche, just as technological innovations do, and initially as minor alternatives to a dominant social practice. However, it is important to keep in mind that there also important differences between technological and social innovation (in terms of their respective nature) as well as between profit-oriented and social purposes of innovation. These differences are reflected in the relative importance of different kinds of generative and generalisation mechanisms driving the emergence and impact of innovations.

Figure 3.1: Multilevel perspective on innovations (based on Geels and Schot 2007) and Bodenheimer (2019); adapted by authors)



The term landscape describes a contextual system that embeds regime and niches. Changes at the landscape level are slower than at niche or regime level. Geels and Schot do not explicitly say how such changes occur and why. The question of whether or how changes at the regime level also affect the socio-technical landscape has not been discussed so far (e.g., how 20th-century consumption patterns have accelerated climate change). This interpretation is supported by Geels and Schot’s explanation of transition, which is a process that happens through interaction at all three levels. Both niche innovations and changes at the landscape level (e.g., demographic change) create pressure at the regime level and can lead to a transformation of that regime and give a niche technology the chance to install a new regime. This transformation can even be radical. Landscape pressure is also crucial for the development of a social innovation. Whether and how a social innovation can become stable, grow in scope and scale and succeed at the regime level depends to a large degree on the opportunities induced by changes at or pressures from the landscape level. Pressure on the incumbent regime might open up opportunities for niche solutions and become regimes themselves. In our case study – and in many others on social innovation – the regime level is crucial for governmental intervention. The internal contradictions of a policy area (such as housing) mount to the point that government intervention becomes inevitable. The pace of change at this point – or the total absence of governmental intervention – is of central importance in determining the consequences of this development for society.[26]

A more recent understanding of technological innovation and its causes and effects in the context of MLP directs attention to studying change not only as being triggered at the niche level but as a result of ongoing processes at the regime and landscape level and mutual interaction between all three levels as well. In this view, niche developments should not be analysed in isolation or out of context.

Scholars of MLP assign niches and regimes to the same or similar kinds of structures, though there are differences in size and stability. Both have communities of interactive groups, also called “organisational

[26] Additional theoretical threads to explain change were introduced by Berkhout et al. 2004 who also regard change as the outcome of a selection process at the regime level by – what Geels and Schot call – “landscape” and “niche” “forces” (Geels and Schot 2007). Pressure from niches can be of economic origin (e.g., competition) or can originate at the landscape level of political, social and economic developments (globalisation, neoliberalism). This pressure can be internal and/or external, whereas the landscape level usually exerts external pressure.

fields". At the niche level they are smaller than at the regimes level and less stable. Their communities share certain rules that coordinate action. According to their different character, niches have less articulated and less stable rules than regimes: "actors are embedded in rules and structures, but at the same time reproduce them through their action" (Geels and Schot 2007, p. 403). Rules are much harder to change for actors of established regimes than for actors in a feeble or ephemeral niche. "Niche-innovations can become regimes, when social networks grow larger and rules become more stable and constraining, leading to a reversal in their relation to agency" (Geels and Schot 2007, p. 403).
Landscape changes can also influence the developments of niches and regimes. But since landscapes are structured differently, they do not determine directly the developments of the other configurations but make some actions easier than others. Generally, socio-technical landscapes are relatively static and solid and change only over much longer periods of time and more on a macro scale (e.g., globally). One exception is an external shock such as war. Actors of regimes and niches are usually unable to influence developments at the landscape level.
To categorise differences in transitions, Geels and Schot (2007) introduced a typology of various pathways that differ in terms of the timing and nature of interaction. Timing is important with regard to when landscape pressure hits regimes and in which state niche developments are at that point: "If landscape pressure occurs at a time when niche-innovations are not yet fully developed, the transition path will be different than when they are fully developed" (Geels and Schot 2007, p. 405). Landscape pressure on the regime can open up a window of opportunity for niche developments to stabilise and replace – or at least alter – the old regime if the niche developments are ready for this.

5.3.2 Type of change

Frome Homelessness to Settlers Movement: De- and re-alignment
If we categorise the phase before 1919 according to the types of change in the MLP approach, it would be classified as a reproduction process in which low pressure, or the absence of pressure reproduces the incumbent regime. When the settlers' movement started, in phase one, however, we observe a de- and re-alignment process that was triggered by the lost war, the loss of major (agricultural) parts of the former empire and by an economic crisis. In light of the problems faced, the regime could not respond to the crises of homelessness. Instead, the culminating problems lead to the erosion of the old regime. Niche solutions had not yet been sufficiently developed to the degree that they could step in and substitute the old regime. The vacuum situation created space for the settlers' movement to point to new directions for policymaking that were then adopted in a strongly modified fashion by the Red Vienna social housing policy (Giesecke 2016).

- *De-alignment and re-alignment*: Accompanied or even triggered by a massive and sudden landscape change, regime problems occur, and the regime cannot respond to the disruption. Traditional regime actors lose faith and turn to new options or resign. "This leads to de-alignment and erosion of the regime. If niche-innovations are not sufficiently developed, then there is no clear substitute. This creates space for the emergence of multiple niche-innovations that co-exist and compete for attention and resources. Eventually, one niche innovation becomes dominant, forming the core for re-alignment of a new regime" (Geels and Schot 2007, p. 408). This pathway is often accompanied by a vacuum of some sort, a power vacuum, a regulatory vacuum, a market failure and the like.

From Settlers Movement to Superblocks: Re-alignment or substitution?
The type of change we see in the second phase does not fit any of the predefined categories of the MLP approach. We are rather dealing with a mixture of types in this case. There was a re-alignment insofar as a niche innovation such as the superblocks model (and its funding scheme) became dominant, forming the core of a new regime. The superblocks also replaced the pre-war model and the regime represented by the settlers' movement (the latter was never a dominant regime, though). The massive landscape pressure was almost the same in this phase as in the previous one. As opposed to the settlers' movement, the superblock model was ultimately developed to the point that it could achieve a breakthrough in "the market". But, contrary to Geels' and Schot's definition, the superblock model was not a typical technological substitution because it had not developed under the old regime over time and had not just been waiting for a breakthrough. Rather, it was a scaled-up version of settlement housing born out of the settlers' movement and with a newly established institutions and infrastructures providing an ideal situation. The change was also an expression of a broader

reconfiguration since the change in one subsystem (e.g., equal voting rights) triggered change in another subsystem (e.g., in the taxing and funding model, via the composition of the municipal government, subsequently leading to a new overall organisation of production and redistribution (Giesecke 2016). The mode of change, thus, can also be characterized by a sequence of transition pathways as first the settler's movement emerged as a niche to replace the old regime; though upscaling was not possible it at least paved the way for the new regime of the superblocks.

- *Technological substitution*: Here we are also speaking of massive landscape pressure of the same quality as in the de- and re-alignment case but at a time when niche innovations have sufficiently developed and can break through in the market. „ A new regime is in the process of substituting the incumbent regime. Such innovations have been developed over time under the old regime but could not yet break through because the old regime (and the landscape) was still stable.
- *Sequence of transition pathways*: A combination or sequence of transition pathways occurs if slow but continuous pressure is exerted from the landscape to the regime level. The initially moderate reaction of regime actors to cope with the changes imposed by the landscape level eventually becomes more disruptive as more and more problems occur at the regime level. If adjustments from within the regime are sufficient, the change can be characterised as a transition path. If such adjustments are sufficient, niche innovations are adopted and find their way into the incumbent regime. This change will entail even more adjustment measures. If the regime architecture is changed during the course of this transition, it can be characterised as a "reconfiguration path". If landscape pressure and regime problems continue, radical niche innovations, new firms, entrepreneurs and so on enter the scene and can set foot on the market. If the incumbent regime is able to make sufficient adjustments before such new actors and developments become prominent in the market, the traditional actors will survive. If not, many of the traditional regime actors, products, processes and systems will be substituted by new ones. Depending on whether there is further pressure from the landscape level and the niche development has reached the stage of sufficient maturity, technological substitution and/or de-alignment and re-alignment mechanisms will change the configuration.

5.4 Actors' roles in the process

5.4.1 Proletariat finds a home

This change was the result of the interaction and networking of crucial actors – and in part of their failure. For a betty analysis of the roles of the actor groups we need to distinguish three groups of actors:

1. Governmental/municipal: The Austrian national government and the Vienna municipal government
2. Social/civil society and their organisational forms: the settler's movement, the mass movement of the proletariat and the cooperatives; the discharged solders; the emerging political parties
3. Professional actor groups (even though these have a societal feature as well): the architects and interior designers.

Before World War I the influence of the unions and their degree of organisation was low. It had been forbidden by law to form labour-representing organisations. Thus, poor workers had almost no voice to speak for their interests. The ruling class, however, the so-called bourgeoisie, enjoyed a high degree of representation, e.g. in guilds. They speculated on property and housing. But after World War I the prices in Vienna fell drastically and the city bought up prime plots of land for their social housing campaign. The introduction of men's suffrage (1907) and women's suffrage (1919) marked a crucial change because from that on the voting right was decoupled from individual tax payments. Subsequently, mass parties emerged and grew, in particular the Christian Social movement and the Social Democrats, whose rise began with the end of the World War I. The Social Democrat Party became the net and the voice of the mass movement of homeless and underprivileged people of the era, at least in the city of Vienna. While the national government, dominated by the Christian Social party and the bourgeois class failed to provide solutions for the time, the Social Democratic government of the Vienna municipality felt not only the pressure from the mass movement, the settlers and the cooperatives that took the streets at that time. Another social group to be considered were the discharged soldiers that were gathering in the capitol after the former crown lands in the East and South had been lost. In order to offer them a decent future and prevent para-military insurgencies, they had to be integrated into the social policymaking, providing housing and employment. Finally. the last actor group that was crucial in this

transition phase were the architects and interior designers. Influenced by the British garden city, the German "Neues Bauen" and the masterplan for the city of Vienna formerly designed by Otto Wagner, a fascinating symbiosis emerged combining the principles of functional and healthy building with affordable and effective mass production of housing constructions.

A crucial turning point for the social transformation was the rise of the Social Democratic Party, and the elections to the mayor of the city of Vienna that brought them to power – at least in the capital. Though Jakob Reumann had been elected the first Social Democratic mayor of Vienna in 1917, the Social Democratic Party could unfold its potential in the city of Vienna only after women's suffrage. One of the biggest political challenges that the new Social Democratic municipal government faced was the housing shortage.

In order to design new strategies, the political decision-makers turned to the poor people's settlement movement, which was essentially a grassroots movement of illegal settlers in and around Vienna that aimed to provide food and housing in response to the lack of public provision in these areas. Although these movements were primarily initiated to ease the food shortage, the exponential shortage of housing after WWI shifted their focus. Gardens, which were initially intended for self-sufficiency, became areas of cheap and often primitive shelter. During the first years of the young republic there were an estimated 60,000 of such gardens and shelters (Novy 1981, p. 46; Novy et al. 1991, p. 26; Bauer 1923, p. 171; Förster 1980, p. 406). The settlement movement was indirectly supported by the new laws on the eight-hour workday (Hoffmann 1982, p. 9). The movement became stronger as the settlers began to organise themselves into cooperatives (*Genossenschaften*) in order to build settlements together. In Vienna, some 50 cooperatives were established, representing more than 80 local groups (Kampffmeyer 1926, p. 131). They soon created a central organisation (*Zentralverband der Kleingärtner und Siedlungsgenossenschaften Wien*) with more than 70,000 members. This organisation was active at the federal level along with similar interest groups and represented the interests of more than 700,000 members (Kampffmeyer 1921, p. 84). This movement marked an important network factor from civil society perspective. It was one of the first movements that gave the marginalised a voice and took action to improve their living conditions. It is important to note that this was actually a bottom-up movement initiated by the deprived people themselves and only later also attracted more influential groups.

These settlements were located mostly at the urban periphery where land was still available but not easy to reach. On account of illegal logging in parts of the Vienna Woods that bordered the city, new land became available for building settlements. Within the city, the former parade grounds were turned into small gardens and areas for shelter (Förster 1980, p. 90; Hoffmann 1982). Later on, during the 1920s, some settlements became legal, others were removed, and some had to wait until 1975 to gain legal status (Auböck 1975, p. 112). This was an important change that marked the transition from one regime to the other, as the new institutions built and run by the Social Democrats in power responded to the needs of the underprivileged and rendered those illegal movements not only legal but socially acceptable. This not only strengthened the networks of the marginalised but also changed their cognitive frames. Suddenly, they were a group with an identity and had rights that they could claim and make use of. At this point in time, the government took crucial measures – though limited to the city of Vienna – to protect people, especially the marginalised, from the forces of the free market.

Private and public housing construction had stagnated during the war, and once it was over, there was no investment because banks would refuse to loan money for housing projects. This is an example of the erosion of former institutions and networks. This circumstance opened a window of opportunity for new networks and institutions. As an effect of the new labour law, workers had more time after work to engage in cooperatives and build houses and the necessary infrastructure.

5.5 Dynamics and generative mechanisms

5.5.1 Upscaling municipal housing: Transition from settlements to superblocks

Several developments were responsible for the fact that the settlers' movement ceased to be the focus of interest and the subsequent Red Vienna movement received more attention. Some external factors that accounted for this were located at the landscape level such as increased inflation, which considerably decreased capital investments in housing construction. In 1922, the victorious allies concluded an agreement on monetary stabilisation, which led to a shortage of public investment in Austria. The ruling conservative party withdrew from public financing of housing and mainly favoured private investment. The Social Democrats had profited from incorporating the settlers' movement, but the movement itself had lost its dynamism over the years and

was not capable of fighting the financial odds by means of sheer self-initiative. Actually, the settlers' movement lost the characteristics of a movement and became more and more part of Vienna's municipal housing policy (Hoffmann 1982, p. 140).
As we will see in the next section, settlements, as a social innovation to solve the problem of homelessness, remained a niche. But the networks and institutions that were formed along this social innovation were crucial starting points for the next generation of social-housing projects and their upscaling towards social transformation.

5.5.2 Institution building from niche to regime

As indicated in the previous chapters, the housing market is easily overstretched when free-market principles are applied. When state policies move in the direction of disembedding through greater reliance on market self-regulation, not only the marginalised but also even ordinary people are forced to bear higher costs. Workers and their families are more sensitive to the effects of the free market than others because they are more vulnerable.
Institutions are crucial for a social innovation to develop from a niche into a regime, to use the terms introduced by Geels and Schott, especially when these institutions are legally grounded. The Social Democrats won the elections, which made Jakob Reumann the first Social Democratic mayor of Vienna and determined the course of some long-term changes in society that would reach far beyond the city. The municipal election was made possible through a constitutional change that had been discussed for more than 50 years. In the early 1920s, Vienna obtained the status of a federal state in its own right and became independent of the federal state of Lower Austria. Some politicians also wanted to reform the municipal boundaries, integrating some parts of Lower Austria into Vienna, in order to have agrarian land for the city's food supply. This reform, however, was not implemented, forcing Vienna policy makers to devise alternative strategies to solve the severe food situation in the city. This was a condition that defined the framework for the city of Vienna's subsequent development.
On 21 September 1923, a few weeks before the general parliamentary elections, the Social Democrats announced the municipality's plan to build 25,000 housing units over the next five years. Thus, the period of superblocks started and the short settlement era as a solution to the housing shortage slowly came to an end. However, the settlement period was crucial for all phases that followed as it constituted the social grid of a new type of housing regime. Like the earlier programme of settlement support, this plan was linked to efforts to curb unemployment in Vienna. It intended to provide jobs for thousands of construction workers, craftsmen, sculptors and architects. The new housing programme also promised to contribute significantly to the beautification of the city. The estimated budget for the building programme was 400 million crowns per year (approx. US$5,700,000 in 1923), which was to be paid out of the housing construction tax. In turn, this new institutional arrangement contributed to a further strengthening of a publicly sponsored social-housing regime and circumventing traditional market forces which had failed before.
The total number of new dwellings built by the municipality of Red Vienna, including those constructed between 1919 and 1923, was 64,125. In addition to this new construction, the city had provided further 2,145 dwellings in renovated or requisitioned old buildings. By the end of the Social Democrats' tenure, the municipality owned and administered 66,270 of total of 613,436 living quarters recorded in the census taken in the capital in 1934. This means that the Social Democrats had increased the housing resources in the city by 11%. By 1934, between one-tenth and one-eighth of the total population of Vienna lived in municipal dwellings built almost entirely through the city's budget (Czeike 1959, p. 53). The settler's movement could not move up to regime level, but the superblocks could. What this illustrates is that a window of opportunity to establish a new social-housing regime in Vienna had opened up at the landscape level during the 1920s.

5.5.3 Tenant Protection and the Social Democratic clientele

The Social Democrats in Vienna had made housing policy one of their priorities and regarded it as a socially and economically fundamental issue, thus strengthening their own clientele and political support – at least in the city of Vienna. The newly formulated right to housing led to big municipal housing programmes and thus to a major cultural leap among the working class, again an important factor for rising class consciousness (Pirhofer 1982, p. 230; Förster 1980, p. 105). Tenant protection was a central prerequisite for public-housing policies and was a major object of discord between the different parties during the entire interwar period. In 1922, parliament passed the new tenant-protection law with the support of the (oppositional) Social Democrats

and the ruling conservative party against the interests of the landlord organisation. At the time, no other country made use of tenant protection as a means of social welfare and doing so changed the structure of housing in the city of Vienna with its two million inhabitants. The new tenant-protection policy was a precondition for the extensive public-housing programme and, like the building programme, made tenant protection a long-lasting institution. So, even though the tenant-protection law can be classified as an institution that was part of the newly formed social grid, the fact that the Vienna Social Democrats were promoters of the tenant protection law to be passed in the national parliament is a case for the formation and strengthening of networks, as they could credibly show that this law was crucial for the whole country.

Some of the politicians inaugurated by the Social Democratic mayor Jacob Reumann during the first period promoted the incorporation of the settlers' movement into the Social Democratic movement. At first there were resentments of some Social Democrats, because the petty-bourgeois lifestyle of the settlers did not match with the progressive ideals of the new human being. However, many of the settlers could be regarded as Social Democrats. They were labourers, railway workers and some worked for the city of Vienna. This incorporation of the settlers by the Social Democratic movement must be understood as a dynamic process, not a static one, and there were also other options. Nonetheless, it enlarged the Social Democratic network and bolstered their political support among the settlers and their sympathisers. The joint objective of the majority of the settlers sharing Social Democratic convictions was not only the creation of new spaces for living but also a transformation of the social order. However, it also marked the start of the end of the autonomy of the settlers, and what had started as a grassroots movement now became co-opted by party politics.

The architects and urban planners involved followed the creed that the focus of their design should not be on individual houses but rather on housing ensembles.[27] Unifying ornaments and clear lines were to emphasise this point of view (Neurath 1922, pp. 34–40).

5.5.4 Co-developments: Circumventing traditional market forces with cooperatives

Many of the city's communal facilities – hospitals, counselling centres, libraries, playgrounds, kindergartens, youth centres, gymnasiums, day-care facilities, laundries, carpentry shops, theatres, cinemas, post offices, cafes run by the city, cooperative stores etc. and sometimes also the offices of various municipal departments – were in the new housing blocks. Historians have pointed out that by incorporating workers' dwellings in the party's new social and cultural organisations, the *Gemeindebauten* (municipal housing) thus became the framework for and focus of intense socialist activities. Accordingly, the housing areas, as the locus of so many of the municipality's communal organisations and facilities, were the nexus of Red Vienna's institutions and the spatial embodiment of its communitarian and pedagogical ideals. The co-developments were also signs of a social transformation showing the limits of traditional market forces, which failed to cope with the challenges of the interwar period. The new housing regime and the co-developments, circumventing market forces, showed that alternative models could work well (at least to some degree) and reinforced each other in this new type of regime.

5.5.5 Financial institutions for scaling up social housing

As opposed to the initial intentions in the first period described above, the majority of funding was not invested in bigger settlements but in tenant houses (superblocks). In the following years, the Social Democratic municipal government of Vienna invested far more in these settlements than the national government in social housing in all of Austria (Hoffmann 1982, p. 103). We have already identified financial resources based on legal provisions as one of the key – if not the key – factor for a substantial transition and for the succession of one regime by a new one coming out of a niche position.

The institutionalisation of the settlement movement in Vienna's municipality became obvious in the establishment of the *Siedlungsamt* (settlement office) and *Siedlungsfond* (settlement fund). All administrative competencies relevant to the support of the settlements were concentrated in one public institution (Posch 1981, p. 48). Hans Kampffmayer, an internationally renowned promoter of the garden-city concept became director and Alfred Loos became chief architect and later Kampffmayer's successor. Some of the major pioneers of modern urban development were hired as architects, for instance, Heinrich Tessenow and Josef Frank (Hoffmann 1982, p. 17; Novy 1981, p. 31; Novy et al. 1991, p. 29). The settlement office pursued a

[27] The characteristic design of settlers' houses as part of a cooperative dates back to the traditional British workers' homes as they were once built by many corporations and by the British garden city movement around 1900 Novy et al. 1991, p. 87.

holistic approach: it took care of social benefits for settlers, organised the property, supervision of construction, building loans and consultation in construction matters (Posch 1981, p. 18; Kampffmeyer 1926, p. 131).
Another landmark of the ongoing social transformation inspired by the settlers' movement was the foundation of GESIBA in September 1921. All these formal institutions and their budgets were important cornerstones of the generalisation (or up-scaling) of the superblock era. And even though they were largely suspended during the *Ständestaat* ('corporative' Austro-fascist state) period and the Nazi regime, these institutions were revived in similar form after WWII because of the landmark role that they had once played.
One noteworthy characteristic of the Vienna housing policy and a landmark of the first period was that the administration of communal housing was transferred to the housing cooperatives. The cooperatives as communal property owners put an alternative to private for-profit home ownership. A new law prevented property speculation, at least to some degree. Property owned by the municipality was transferred to the cooperatives at a minimum interest rate. In this way, the cooperatives and the subsequent settlers or residents did not have to invest money for buying land but just for the annual lease. Where land was scarce, the municipality expropriated land or negotiated a low price for the cooperatives. By the end of 1927, 1,430,000 m^2 of community land had been transferred to the cooperatives and the settlers. The cooperatives or residents were not permitted to sell the land; however, if a resident died, the right to live there could be transferred to the heirs (Novy et al. 1991, p. 114; Novy 1981, p. 29).
Central to the new superblock housing policy was its financial basis. The Social Democrats in the Vienna municipal council passed a new building tax in January 1923, which marked the beginning of the second period: the building of superblocks. This was made possible through Vienna's independence as a city with its own tax sovereignty and an absolute Social Democratic majority in the city council (see above; Brahmas 1987, p. 34; Hautmann and Hautmann 1980, p. 31; Förster 1980, p. 103). The tenants did not pay a regular rent to their landlords but a tax to the city, and this money was invested in the construction of new public housing. Thus, this tax revenue was earmarked for the construction of housing. The taxes were graduated in accordance with the size and location of the home and the financial abilities of the tenants. Poor people in small homes paid only little or no tax at all. It was a progressive mass and luxury taxation reflecting the creed of social justice, which implied that those who already had a home should help those who did not. In comparison to other cities and countries, a strong tax progression characterised Vienna's housing policy. It was an essential contribution to solidarity in housing policy (Förster 1980, p. 104). The new housing tax also had the psychological effect of signalling that building houses for people in need was a joint undertaking, thus reinforcing the notion of solidarity among the working class (Bauböck 1981, p. 130).[28]
Compared to the pre-war period, construction costs rose by 60% and interest rates doubled. Without the new housing-construction tax, the landlords of the traditional tenant houses would have achieved enormous profits. However, since the private construction of housing had become unprofitable, their income would not have been invested in new homes but in other sectors of the economy. The success of the city's public-housing policy demonstrated that public policy could limit free market forces and find alternative solutions for the housing problem (Novy et al. 1991, p. 54). Additional taxes used for the public-housing sector, even though less important, were the property tax and capital gains tax (Förster 1980, p. 104). The gains from the housing tax reform were to be used as follows: 60% for social housing (blocks), 30% for the settlers' housing and 10% for the remodelling of existing social housing (Kampffmeyer 1921, p. 33).
The tenant-protection law had resulted in radical land depreciation in Vienna, which enabled the city government to buy enough land within the city for its ambitious housing projects. By the end of 1924, the city had acquired 7,300,000 m² of construction land; by 1930, the city already owned more than a quarter of Vienna's land property (Brahmas 1987, p. 35).

5.5.6 The Red Vienna period comes to a hold

In February 1934, the ban on all political parties except for the Christian Social Patriotic Front (*Christlich Soziale Vaterländische Front*) led to a civil war during which many of the social-housing superblocks were

[28] The city was able raise its revenue from the housing tax from 3.37 million schillings to 38.47 million schillings between 1923 and 1926 and reached a stable level of 36 million schillings in 1931. Between 1924 and 1927, the city yielded net revenue of 117 million schillings from the housing tax alone, while its total expenditure for housing construction increased to 372 million schillings, which was a record high (Czeike 1959, p. 403).

damaged. Vienna lost its federal independence and came under Austro-fascist rule. The social-housing programme was put on hold.[29]
After the annexation (*Anschluss*) of Austria by the Third Reich in March 1938, thousands of Jewish tenants and settlers (and also some of the brains of the social-housing programme like Hugo Breitner) were deported and killed. The Nazi regime lifted tenant protection and expelled Jewish inhabitants from more than 70,000 homes. Even though the regime announced in the beginning that 60,000 new homes would be built in Vienna, only 300 per year were in fact constructed.

5.5.7 The situation today

While the city of Vienna still leads the way in social housing, the prevailing trend in the sector has also affected its social housing policies. Since the 1950s, there has been a significant withdrawal from publicly funded housing programmes. "Between the 1950s and the beginning of the 21st century state/municipal housing as a percentage of new housing construction fell from 35 to 1" (Reinprecht 2007, p. 35). The city of Vienna withdrew from public involvement in new construction because of financial pressures and a neoliberal turn in the housing sector (in part due to the conservative right-wing government at the time).
Today, in 2023, some 500,000 tenants live in more than 220,000 municipal housing units. The City of Vienna has managed to mobilize additional financial sources and overcome the EU competition clause. For many years now, Vienna has been recognised as an international pioneer in publicly subsidised housing construction; its policy of providing supply-side building subsidies has encouraged more new flats to be built than in other major cities. The city is even further ahead of the field when it comes to housing refurbishment: the city of Vienna subsidises the modernisation of some 10,000 flats per annum, while in Munich the figure is only about 1,000 (Wiener Wohnen 2015). Vienna's first municipal housing complexes brought a quantum leap in living standards for their tenants.

5.6 Rationales and options for policy intervention

5.6.1 Types policy interventions observed

In this case study, we started with the transition of a social and economic housing market during the Austrian Empire before 1919 and discussed the role of social innovation in making housing not only affordable but a common good for the marginalised in the city of Vienna. We showed the flaws of a liberal housing market that subordinates human purposes to the logic of an impersonal market mechanism. To overcome this situation, the Social Democratic government of the city of Vienna used governance mechanisms to control and direct the economy to meet the individual and collective needs of the people during the 1920s.
In our example, the social innovation of community housing served to restore the working relationship between the economy and society to integrate the marginalised into the economy and society. We also showed that this social innovation affected how the individuals of their time related to each other, for instance, how they created collective goods and community services.
The role of the state is significant here. Even though the social innovation in housing started as a grass-roots movement, it could develop from a niche to a regime of housing supply only through state intervention and the prominent position of the state in shaping the different regime elements. We see a methodological and theoretical enrichment in bringing the approaches of the social grid and of the multi-level innovation perspective together for this case study.
The reasons for the failure of this movement to spread beyond Vienna and expand all over Austria are complex and rooted in the history of the country and in the global trends of that time. They are too complex to be explained in this paper. Neither the Social Democratic movements nor any other was able to impose a solution to the economic crisis at that time; tensions mounted until fascism gained the strength to seize power and break with laissez-faire and democracy both.

5.6.2 Failures to justify policy interventions

In this paper we showed that for social innovation to have a transformative impact, support from strong institutions, especially governmental (municipal, national, transnational) ones, is needed. Only if this requirement is met will social innovation make a difference in the lives and integration of the marginalised. In

[29] The only exceptions were the settlements allowing for supplementary income opportunities (*Nebenerwerbssiedlungen*), which were intended to ease the situation of an increasing number of homeless and unemployed people.

Polanyi's terms, transformation is a social reaction to prior attempts to giving markets primacy in society and pursuing policies that let the self-regulating market forces unfold in an unrestrained fashion. These self-regulating forces do not exist, however. In our example, they have failed to provide for the basic human needs of housing over a length of time and maintain a stable social grid. The self-regulating market for social housing neglected the marginalised and contributed to social unrest until social transformation restored equilibrium.
Acting as if such forces existed has led to tensions and eventually to social transformation towards the negative. The attempt to dis-embed the market from society is doomed to fail. It leads to a breakdown of social relationships – and ultimately their restructuring as self-regulating market forces provokes counter-movements. Polanyi suggests that any movement toward a laissez-faire economy needs a countermovement to create or re-establish stability. This does not mean, however, that the transformation lasts over generations. Even in a phase of stability, changes at the landscape level can induce changes at the regime level and introduce new niche solutions as serious alternatives to established regimes.
Not only did we observe a massive **market failure** before and after World War I to cope with the homelessness and poverty situation, but also a tremendous **capability and transformational failure** at national level to provide housing for the poor as well as employment and nutrition. Only after the change from the monarchy to a parliamentary democracy could the **institutional failure** be tackled, supported by other institutional reforms such as suffrage, decoupling of tax-payments and voting rights, the relative autonomy of the City of Vienna as a souverain judicial and political body, able cope with such failures at municipal level by introducing the reform of the housing tax and the institutionalisation of several administrations and off-market companies to support the social housing programme together with accompanying efforts in the education, health, culture, art and economic sector.

5.7 Implications for the German housing situation

The central question for policymaking of course is, how a social innovation such as the example of municipal housing in Vienna can be shaped. One key lies in the role of niches, or rather making possible. Every eco-innovation system needs niches to survive, no matter if it is a natural one, a technical or a social one. Even if a first sight the story of the Red Vienna housing project seems to the result of a top-down planning approach, the reality is much more complex, involving the contingency of various actors, institutions and framings. This contingent phenomenon resists any macro-theoretical approach. In this sense it cannot be reproduced easily because in every reproducing action and in the principle negotiation-conditionality of social structures there is at the same time the possibility of change and thus a huge field of possible transformations (Howaldt et al. 2014b, p. 37).
The success of the Red Vienna social housing case is not only the result of a courageous policy intervention to regulate the housing market by overriding free market forces that had failed in the first place. There are also crucial developments to take into account at the landscape level and at the niche level. At niche level we observed grass root movement from settlers and other masses of deprived people who were willing to organise themselves and to take collective action – not only to demonstrate for their rights as equal citizens but to build a better society, e.g. taking part in the construction brigades, investing their own time and resources in other communal activities. There were not only movements from the deprived class but also many intellectuals supported these ideas and actions such as in the reform movement of the architects and interior designers, in the political and economic class as well.
At landscape level it was the end of World War I and political vacuum that offered a window of opportunity that was seized by the city administrators and the Social Democrats in the City of Vienna a direct the changes of the law and institutions to solve the precarious housing situation and at the same time turn this political action to a success model for their ideological dreams to build a better society. We must nut underestimate that the cognitive frame of that time, the myth of the Red Vienna, the Austro-Marxism was able to mobilize not only the masses but to provide and ideological home form them that could be catalysed into action not only for the housing sector but for many other sectors (health, education, culture, economy, art, etc.), helping to manifest the notion of a new, a better society.
Thus, the expansion of the ideological notion across sectors, across large parts of society and the continuity of the housing policy were crucial factors for the success of the social innovation until today. Even though social confrontations, political turmoil, war, fascism were challenging the social housing policy and at times putting it to a hold, the post-World War II era marks a serious of adaptations until this day to make social housing compatible to the changing economic, political and social environment.

Thus, while there are constant incremental reforms going on, the social housing stock was never privatised. This is one important lesson to learn also in the German context. Additional ones are the continuity and the diffusion or generalisation into other sectors. And finally, there needs to be the "framing" in the right clientele to take up the SI and promote or "live" it. Both, institutions and framing can – in part – be shaped by policy, but not entirely created.

6 COMPARATIVE ANALYSIS

In the previous chapters we presented four very distinguished cases of social innovations, each representing a certain type. Comparing these cases despite their differences, one can observe that each social innovation needs to compensate a broad variety of different kinds of failures. In order for social innovation to unfold its genuine social potential it needs its own innovation ecosystem that consists of various elements, coming together and interacting with each other: society, policy, economy of course, are relevant but also the financial opportunities and certain technologies. As regular technological innovations, social innovations usually emerge in niches and go through a phase of maturation where they are tested, altered, adapted, sometimes they disappear, sometimes they crowd out an existing social solution at regime level that is not appropriate any more for a current challenge. In order to become the new incumbent solution or at least co-exist with an older one, the developments at landscape level have to be favourable for the new social innovation to unfold and generalise. While at regime level, public policy can use the window of opportunity to set incentives for the SI to become stronger and support its wider uptake, replication and scaling, developments at landscape level are usually not under the influence of national governments, at least not intentionally.

Especially at landscape level, global challenges are far too complex for national policies to coordinate them. The high degree of complexity makes any form of intentional coordination (or governance) ('Steuerung') impossible. Instead, for policymakers to act, Willke (1987) concept of 'Kontextsteuerung' (distributed coordination) offers insights how contexts such as innovation ecosystem can be influenced in order to provide a favourable environment for social innovation without knowing the exact outcome.

Political coordination (or governance) on social innovations cannot act top down but has to stimulate enabling factors through heterarchical and distributed coordination. Some scholars state that failure is inherent in any form of governance or coordination. Only the acceptance of incompleteness can bring some kind of governance at meta level to the fore. This meta-level governance does not imply the setting of a monolithic mode of governance but a form of governance that enables dialogue and negotiation between the plurality of actors. For fostering social innovations at niche level (but also for other political governance issues) this means that the involvement of the state becomes less hierarchical, less centralized, and less dirigiste in character. The state takes on the role of providing mechanisms for moderation, collective learning and the development of shared visions (Scharpf 1994).

One essential mechanism that we have clearly observed in the case of social housing in Vienna is the municipal government's role to foster the self-organisation of the civil society – in this case especially the proletariat. It was not simply the building of affordable dwellings for marginalised people that made the Vienna housing case a general solution for a grand challenge. The emergence of new forms of social representation such as in consumer cooperatives, educative institutions (child care in the social housing complexes, library network and adult evening schools all over the city), health care institutions (welcome package for every new born) and many more were manifestations of representation, self-coordination and focused competence that supported democratic mechanisms of distributed governance and dialogue between the people affected by the societal challenge of deprivation and marginalisation.

In the case of the energy cooperatives, we can observe corresponding mechanisms of distributed coordination. After a window of opportunity opened at landscape level induced by the Fukushima disaster, the climate crises and new technological opportunities, the oligopolies of energy supply were challenged by social innovation at niche level that had existed at small scale long before but that now offered a realistic alternative because energy consumers realized more and more that they could control the price of energy at least in part when forming cooperatives and at the same time could contribute to the exnovation of the fossil age. The national and EU government accompanied that change through proactive law making.

The case of the Corona Warn App is – in many respects – a typical example of "over-coordination" (Übersteuerung or Fehlsteuerung). The window of opportunity that opened up to implement the app was of course the Corona crisis and the danger of collapse of the public health system. The app was mainly an initiative of the national government and was realised in cooperation with some key health and technological institutions. At technical level there were more actors involved than at social level in terms of representation. Some prominent IT organisations with specialisation in app design were involved in the development and especially in testing and refinement. Thus, we can observe some degree of distributed governance at least at technological level. And from a technological perspective the Corona Warn App functioned satisfactorily. However, the app initiative did not encounter an opportunity structure at society level, at grass root level. Thus,

from the perspective of public health level it might be considered less successful than from a technological point of view. Tracking of Corona incidents had before been accomplished by the local health administrations in tedious, analogue way. The CWA was more complementing this procedure than substituting it. One crucial stage that was also missing during the life cycle of the Corona Warn App was the niche and the subsequent maturation phase. Policy makers had to act very quickly, and the dilemma was that there were no matching solutions available 'off the shelf' or quickly adaptable from any pre-existing grass root niches. The life cycle of the CWA came to an end when at the landscape level the Corona pandemic faded out, thus no technological tracking solution was needed anymore.

Future will tell what autonomous driving will bring as a case for social innovation. It offers a lot of opportunities for transformation activities if policy makers are able to recognize the window of opportunity for its uptake and generalisation. At regime level, AD has the potential to substitute private car ownership for those people who use a car mainly for the last mile only. It could also substitute costly taxi services. More potential may lie even in the services for people who want to be mobile but cannot because they have physical challenges, do not own a driving licence or feel too old for driving. At niche level, there is already a variety of solutions for car sharing, or alternative taxi services and services for people with disabilities, however all these have limits for presenting satisfactory solutions for their clientele. At the same time, private automobile companies and public research organisations are exploring AD solutions at technical level. Now, the policy level would have the task to bring these actors together and set the stage for mutual learning and an engaged dialogue to develop common visions and – building on these – newly configured solutions with a clear benefit to individual users and society at large. Stakeholders and users are represented in various niche activities and even at regime level, the adaptation of AD as a future solution is thinkable. If future developments at landscape level provide a window of opportunity, it is the government's role to seize momentum and provide appropriate heterarchic, decentralised, and inter-systemic coordination. Depending on how these mechanisms are designed, they can make the difference whether autonomous vehicles will be introduced at larger scale to complement public transport or to sustain the trajectory of privately owned (and possibly shared) vehicles or a fleet of private providers of individual mobility solutions using AD.

CHAPTER 4: POLICIES IN SUPPORT OF SOCIAL INNOVATION FOR SOCIETAL CHALLENGES

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1 INTRODUCTION

Why should public policy support social innovation? The historic case of social housing in Vienna (Chapter 3 of this report) or the current policy approach to social innovation in Portugal (see the case study in this chapter) show how impactful public policies can be in creating and supporting social innovation activities, if opportunities are used and a long-term view is guiding political action. Moreover, social innovation is assumed to have an important role for developing responses to current challenges and contexts of (R&I) policy making, such as socio-technical system change needed for sustainability transitions, the emergence of disruptive technologies as well as crisis reaction and crisis resilience (cf. *social innovation for goal-oriented societal transformation* (SI4ST), chapter 1 of this report). While it is one of the objectives of this study to improve the understanding of the role of social innovation in these three contexts, the objective of this chapter is to devise rationales and inroads for policy interventions in processes of social innovation accordingly.

There are two problems related to this ambition. First, social innovation is often hard to steer, because of its mainly bottom-up nature, its context-dependency and often informal interactions in the creation stage. Moreover, successful policy support for SI often needs to meet narrow windows of opportunity in the course of the emergence of an SI and thus a smart supporting management of opportunities by political actors. Second, an important pre-condition to alleviate this challenge is a conceptual foundation for policy intervention in processes of social innovation, a better understanding of possible inroads as well as of suitable policy mixes. As we will argue, such a conceptual foundation needs to rest on a broad understanding of innovation, which goes beyond a technology-centric and business-centric understanding of innovation processes. Bearing these two aspects in mind, this chapter tries to close the gap and to provide rationales for policy intervention in support for SI.

In principle, at EU-level or OECD policy discourses on the three contexts of societal transformation, there are hints to a broadened understanding of innovation, which include social innovation (cf. chapter 1). Similarly, in the current German R&I policy debate, we can find such acknowledgements of the need for a broad understanding of innovation that takes in particular SI more seriously than in the past. As the following examples show, however, these acknowledgements regarding the assumed role of social innovation in these contexts are still formulated rather implicitly:

- The recent OECD report on German innovation policy (OECD 2022a) sees a role of social innovation for **activities of cities and municipalities** in their efforts to better address **sustainability transitions** but does not elaborate on how central such a role might be.
- In the discussion around fostering **disruptive innovation** in Germany, the think tank 'Das Progressive Zentrum' has recently come to the fore with the suggestion that the agency funding disruptive ideas (SPRIN-D) should not focus on technological solutions solely, but rather broaden its remit to **'techno-social' innovation** (Bohne et al. 2023). The think tank's inputs to the policy debate are broadly debated at a time when SPRIN-D is being evaluated for the first time. This opens up a window of opportunity to further discuss the role of SI for disruptive technologies.
- The hackathon 'We vs Virus' to address challenges of the COVID-19 pandemic was explicitly designed as an open social innovation process and, although more implicitly, expected to contribute in a **mitigating way**[30] to the **crisis** (cf. also (Weber et al. 2021a).

Neither current social innovation literature nor the academic studies of R&I policies have so far developed broader policy approaches that provide a framework for the justification of social innovation policies on the one hand or a comprehensive concept covering different policy approaches, instruments and mixes to foster SI on the other hand. Some first attempts in this direction have been confined to specific application fields like energy (Rogge and Stadler 2023).

Therefore, in this chapter, we discuss substantive rationales for policy intervention for SI by building on an extended failures framework. In a market economy, it is essential to identify such failures in the operation of market forces in order to justify policy interventions in research and innovation, complementary to procedural rationales, which are essential elements of decision-making in democratic systems. More specifically, we discuss that the established framework of market and system failures can underpin policy intervention for social innovation, when acknowledging a broadened understanding of innovation. Further, we argue in this

[30] https://wirvsvirus.org/abschlussbericht/.

chapter that public policies in support of social innovation for societal challenges need to rely additionally on the more recent, but already established framework of transformation failures. It has been developed to underpin R&I policies which address transformation processes in the direction of sustainability, however, we also consider it to be applicable to other contexts of transformative change, such as the emergence of disruptive technologies or – though with some caveats – situations of crisis. Although transformation failures were not developed with rapid crisis reaction in mind; but were rather developed with a view to long-term sustainability transitions, we discuss political intervention in SI also from the point of view of preparedness and pro-active policy making. The failures framework is illustrated by referring to the case studies presented in the previous part of this report. At the end of this chapter, a few mini case studies from four European countries (Portugal, UK, the Netherlands and Finland) illustrate policy approaches and specific instruments to inform first conclusions on how to inspire policies for SI in Germany.

2 RATIONALES FOR POLICY INTERVENTION FOR SOCIAL INNOVATION

2.1 Two major shifts in innovation policy: Directionality and a broad understanding of innovation

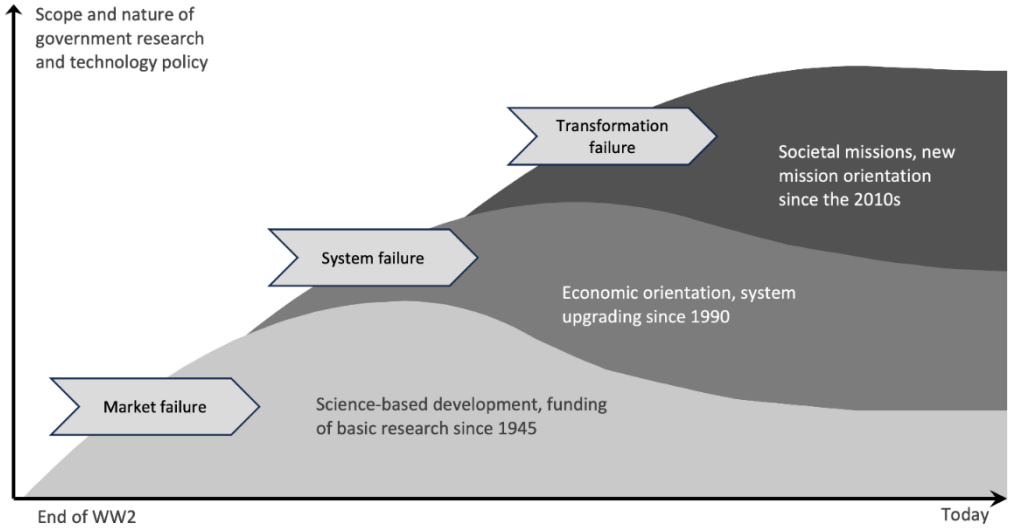
Over the past years, two major overarching shifts have been discussed in research and innovation policy, namely i) the 'embedding' of R&I policy in wider directional and transformational policy goals and ambitions, and ii) the broadening of the understanding of innovation. In other words, this first shift is about the '*what*', or the purpose, which is not only building any longer on the assumption that innovation is good *per se* for growth and competitiveness. Now, it is about addressing different societal objectives, which are in this study being grasped as three different types of societal challenges: sociotechnical (system) change, disruptive technologies, and crises. The second shift is about the *'how'*, or the object of possible policies, and its delimitation: the shift from a narrow to broad understanding of innovation activities, processes and actors involved. We introduce these two shifts here separately, although they are intertwined in many ways. Actually, for the policies resulting from those shifts, the analytical distinction at this point makes sense. This is because we argue in this chapter, that R&I policies have embraced in many ways the shift to directionality, while they have far less paid attention to the implications of a broad understanding of innovation for policymaking and policy implementation. As we will show in the application to social innovation from section 2.2 onwards, this broad understanding of innovation is a prerequisite for legitimising policies for social innovation.

2.1.1 Directionality

The need for policy action in response to addressing environmental and social challenges provides one of the major, if not *the* most important rationale for policy intervention in research and innovation policy today (cf. figure 1). As has been discussed in the literature (e.g. (Weber and Rohracher 2012; Daimer et al. 2012; Schot and Steinmueller 2018), this rationale is different from the earlier rationales, as it builds on - admittedly radical and far-reaching - policy decisions, which require research and innovation activities to be directed towards addressing needs and challenges of society beyond economic objectives of growth, competitiveness and employment. Moreover, it emphasises the need to better connect research and innovation policy with other, often sectoral, policies that influence the uptake and scaling of new and innovative solutions in line with sectoral policy directions and priorities (Kallerud et al. 2013).

Figure 1 displays the current framework of rationales underpinning R&I policy. It links in a simplified manner the major scope and nature of R&I policies to the major rationales justifying policy interventions (failure categories). As figure 1 suggests, the established rationales for policy intervention (market and system failures), are still valid. As (Weber and Rohracher 2012) pointed out, innovation systems are not only challenged in structural terms, but additionally in their aptitude to cope with the transformative change needed. To denote this paradigmatic shift, they suggested the new category of transformational system failures (which are being discussed in the following sections as transformation failures).

Figure 1: Phases and rationales of R&I policy



Sources: Own compilation based on (Breitinger et al. 2021); adapted from (Daimer et al. 2012; Gassler et al. 2006)

2.1.2 Broad understanding of innovation

The acknowledgement of a broader understanding of innovation has meanwhile been brought forward as a central characteristic of contemporary 'transformative innovation policy' (Diercks et al. 2019). Having analysed various forms of transformative innovation policies, the authors observe 'notable differences concerning the understanding of the innovation process' (Diercks et al. 2019). According to their concept, the understanding of the innovation process is made up of three elements: (i) which actors are actively involved in the innovation process, (ii) what types of activities are contributing to innovation, (iii) the different modes of innovation, i.e. in terms of levels of interactivity and learning among different actors involved in knowledge creation (Diercks et al. 2019).

Table 1 displays the differences along the three categories. It shows that a broad understanding of the innovation process includes non-business-driven and non-technological types of innovation, and modes of innovation, which are not based on science and technology (only), but include doing, using and interacting. Further, it entails a broad conceptualisation regarding innovating actors, including a diversity of civil society actors and public bodies.

Table 4.1: A narrow versus a broad understanding of the innovation process

	Narrow	Broad
Actors	Academia, industry and national governments as leading actors	A wide variety of actors with active roles for a diversity of public and civil society bodies
Activities	Supply-side focus (technological domains)	Demand-side focus (end-use domains) in addition to supply-side
Mode of innovation	Science, technology and innovation	Doing, using, interacting in addition to science, technology and innovation

Source: (Diercks et al. 2019)

Recalling the main characteristics of social innovation, it is de facto not part of a narrow understanding of innovation, but clearly embraced by the broad understanding. We turn to the implications of this broad understanding of innovation processes for the justification of R&I policies in general and for the justification of social innovation policies more particularly in the next sections.

Although (Diercks et al. 2019) note signs of a paradigmatic change towards a broader understanding of the innovation process taking place in policy making, their paper underlines the need for further change to take place in current R&I policy approaches. This observation is still valid up until today. Governments seem to

have broadly embraced directionality at a programmatic level and adapted their overarching policy objectives in order to include e.g., climate goals, sustainable development goals, or societal resilience. In the field of R&I policy, however, the step from a narrow to a broad understanding of innovation underpinning the operational policy approaches, is still taking its time. It is being referred to often only symbolically e.g., in the case of Germany in the current future strategy or the Hightech strategy or by the appointment of a national representative for social innovation. However, the consequence to adjust R&I policies accordingly and direct them to what is often referred to as socio-technical system change (Savaget et al. 2019) is lagging behind. Referring to the example of the German agency funding disruptive innovation, SPRIN-D, above, this is exactly, what the claim to broaden the approach to 'techno-social' innovation means.

2.2 Implications of major policy shifts for the justification of policy interventions in general

The broad shifts in research and innovation policy as described in the previous section have implications for the 'policy logic', the way political interventions are being rationalised. Rationales for policy interventions, as shown in figure 1, build on broader policy objectives, and more particularly on the diagnosis of failures in reaching those objectives. This section is about how the rationales need to be reformulated in light of these two big shifts in more general terms and recalls some major elements of the failures framework. Section 2.2 ,discusses the application to social innovation.

The discussion of these implications has lasted for about a decade now and will be summarised in the following paragraphs. First, (Weber and Rohracher 2012), in response to increasing directionality, defined a new failure category, the 'transformational system failures', which comprises four different types of specific failures. These four new types of failures also carry the flavour of a broad understanding of innovation and can be easily extended in that regard (Larsen 2019; Diercks et al. 2019). Second, the two major shifts to directionality and a broad understanding of innovation also affect our understanding of almost all types of market and system failures. The OECD report on system innovation in response to societal challenges discusses various market and system failures from the point of view of this new context (OECD 2015), which we will extend here by some further considerations.

2.2.1 Implications of the two policy shifts

Adopting directionality in R&I policy means that additional types of policy objectives become relevant for R&I policy. The major rationales for research and innovation policy have also been equated to three frames or generations of innovation policy (Schot and Steinmueller 2018): First generation policies are focusing on supporting science and technological development, second generation policies on the well-functioning of innovation systems and third generation policies are aimed at societal transformation. Whereas policies of the first and second frame clearly relate to an economic and industrial policy agenda, the third-generation policies are driven by societal policy objectives (Diercks et al. 2019), which relate to other policy fields (Kallerud et al. 2013). These include sectoral policies such as energy, health, transport and mobility or agriculture, but also cross-cutting policy fields such as cohesion, social or education policy. This extension of policy domains beyond the realm of R&I has a couple of implications, which in turn might affect the occurrence of failures. These implications are:

- Policy mixes become broader and more diverse, creating more options for policy interventions, and, in case of their absence or bad fit potential inroads for failures.
- Networks of innovating actors and interactions of actors might need to reconfigure or broaden well beyond the established actors in science and industry. Thus, it is also more likely that these interactions do not come about or are impeded.
- In R&I policy, knowledge is a public good, which creates spill-over effects. Thus, there are not enough incentives for the market to provide knowledge. When the policy agenda broadens to societal objectives and societal transformation, more public good(s) beyond the provision of knowledge come into scope. Issues like public health, public transportation, biodiversity etc. might be public goods, for which market failures might occur. At the same time, third generation R&I policy might affect the provision of these public goods in a positive way.
- The infrastructures relevant for the provision of solutions to societal challenges are not necessarily limited to knowledge infrastructures. In the same way as other public goods than knowledge become relevant for

the new type of transformation-oriented R&I policy, also the infrastructures needed for their provision become relevant.

- Directionality has a huge impact on the logic of supply and demand of knowledge. In an extreme view, knowledge generation and development become challenge- and policy-driven. In a more moderate understanding, there should be neither a complete upstream or downstream logic to knowledge generation, but a mutuality of 'communicating pipes, which also has been called 'midstream modulation' (Fisher et al. 2006). It is likely that complementing the supply of knowledge with demand from policy and society create the need for new mechanisms of demand articulation as the example midstream modulation shows.
- Cross-domain policy approaches require harmonisation not only across departments of government but also in a vertical sense across the levels (from EU and national to regions / federal states and municipalities). This is an opportunity and at the same time an often-mentioned barrier for the new type of innovation policy.

Similarly, **broadening the understanding of innovation** points to a number of implications for R&I policies. As outlined above, the understanding of innovation processes includes a different conceptualisation of actors, activities and modes of innovation. This leads to the following implications:

- Actors new to innovation processes bring a lot of diversity to these processes. The knowledge, networks and resources they bring to these processes are expected to be enriching but can cause various failures as well.
- The types of activities relevant for transformative innovation processes are broader than scientific and technological development and related knowledge transfer and exchange activities. They now include the modes ‘doing’, ‘using’ and ‘interacting’. Their contribution to developing solutions in response to challenges must be further understood. Moreover, these new activities must be addressed by funding and support instruments.
- In frame 1 and 2 policies, demand is understood as usage and consumption, and as something that is regulated by the market, mainly by way of supplying new products and services. In a broadened understanding of innovation, the demand-side gains in importance and modulates or co-shapes the supply of solutions. We have discussed above that the implications created by introducing directionality mean first of all for the demand-side that new ways and opportunities of articulating demand need to be created. A broad understanding of innovation has a similar policy implication, which also can go even further: It can mean that the actors owning needs are more diverse (e.g. civil society organisations, municipalities etc.), and that their roles in innovation processes are not necessarily limited to articulating demand, but also to (co-)creating solutions.

To conclude a broader understanding of innovation, points to the kind of actors involved in innovation and the types of activities, which now include 'doing, using, and interacting'. It further reinforces the implications expected for the demand side and its relationship to the supply of innovation.

2.2.2 Transformational system failures

Against the background of the new directionality in R&I policy and somewhat less explicit the developing broader understanding of innovation, a new category of failures was suggested. These 'transformational system failures' (Weber and Rohracher 2012) should account for the fact that innovation processes as understood by the innovation system heuristic, would not bring about solutions for societal challenges to an extent needed to cope with these challenges. When introducing directionality into innovation system thinking, the authors noted four new types of failures, which were different from the well-known system failures in the way that system failures so far addressed dysfunctionalities of an innovation system meant to deliver innovation *per se*, i.e.. in line with the first and second generation of R&I policy. As opposed to these so-called structural system failures, the proposed transformational system failures address the four types of shortcomings of innovation systems to direct innovation activities to societal transformation. We introduce these four failures here and outline for each of them how their meaning broadens or can be further accentuated in the light of more recent academic work.

Directionality failure: Introducing directionality to innovation would mean to agree collectively on a desired direction of transformative change, an overarching policy objective or strategy, which sets a framing direction

for innovation activities. Directionality failure thus is a (partial or complete) lack of means to collectively prioritise, coordinate, and consolidate the direction of change in innovation systems. It also includes shortcomings in the 'translation' of the overarching direction into the relevant sub-systems, organisations and activities performed by innovation systems.
The more recent academic discussion has highlighted that a cross-policy-domain and cross-sectoral approach to societal challenges, which is needed to make R&I policy transformative, puts the conceptual heuristic of the established innovation system in question. *Broader systemic concepts*, which not only capture research and innovation dynamics, have been suggested such as the notion of socio-technical systems (see for an overview of this broadly discussed concept (Savaget et al. 2019) or innovation ecosystems (Botthof et al. 2023). So, directionality failure is not only a deficit in a politically agreed direction for innovation, but also a failure to acknowledge that transformation also encompasses other societal processes, such as mobility behaviour. Further, the notion of system change and system innovation, has been made more explicit (e.g. (OECD 2015) pointing to the fact that transformative change can mean a whole reconfiguration of societal (sub-)systems. *System innovation* (and system transformation respectively) are characterised by new configurations of actors, by innovative ways of providing the functions of a system (i.e. mobility), and by a combination of different types of innovation including social innovation, organisational innovation and institutional innovation (i.e. the change of behaviours and mindsets).

Demand articulation failure: A different, more attentive view on the demand side can be seen as a logical consequence of increased directionality in R&I policy. Demand-articulation failure thus has been defined as failure to provide the possibilities to express other forms of demand beyond economic objectives such as societal and environmental objectives. It also points to the fact that innovation processes usually lack to integrate the perspectives of users.
Introducing a broader notion of innovation underlines that the demand-side is not only determined by users and consumers, but by those who are affected by transformation processes or those who have specific roles in those processes. The 'social needs' perspective that is central to social innovation gains in relevance, and hence the notion of 'need owners'. The articulation of their needs or more specifically the integration of the needs into knowledge generation and innovation processes is challenging, which is why need owners also attempt to become innovators themselves.

Reflexivity failure: Embedding reflexivity into innovation processes and their governance means to embed a long-term perspective on the desired transformation, the progress made and potential alternative solution paths that might open up in the course of a transformation. Reflexivity failure is thus a failure to deliberate over the visions, values, and interests of society to explore alternative pathways of development, and also to generate the strategic intelligence needed to underpin these deliberations. Often, reflexivity failure is a failure underlying other failures.
This point also has been made more recently by (Larsen 2019), who highlights the fact that still in the today's debates the pro-innovation discourse remains undisputed, "which asserts that science, technology and innovation can decouple economic growth from environmental degradation without any fundamental changes in societal structures, lifestyles, or human behaviour" (Larsen 2019).

Policy coordination failure: Societal transition requires horizontal coordination of R&I policy with sectoral and cross-cutting policy domain as well as vertical coordination of national and European level policies as well as with sub-national levels. Consequently, a failure becomes prevalent in case of a lack of multi-level policy coordination, and coordination across policy areas. Further, the inability to coordinate policy strategy and implementation creates policy coordination failure. Policy coordination failure also means temporal mismatches of the interventions by different actors.
More recently, it has been emphasised that system innovation of socio-technical systems involves less top-down approaches and instead more reflexive, tentative and open-ended processes of working among a broader and more diverse set of actors (Kuhlmann and Rip 2018). Thus, the analytic lens on the efforts to foster system innovation should not be limited to public policy. The coordination requirement includes the efforts by various private actors. From this point of view, policy coordination failure is a governance failure in case there is a lack of mechanisms (a platform for example) to orchestrate, connect, bundle and direct various efforts by public and private actors.

As the transformational system failures have been formulated against the backdrop of innovation system thinking and in addition to structural system failures, it seemed important to highlight their systemic nature. With the discussion around needs for changes in the understanding of systems (see above), it becomes clear that the new failure category is applicable in a broader sense, not necessarily limited to innovation systems. Therefore, we suggest speaking of *transformation failures*.

2.2.3 An extended view on market and system failures

Recalling the three major paradigms which serve to justify R&I policies as presented in figure 1, it is important to note that they exist in parallel. The third generation R&I policy (transformative R&I policy) has emerged as an additional layer in the past 10-15 years and gains in relevance as compared to first and second generation R&I policies building on market and system failure argumentation. So, market failure argumentation for the provision of knowledge (Arrow 1962; Nelson 1959) and justification based on dysfunctionalities of the innovation system (system failure) still continue to exist (cf. (Smits and Kuhlmann 2004; Klein Woolthuis et al. 2005; Wieczorek and Hekkert 2012). At the same time, the major shifts in R&I policy - directionality and a broad understanding of innovation – also have implications for these established failure frameworks. These implications constitute additional justifications for policy interventions, when linked to the failures framework. Basically, they result in extended interpretations of many, not all, market and system failures.

For example, in the **market failure l**ogic, knowledge is no longer the only relevant **public good** to be addressed by R&I policies. A public good is the extreme version of positive externalities. In the case of knowledge, the knowledge and the benefits it creates spill over to society, which lowers the incentive for private actors to invest in knowledge creation. When it comes to policies for transformative change, which are linked to policy objectives of other policy areas, the role of knowledge and innovation for the provision of *other* public goods (such as health, mobility or energy provision) becomes an additional relevant justification for policy intervention.

Negative external effects are a widely discussed phenomenon in economic theory. In the justification of R&I policies, they have only played a minor role (OECD 2015), for the reason that there was and is a strong belief in the benefits of (technological) innovation for humankind. However, at the same time, "the possibility to externalise costs leads to innovation that can damage the environment or social cohesion" (Weber and Rohracher 2012; Sengers et al. 2021). In the light of third-generation innovation policies, and in particular against the background of introducing directionality into R&I policies, a similar kind of argumentation for an extended interpretation holds as for the public good: In those cases where knowledge and innovation promise to provide beneficial solutions to mitigate negative externalities caused by other factors than innovation, for example by external shocks, this justifies public policies in support of innovation.

The **system failures** framework builds on a different school of thought than the market failures, however, the rationales it provides are often used alongside market failure argumentation to justify policies. In fact, system failures point towards more fundamental problems of knowledge generation and exchange and the related framework conditions, which often result in the fact that innovation does not take place at all.

Capability failure can be considered as a highly relevant mechanism in the system failure concept. It denotes insufficient knowledge, skills, and resources, which negatively influences the capabilities needed to manage innovation and technological change. In our view, capability failure also provides a highly relevant justification for policy intervention against the backdrop of a broadened understanding of innovation in at least two ways: (i) It refers not only to (lacking) firms' capabilities or that of other professional RTDI actors, but as well to the lack of capabilities of a broad array of actors new to innovation. (ii) Further, in the case of transformative change (system innovation, disruptive technologies or crises), both, established and new actors may lack specific capabilities needed for these contexts.

Likewise, the acknowledgement of new actors being relevant for innovation processes, affects the **interaction or network failure**. The failure can either be due to too weak or too strong interactions and network relationships. Considering socio-technical system change, networks of innovating actors might need to

reconfigure in a substantial way. Thus, in the new policy context, network and interaction failures seem to be even more likely.

In the system failures framework, **infrastructural failure** means a lack of knowledge infrastructures, which is mostly ICT related. In the case of a broadened, directional policy agenda, with societal challenges requiring knowledge and innovation, this also includes the lack of other infrastructures, often related to the provision of public goods.

Last, but not least, **institutional failures** constitute a broad category of justifications for policy intervention. They refer to the lack or excess of formal (e.g., regulation, standardisation) and informal (e.g., norms, practices) institutions to regulate the interaction between the components of the innovation system. The failure mechanism does not alter considering the recent shifts in R&I policy; however, its occurrence might be more probable given that a linkage to other policy domains and a widening of the systems understanding to socio-technical systems increases the number of too weak or too strong institutions.

2.3 Implications of major policy shifts for the justification of policy interventions for social innovation

Directionality and a broad understanding of innovation as the two major shifts in R&I policy have shed a new light on social innovation, and on the benefits social innovation can have for a third-generation innovation policy.

- SI brings new purposes to the R&I policy field, as SI typically aims to contribute to social needs and ends, which are thus different from the policy agenda of economic growth and competitiveness dominant in earlier frames of R&I policy.
- SI brings new actors to the group of innovating actors, such as individuals, grassroot initiatives, civil society organisations, etc.
- SI are typically addressing the demand-side. They originate from a social need.
- SI brings a new nature of innovation to the fore, as it represents other modes than scientific and technological development and stands instead for 'doing, using and interacting'. Although SI can have a technological component, it more often addresses social processes and thus has the potential to complement technological innovation in a way that leads to socio-technical change.

In this light, social innovation can be seen as a crucial element for implementing third-generation innovation policies, which realise the implications of the two major shifts.
In this section we outline what this means in more detail for the rationales underpinning the support for SI. We also discuss in a next step how the characteristics of SI result in or should result in a specific policy approach to SI, which is for example characterised by opportunity management and pro-activity. Finally, we apply this framework to the case studies to illustrate the idiosyncratic nature of SI policies when applied to contexts of societal transformation.

2.3.1 Most relevant rationales for SI policies

Social innovation is linked to the failures' framework in two different ways. The first logic is about how failures affect social innovation processes, i.e., what kind of barriers typically arise in such processes and how these are captured analytically by the framework. The second logic is about how SI is expected to contribute to the mitigation of various failures, which arise in complex settings of socio-technical change processes in response to societal challenges.
This section is about both logics; however, it is this second logic of the leverage potential of SI which makes a strong case for state intervention in social innovation processes (Edler et al. 2023). As social innovation processes are complex and often the result of contingencies, the idea that SI processes can be steered by policy should nevertheless be abandoned in favour of a stance that starts from the assumption that **political support for SI is about the management of opportunities.**
Table 2 gives an overview on how selected failure mechanisms are relevant in the context of social innovation, while differentiating between the two logics, (i) the affectedness of SI by barriers, which constitute justifications for SI policies along various types of failures, and (ii) the beneficial nature and leverage potential of SI in contexts of socio-technical change.

The beneficial nature of SI in response to societal challenges

Regarding this second logic, and against the backdrop of the sketched major shifts in R&I policy, social innovation is expected to reap benefits in response to the modified understanding of **market failures**: Some SI can contribute to the provision of **public goods**, other than knowledge, or more generally SI intend to create **positive externalities** (Phills et al. 2008; The Economist Intelligence Unit 2016), e.g. the provision of services of general interest, such as health. SI can even have central roles in transformative change of socio-technical systems (which often provide public goods), as the case study on autonomous driving in this study suggests for public transportation. Further, SI can address **negative externalities** of transformation processes such as poverty and social exclusion. If it is the nature of quite many SI initiatives that benefits accrue to society or groups in society rather than to individuals (Phills et al. 2008; The Economist Intelligence Unit 2016), the danger is that it gets instrumentalised by policy, especially in countries characterised by austerity policies. There is a fear expressed by social innovators that public actors, under constant financial pressures as they are, use the label and concepts of social innovation to not take responsibility for tasks that – in essence – are public tasks.

The way social innovation can be beneficial in addressing **system failure** is straightforward, as this builds on the core character of SI: As social innovation is always a mechanism to empower actors, it can mitigate **capability failures**. This means SI can have a positive impact on the capabilities of individuals and organisations who are actively engaged in social innovation processes. There might be spillover effects as well to other groups in society, but it might less affect established innovation actors. These groups can have more active roles in the provision of knowledge and of solutions to social needs. Further, institutional change can be a desired outcome of SI, which in turn might help to remove **institutional failures** affecting other types of innovation processes.

The empowerment of SI actors is very much related to the mechanism which has been captured as **demand articulation** (failure) in the **transformation failures**' framework. SI is a channel to articulate (and address) specific social needs. Further, in SI, citizens do not remain in the role of users or 'need-owners', they also can act as (co-)developers of transformative change processes. Finally, the crucial role SI can supposedly have on the provision of public goods can be a 'directional' one in the context of transformative change. Again, the example of the case study on autonomous driving suggests, how SI can help to mitigate the **directionality failure** in the current trajectory of the technological development, where it could enable the exnovation of individual car ownership as the dominant solution of individual mobility.

Failure mechanisms affecting the formation and maturation of SI

While all these mechanisms provide rationales for SI policies, the failures' framework also helps to differentiate a couple of mechanisms, where SI processes are hampered by failure mechanisms. This argumentation for political intervention in favour of SI builds on system and transformation failures, which need to be understood and modified considering the peculiarities of the formation and maturation of social innovations.

As outlined by the process model of SI developed in this study, we distinguish between the phases of early niche formation, niche maturation and regime change. When a social innovation emerges and begins to form, a couple of generative mechanisms have been identified, which characterise this phase in the lifecycle of an SI before the niche becomes more mature. SI processes often start with experimentation, trial and error approaches, accompanied by learning and unlearning processes. The capabilities acquired by the SI developers in that phase are a precondition for knowledge spillovers and empowerment in later phases. In this phase, interactions with initiatives addressing the same social need, or with promoters and supporters begin to take place. Typical **failures in the phase of early niche formation** might thus be linked to the acquisition of capabilities and to various kinds of interactions. Typically, such failures belong to the category of **system failures**.

- The lack of framework conditions supporting an environment favourable for experimentation might hamper the acquisition of capabilities. Thus, a situation of nested failures emerges, where **institutional failures** lead to a **capability failure**.
- In the case of institutional failure, the failure mechanism does not alter significantly as compared to technological innovation processes: Formal (regulations) and informal (practices, norms) institutions might affect the formation of SI.

- Although social innovation processes are often characterised by well-developed interactions of initiatives or between developers and promoters or supporters, there might be hindering factors, for example if initiatives are very small or geographically scattered. There might also be a timewise **interaction failure**, when the outreach activities start later than they could.

Next to system failures, the different **contexts of societal transformation** might entail also **transformation failures** hampering SI.

- When societal challenges are complex and require **long-term system transformation**, there is often uncertainty about the solution pathways. In such cases, it is important that the experimentation opens various solution pathways in parallel, and framework conditions support consolidation, but also mechanisms like competition, selection and even conflict (between existing and new solutions). The lack of a variety of approaches being experimented with might create a **directionality failure**. (As a side note, as system change requires completely novel configurations, there is a higher probability for *interaction and network failures* in this context).
- In the case of (enduring or gradually progressing) **crises**, SI are expected to mitigate negative external effects, such as poverty, homelessness or the spread of diseases. As SI often, but not inherently, have an inclusive character, there is a need to "gauge" SI in such a way that positive effects are created, and potential dark sides avoided. The lack of such a calibration can be seen as a **directionality failure**.
- In the case of **disruptive technologies,** it is often assumed that scepticism about new technology is based on a lack of information. So, policy action is often directed to compensate for an information asymmetry (which would constitute a type of market failure) and overlooks the fact that there are often other reasons for scepticism or rejection. The lack of awareness for underlying reasons, which are often undisputed narratives or belief systems, is a **reflexivity failure**.

Established (i.e. market and system) failure frameworks are not justifying intervention into diffusion processes, but when it comes to contexts of transformative changes, such as the three described in this study, it is necessary to intervene at later stages of the innovation lifecycle, as the required effects at these stages are not simply about scaling (Edler et al. 2023). **Political intervention in later stages of innovation processes is particularly relevant for system innovations.** Social innovation in such contexts also might require policy interventions beyond the early stages of niche formation. Policy intervention in the phase of **niche maturation** and even regime change can be justified by using the framework of the generalisation mechanisms as discussed by (Sengers et al. 2021) in the first part of this study. The four mechanisms are in brief: (i) Challenging, reframing, and adapting institutional frameworks, (ii) Replication, adaptation, and proliferation, (iii) Expansion, scaling, and consolidation, and (iv) Circulation and anchoring of new knowledge.
The linkages to the failures' framework, which become apparent, are mainly reinforcing the relevance of **system failures**, and underline that policy coordination failure is the most relevant type from the category of **transformation failures**:

- Like in the early niche formation phase, institutions remain relevant throughout the lifecycle of SI, In the maturation phase, the generalisation of SI might work via institutional change. So, while institutional change is an outcome of SI, the process leading to it, might still be affected by existing institutions (**institutional failure**).
- All four generalisation mechanisms require interactions in various forms: SI developers, promoters and supporters might need to interact with dominant (regime) actors when challenging institutional frameworks. Replication, adaptation and proliferation is about facilitating inter-local learning and knowledge sharing. For the consolidation mechanism, one step can be to establish more formal networks, exchange platforms or interest organisations. Finally, circulation and anchoring of new knowledge might include applying the knowledge in new contexts, new types of application areas, and to contribute to the social appropriation of the knowledge. Thus, there are plenty of inroads for **network and interaction failures.** The failure mechanism works very similar to that for science-driven innovation: networks might be either too strong or too weak.
- Generalisation patterns like replication, adaptation and proliferation as well as expansion, scaling and consolidation require more standardised approaches. Infrastructures are often necessary to support these processes. The lack of these infrastructures constitutes an **infrastructural failure.** Moreover, lacking equity of access to infrastructures could also be an indication for an infrastructural failure.

- With the transition from maturation to regime change, the exnovation of existing regimes is a demanding step in societal transformation processes. Therefore, it has been argued, that policy needs to intervene in these phases as well. This also applies to interventions in support of SI (Rogge and Stadler 2023; Edler et al. 2023). In the phase of regime change, often sectoral policies need to take over. Thus, the most important task is to coordinate R&I policies with sectoral policies to avoid **policy coordination failure.** Vertical and multi-level coordination are equally important at this stage.

Table 4.2: Categories and types of failures to justify policy intervention for social innovation

Type of failure	How the failure mechanism acts as barrier in the context of social innovation	How social innovation is seen as a means to address or mitigate the failure mechanism
Market failures		
Public goods	.-.	Some SI can contribute to the provision of public goods, other than knowledge. SI can even have central roles in transformative change of socio-technical systems (which often provide public goods).
Externalisation of costs	.-.	SI can address negative externalities of transformation processes such as poverty and social exclusion.
System failures		
Capabilities failure	Lack of capabilities hampers in particular the formation of SI, as various capabilities are needed to cope with the different interaction types needed in this phase. Capability failure might also occur in the phase of maturation, connected to various generalisation mechanisms.	SI is expected to contribute to the empowerment of actors.
Interaction or network failure	More actors need to be brought on board in the case of social innovation. Highly relevant for both, the formation and maturation of SI.	.-.
Institutional failures	Highly relevant for both, the formation and maturation of SI.	Institutional change can be a desired outcome of SI, which in turn might help to remove institutional failures affecting other types of innovation processes.
Infrastructural failure	The lack of infrastructures hampers the establishment of new social practices and the spread of standardised solutions, in the maturation phase of SI.	.-.
Transformation failures		
Demand articulation failure	.-.	SI is a channel to articulate (and address) specific social needs. Further, in SI, citizens do not remain in the role of users or 'need-owners', they also can act as (co-)developers of transformative change processes.
Directionality failure	SI in the context of system innovation: New behavioural patterns or new ways to collectively organise a functional system depend on a 'directional' decision on how to further pursue a transformative path. Also, crisis mitigation might require directional decisions.	Social innovation can enable exnovation of dominant solution and the adoption of alternative development pathways.
Reflexivity failure	Lack of awareness for underlying reasons, which are often undisputed narratives or belief system in the context of disruptive technologies.	.-.
Policy coordination failure	Maturation is the stage where R&I policy still matters a lot before moving to transformation policies (that are often sectoral). This calls for policy coordination (horizontal, vertical, multi-level) already at the maturation stage.	.-.

Source: Own compilation

2.3.2 Proactive policymaking in view of future transformation needs

Two major shifts in R&I policy were discussed at the beginning of this chapter, directionality and a broad understanding of innovation. It was outlined how they are about to change current R&I policies, and that especially the broader understanding of innovation still needs to be integrated further into policymaking.
In this section we discuss proactive policymaking as a so far less discussed theme that means to extend and shift again the justification for public R&I policy. It is inspired by the idea that 'reactive policymaking' based on a failures concept might fall short of a future-oriented, pro-active notion of policymaking. This has been argued by (Kubeczko and Weber 2009) and more implicitly again by (Weber and Rohracher 2012) when introducing the transformation failures.
Thus, the term failures only holds, if we extend its meaning also to 'potential future failures' in view of future social needs arising due to anticipated long-term threats (e.g. climate change), yet poorly understood consequences of emerging disruptive technologies that are subject to problems of high uncertainty ("ontological expansion problem" (Tuomi 2017)) or due to rapid and slow crises.
As the application of the failures concept to social innovation has shown, this is supported by the fact that there are expectations regarding the beneficial nature of SI for the provision of public goods in general and solutions responding to the three contexts of societal transformation more particularly. In social innovation literature, it is also a common notion that social innovation responds to future social needs.
In parallel, in the innovation research debate, the notion of preventive technology and preventive innovation is being discussed, arguing that there is a failure to invest in preventive technology and markets not yet existing (Cuntz et al. 2020) and a lack of preventive organisational innovation, as shown by the case of the slow adoption of information security management by companies (Mirtsch et al. 2021; Rogers 2002).

2.3.3 Illustration: Policy rationales for SI

In this section, we use the case studies developed for this project as an illustration how the policy rationales framework can serve to justify policy interventions for social innovation. Each example is structured along the following questions:

- What can/ shall SI contribute to?
- Which barriers hamper the SI in this case?
- Why is an intervention by the state needed?

Vienna Social Housing

The case of social housing in the Red Vienna period has been added as a special case to the set of case studies, because it exemplifies in an accentuated manner how a couple of factors coincided to make Si happen. It is also an example of how a crisis-response policy addressing a pressing problem after the World War I evolved into a long-term strategy and institution for addressing housing problems on a recurring basis. Social Innovation must be seen as a result of a contingent management of the opportunities and of the interaction of public and private actors.
Social innovation serves in this case to provide the public good affordable housing in a high and special quality. It shows how a niche idea of community housing invented in the crisis after World War I a solution to the socially precarious situation, marked by massive hygiene problems and homelessness. Housing was not defined as just giving shelter but as a social practice and new form of culture, a contribution to the constitution and reproduction of the working-class family, its collective resilience and identity.
During the implementation, many adaptations served to address barriers of different kinds. As these are very specific to the topic of housing, and less related to the social innovation as such, they are not reported here in more detail.
To overcome many of these barriers a constructive interaction of the people in charge was needed, and to some extent also the participation of the inhabitants of the community houses.
Although both of this was realized to a certain degree over time, there remained the need for (continued) government action, as the sheer number of flats needed could not be provided by private initiatives .

Corona Warning App

The case of the Corona Warning App (CWA) is an example for social innovation taking place in a setting of nested failures, where SI can contribute in a limited way to their mitigation. We observe an interaction of different failure types belonging to all three categories of failures (market, system and transformation failures). The CWA was developed in the context of lowering COVID-19-infection rates to reduce the burden of the local health authorities with contract tracing. Thus, it aimed to serve the public good of public health.

The implementation of the CWA as such made some failures visible while at the same time trying to overcome transformation failures of the German health system. The barriers which appeared, in this case, were primarily related to structural system failures (capability failure and infrastructural failures). The capability failure related to the fact that if more citizens had been digitally literate, the usage of the app would have been higher. The fact that the CWA was not equally available to all constitutes in our view an infrastructural failure, as it required a suitable smartphone, which is not available to approx. 40 % of the German population.

The concept of transformation failures was not developed with rapid crisis reaction in mind; they were rather developed with a view on long-term sustainability transitions. Nevertheless, we consider that the struggle to deal with the scepticisms regarding the app reflect a reflexivity failure. The reflexivity failure corresponds to the often-undisputed pro-technology discourse, which asserts that technology provides beneficial solutions. Scepticism vis-á-vis technological innovation is often interpreted as a lack of 'qualified' information, while disregarding that the reasons for scepticism might be due to other concerns. In the case of the CWA this is the importance of data privacy in Germany, which creates tension with the policy objective of lowering infection rates. The lack to address this conflict of objectives in a broader discourse can be qualified as a reflexivity failure.

None of these barriers and failures could be addressed by state intervention solely, they all require to a certain degree an interaction of public and private actors. Moreover, the capability failure (lack of digital literacy) and the reflexivity failure (lack of discourse) would require more long-term activities to build more societal preparedness for crises like this. The federal government made some attempts to address the underlying scepticism regarding the CWA, by making the code open source and by engaging a hacker initiative (Chaos Computer Club) to check the app for data leaks. But at this point the mistrust in government related to the management of the crisis paired with the high esteem for data privacy were stronger.

Autonomous Driving

The case of autonomous driving (AD) highlights a surprisingly strong role of SI in the trajectory towards one of the potential possible scenarios for the technology. It illustrates the potential of SI for mitigating the risk that transformation failures (directionality and demand articulation failure) become prevalent. Transformation failures are accompanied by system failures (institutional and infrastructural ones), thus a wise management of opportunities at system level is required.

The promise of SI in this case lies in its support of the pathway of 'Mobility as a Service'. SI could mean to change mobility behaviour of individuals and the invention of (social) business models to establish AD as a service connected to public transportation to cover the 'first and last mile'. This in turn might increase the chance to exnovate the current car infrastructures linked to individual car ownership.

Most likely, this would only happen in conjunction with exnovation policies to address institutional failures and infrastructure investment into public transportation and digitalisation of the rural areas: The AD case shows two examples of institutional failures. First, a legal (and more fundamentally an ethical) definition of liability for autonomous vehicles has to be agreed. This is a necessary condition for all AD trajectories. Second, in the case of autonomous driving being successfully integrated into public transportation, a window of opportunity opens that individual car ownership might become less prevalent. The exnovation of this mobility regime is a social innovation, as it is about changing mobility behaviour. It is dependent on a change of institutions, such as revisiting the space dedicated to cars in cities (streets and parking spaces).

All of this would require a wise management of opportunities by the government in close collaboration with stakeholders. Further, the case of autonomous driving underlines that it will be very important to involve citizens to realise the 'Mobility as a service' trajectory. Their perspectives as users of public transportation, as car drivers and as citizens living in either urban or rural areas constitute viable needs, which should be integrated in co-design processes to shape future public transportation, individual car ownership, and the usage of space in urban areas. This approach would prevent a demand-articulation failure.

Energy cooperatives

Institutions, in particular regulation have (had) a decisive impact on the development of energy cooperatives in Germany. Thus, the identified institutional failures can only be solved by governmental action. This is needed even more as there is also a policy coordination failure. Although we need to remind ourselves that SI is always a result of favourable opportunity structures, public policy is in control of some of them.

Energy cooperatives are expected to contribute to the further decentralisation of the provision of energy, the spread of renewable energy production and consumption. Their most important impact perhaps relates to the empowerment of individuals to act in a self-sustaining way.

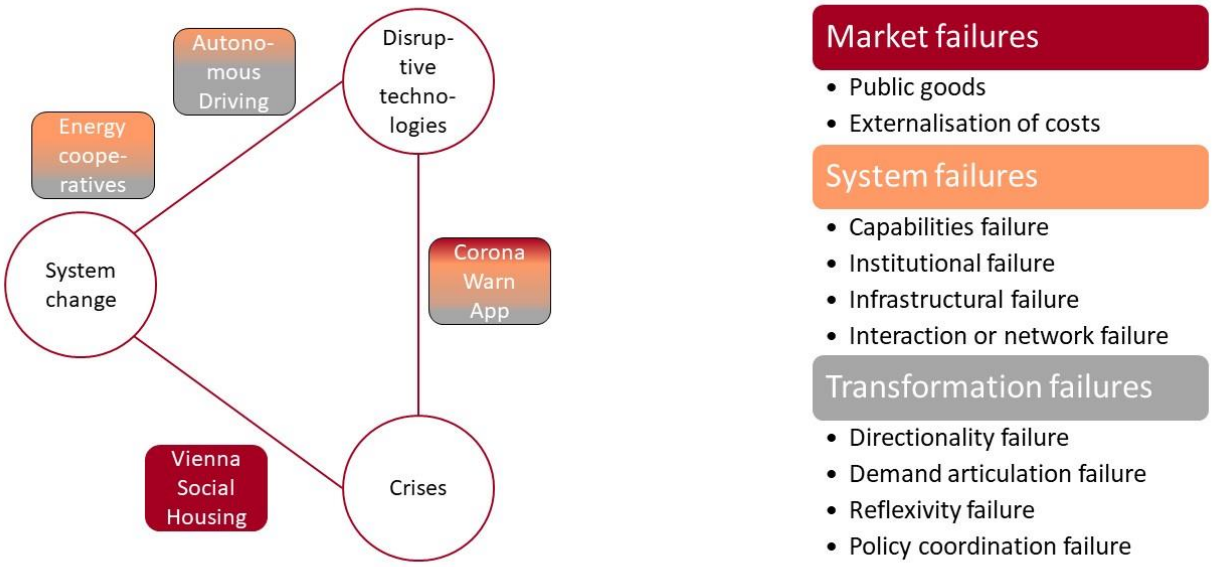
The barriers for SI are institutional and relate to policy coordination: The Renewable Energy Act (EEG) in Germany first fostered and – after several amendments and changing political priorities towards more competition-oriented approaches – finally hindered the development of energy cooperatives. Related to policy coordination: there are potential failures in horizontal as well as vertical coordination. First, the development of energy cooperatives is impacted by policies from different policy domains, such as energy and climate policies but also policies related to cooperative laws, tax systems etc. Second, different policy levels influence the development of ECs over time – from EU directives to local level urban planning policies. The lack of a closer dialogue with EC representatives across policy domains and policy levels can be interpreted as a policy coordination failure.

As highlighted above, public policy has a central role in this case to create favourable opportunity structures for social innovation.

2.4 Interim conclusions: takeaways on rationales for SI policies

The following graph summarises the interaction of policy rationales for each case. It also positions the cases into three contexts of societal transformation. The visualisation of the linkage between the three contexts and the policy rationales was guided by the question, whether any patterns would emerge. These could only be tentative, because of the low number of cases in our analysis. However, no immediate pattern becomes visible. The cases show a high idiosyncrasy.

Figure 4.2: Case studies in relation to contexts and policy rationales



Source: Own compilation

Nevertheless, these illustrative cases confirm the conceptual claim that it is system and transformation failures which act as **barriers to SI**. **System failures**, which appeared in the cases are capability failures (Corona Warn App (CWA)), institutional failures (Autonomous Driving (AD) and Energy Cooperatives (EC)), and

infrastructural failures (CWA, AD). The cases of AD and EC underline how various **institutional failures** become prevalent barriers for SI, which can be addressed by policy intervention. **Transformation failures**, which need policy attention in the described cases, illustrate the different types identified by the rationales concept: **Directionality failure** might hamper transformative change, which is supported by SI in the case of AD, an example of **reflexivity failure** is illustrated by the CWA case, and the energy cooperatives case shows how **policy coordination failure** can act as a barrier for the transition process and the SI in this transition.

All of these failures were present from the early stages of niche formation of SI in the case. The case of energy cooperatives further shows how policy coordination failure can interfere the scaling of SI; here policy coordination failure is a barrier in the maturation stage, thus confirming conceptual expectations.

The Vienna Social House case has shed light on how **a continued emphasis** on and support for social innovation by a cross-cutting policy approach, where R&I policies act in a supporting role, can unfold many societal benefits and major social change, which might even be characterised as transformative change. All of the cases further underline the claim that social innovation cannot be steered, their formation cannot be triggered directly by policy intervention. Instead, the state can build on the leverage of SI only if governments – often in conjunction with stakeholders – **manage opportunities** wisely. Increasingly, the academic literature (e.g., (Rogge und Stadler 2023) argues in favour of policy intervention beyond the early stages of niche formation in the case of SI, as evidence (and expectation) grow that SI play an important role for **transformative change** because of the various positive externalities they create for society. In fact, this argumentation goes beyond the logic of reactive policymaking in response to various system or transformation failures.

Finally, **urgently emerging crises** like the recent COVID-19 pandemic have also shown that reactive policymaking has its limits, and several aspects of crisis preparedness need a **pro-active policy approach.** Given that SI are expected to have a mitigating effect in crises, as they support adaptive resilience of society, this pro-active rationale would support policy interventions which create favourable conditions for SI.

3 SOCIAL INNOVATION POLICIES IN PRACTICE: RECENT EXPERIENCES FROM SELECTED COUNTRIES

3.1 Positioning the country mini-cases

The country mini-cases aim to present recent policy initiatives or policies to foster social innovation in other countries. The selection of Portugal, the United Kingdom, the Netherlands and Finland is a result of an exploratory literature review and the assessments of the Expert Commission for Research and Innovation and the study team. These countries represent different types of political stances and practices regarding the role of the state in general and different approaches to social innovation in more particular.

If we want to apply the 'lens' of this study, which aims to better understand social innovation in three contexts of societal transformation (sustainability-oriented system change, the emergence of disruptive technologies and major crises), the four selected country examples can be linked to those contexts as shown in table 3.

Portugal's social innovation policies date back to the financial crisis in 2008, when they were seen as an important component of long-term recovery from the crisis. All governments have continued this path and established a whole ecosystem, in which next to societal empowerment the creation of economic value (and thus a focus on social entrepreneurship) are important pillars. **Crisis prevention and preparedness** play a role in all the national contexts studied, however to different degrees. Historically, the approach in the Netherlands has similarities to the Austrian case of social housing (cf. Chapter on case studies), as SI were supported to mitigate negative externalities of transformation processes like industrialisation and urbanisation. For the UK, major policies to address SI were driven by NESTA, a foundation (funded by the state lottery), which addressed the topic to support the provision of public goods, in the absence of relevant government policies. Finland finally takes a pro-active stance on crisis preparedness with its foresight activities, which include a relevant role for SI.

Sustainability policies and **directionality to address sustainability** in governmental policies have become increasingly adopted by governments. Implicitly, there are references to the role of SI for this new directionality available in all countries studied. A very explicit stance takes Finland in this regard, which attempts to orient its whole innovation system to this new policy goal.

Finally, there are foci on the **emergence of new technologies** and the role of social innovation in those contexts in two countries observable: in the Netherlands and Finland.

Table 4.3: Social innovation for three different contexts of societal transformation in four selected countries

Social innovation for...	Portugal	United Kingdom	The Netherlands	Finland
Sustainability-oriented system change	(Sustainability as a theme of funding policy)	(Sustainable Futures as a strategic stream)		National Innovation System in general
Emergence of disruptive technologies			Co-evolution of technological and workplace innovation	Competitiveness and Growth of the ICT sector
Crisis prevention and management	Mitigate the effects of the financial crisis after 2008	(NESTA: Compen-sate for state failure in the provision of public goods)	Historically: Mitigate social problems like poverty and housing	Foresight Focus at Sitra

Source: Own compilation. Entries in brackets indicate partial fit to the category.

The intention of the mini cases is to look at inspiring instruments, actions and activities instead of presenting an entire policy mix for social innovation for each country. The evidence presented is based mainly on desk research. The study team made attempts to approach at least one expert per country for an interview, however in the framework condition of our study, only one interview took place for Finland with one interview from a researcher at Sitra.

3.2 Social innovation Policies in Portugal

3.2.1 Background

Social innovation has gained its popularity in Portugal mainly after the financial crisis. The signing of a three-year economic adjustment program in 2011 with the European Union, the European Central Bank and the International Monetary Fund resulted in strict austerity measures that increased social needs (European Investment Bank 2018). To this point, social needs have been primarily addressed bottom-up by non-profit organizations and emerging groups of social entrepreneurs (Pinto et al. 2021).

Against this background, a national public policy for social innovation in Portugal was initiated. Responsible for its implementation is the newly created central mission unit PSI. Within the framework of the initiative "Portugal Social Innovation (PSI)", it is intended to present SI in a simplified version to make it broadly accessible.

The president of the central mission unit, Filipe Almeida defines SI in Portugal as the "the innovation that addresses the fighting of inequalities and the promotion of the autonomy of those among us that are more vulnerable" (Almeida 2022).

In the failures framework to conceptualise rationales for policy intervention used in this study, inequalities can be seen as a negative 'externalisation of costs' following the financial crisis. Thus, social innovation is seen as a means to mitigate negative effects on the financial crisis of 2008. Further, social innovation is promoted to empower those individuals and groups affected most by the crisis. Following the broadened definition of a 'capabilities failure', presented in this study, which also encompasses the capabilities to innovate of actors new to innovation processes, SI is an instrument to address the lack of capabilities of marginalised groups.

3.2.2 The policy mix supporting Social Innovation

"Portugal Inovação Social" was established in late 2014 under the lead of a conservative government as part of the Portugal 2020 Partnership Agreement negotiated with the European Commission (Portugal Social Innovation o.D.). The main objectives are fostering social innovation and social entrepreneurship projects to solve central societal problems and developing a social investment market, which with its instruments should cover more adequately the needs of social projects and lead to a sustainable ecosystem. Another secondary objective is to strengthen the human capital of all actors involved in the system (European Investment Bank 2018).

Within this framework of 16 operational programs there are four overarching themes in Portugal 2020: Social Inclusion and Employment, Human Capital, Competitiveness and Internationalisation and Sustainability and Efficiency in Resource Use (PT2020 2023).[31] PSI got support by 150 million Euro from the European Social Fund and expected to raise funds via the intended social investment market (OECD 2021).

The initiative was continued by the following two social-democratic governments, indicating a cross-ideological nature of SI (Almeida 2022). Therefore, the support of SI can be a type of social policy that is compatible with different ideological values. This top-down approach being the main catalyst of a whole SI 'ecosystem' is what makes PSI so remarkable. It marks a change to the existing way of how social needs are being responded to. Likewise, the involvement of local municipalities (166 of 332) has led to a better understanding of the local problems, the creation of departments for SI and the attraction of further local investors for the ecosystem (Almeida 2022).

There are four financial instruments to achieve the above-mentioned objectives (see table. 4.4).

[31] Unfortunately, these 4 overarching themes of Portugal 2020 are not further used for PSI and classification of SI projects. Instead, so-called intervention areas are used as a classification tool in addition to the instruments, which will be elaborated further below.

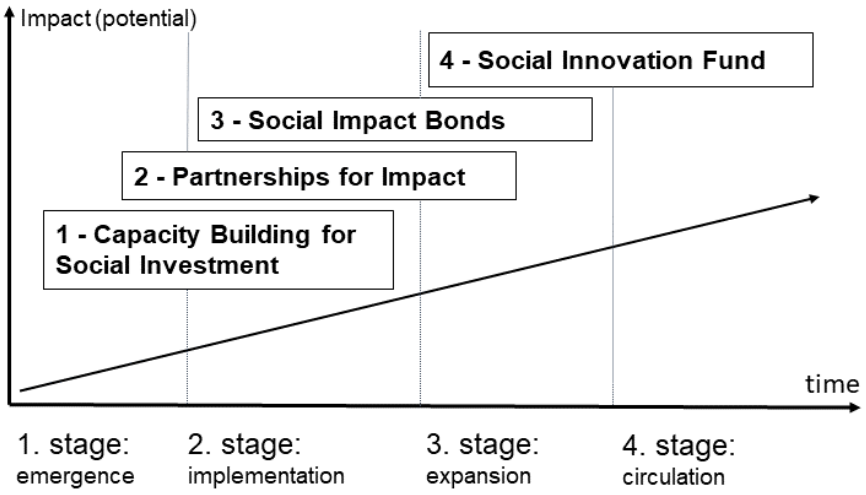
Table 4.4: Categorization of the PSI instruments

	Capacity Building for Social Investment	Partnerships for Impact	Social Impact Bonds	Social Innovation Fund (SIF)
Description	18-month programme (training consultancy service, mentoring, etc.) of up to €50k for involved social sector organisations	finances projects in SI up to 70% of its net needs in combination with co-financing of social investors	support social projects with a greater need than €50k, no economic sustainability of the project is needed	investment via SIF debt or SIF equity in social projects, financial sustainability to repay investments is needed
Objective	support the development of organisational and management skills to execute projects in SI	support creation, implementation and expansion of SI products and the partnership of funder and project organiser	support SI-projects that especially achieve a social outcome in different intervention areas	stimulate the social impact market and enable investors to participate in SI projects
Target group	social sector organisations	private sector, public sector or social sector organisations	Private sector or social sector organisations	institutions and private investors

Source: Own illustration according to Portugal Inovação Social data

Each instrument targets a specific stage of development of a SI project and covers different funding needs at different levels of maturity (Almeida 2022); see figure X). While *Capacity Building for Social Investment* focuses more on the emergence of SI with its 18-month programme, *Partnerships for Impact* covers emergence, implementation and expansion of SI, and thus all phases of maturity. Projects funded by the *Social Impact Bond* are already out of the emergence phase and comparatively have a higher funding need with a minimum funding level of over €50k. As financial sustainability is required for the *Social Investment Fund*, this instrument only covers later stages.

Figure 4.3: Public Policy along the life Cycle of a Social Innovation project in PSI



Source: Own compilation based on (European Investment Bank 2018)

According to the PSI data, 623 projects have been approved so far. They are financed by €90m from the ESF and €42m of social investments from the SIF instrument (Portugal Social Innovation o.D.). Therefore, the SIF must be viewed in a differentiated, rather comprehensive way because it does not specifically finance projects but contributes to the financing of the other three instruments with its fund.

For *Partnerships for Impact*, the total funding is ~ €101m, followed by smaller sums for the Social Impact Bonds (~ €23,3m) and *Capacity Building for Social Investment* (~ €7,4m). Based on the investment scope, one can gain an approximate impression of their relevance for the initiative because the projects have to apply for the respective instrument. However, this remains an approximate impression, as the minimum level of financing varies from instrument to instrument, and especially in the case of Partnerships for Impact, more social capital from private investors flowed in, thus blurring the overall comparability

The large-scale rollout of 623 projects can also be broken down into different intervention areas.[32] The data indicates a focus on the areas of social inclusion, followed by health and education. Accoring to PSI, it appears that not only projects that work directly with vulnerable social groups are funded, but also structures that could have a multiplier effect within regions, such as SI incubators (Almeida 2022).

Table 4.5: Breakdown of projects by intervention areas of PSI

Intervention areas	Number of projects	Social investment	Funding by Portugal 2020 (ESF)
Citizenship and Community	31	2,085,836€	5,120,741€
Education	83	6,243,421€	13,198,325€
Job	68	4,250,568€	9,392,248€
Digital inclusion	16	6,090,048€	7,139,190€
Social inclusion	261	14,211,323€	32,437,193€
Social innovation incubators	28	2,846,178€	6,664,084€
Justice	8	626,706€	1,283,792€
Health	128	5,692,111€	14,790,136€

Source: Own compilation according to Portugal Inovação Social data

The example of the project “Mozart Pavillon” serves to illustrate a typical mix of financing by Portugal 2020 and social investment. This project seeks to promote the social inclusion of prisoners and reduce criminal recidivism rates through participation in the process of creating an opera together with prison guards, family and friends (Silva et al. 2021). The instrument addresses social sector and private sector organisations, while it benefits specific social groups, in this case especially prisoners. The financial scope of this project was €175,674, which was covered 70% by Portugal 2020 and 30% by private investors, which is exactly the intended distribution of the instrument Partnerships for Impact. The private investors are in this project the foundations "Calouste Gulbenkian" and "Caixa Agrícola Leiria". The first one is focused on projects that support people's lives through art, charity, science and education and the second one is a local bank, geographically located in the same city, which sets up the already mentioned regional link between social investor and project.

3.2.3 Learnings for Germany

Social Innovation in Portugal underlines the importance of a persistent social innovation policy across legislative periods and different governments in order to achieve lasting funding. Different funds, as well as the involvement of local municipalities and the creation of a new mission unit are equally important to endure an ecosystem that supports social innovation on a comprehensive, nation-wide level.

Especially the social innovation bond (SIB) instrument can be assessed more in detail in terms of its ambivalent impact to social innovation. (Andrikopoulos 2020) says that there exist around 100 SIB initiatives worldwide, 60 of which in UK and US.

There are various benefits, such as (i) it diminishes the risk of innovation failure in financial matters, (ii) it attracts private funding, or (iii) it potentially adds to the provision of social goods (European Commission and

[32] Unfortunately, PSI does not provide data split up along the four major themes of PSI.

European Investment Bank 2019). For the Portuguese government, the instrument can be an opportunity for reforming its public service and 'achieve more with less' (Carter and Anastasiu 2022). SIBs serve a public need, therefore the investor pays but does not implement and in turn has a clear view of what to measure as a result. The contracting partner experiments and sets up a project to meet a social need in a novel way, as long as the output measures hold. That is the reason why these pay-for-performance schemes are mostly suited for financing undertakings that have ex ante-specified, short-term and easily measurable social outcomes, but normally no it is unclear whether long-term impacts will unfold. This the case for the 22 SIB supported projects in Portugal Social Innovation. The payment of the social investments/ ESF grants was only made after the confirmation of the outcomes (European Commission and European Investment Bank 2019). In this context the (OECD 2016a) said as well that SIBs are in financial matters rather future contracts on social outcomes then "real" bonds.

However, more explicit critics consider the reference to social innovation to be rather tokenistic, while SIBs in fact experiment with (outsourcing) a public service. As (Olson et al. 2022) underline as well, there are still open questions how the model of impact bonds may foster social innovation.

3.3 Social innovation policies in the United Kingdom

3.3.1 Background

For understanding the approach to social innovation in the United Kingdom, the activities of Nesta (National Endowment for Science, Technology and the Arts) are the key ones to look at. In its initial period 1998, Nesta was the first ever publicly supported national endowment that got £250m of National Lottery funding. During that early period, investments were mainly made in the above-mentioned areas for single innovators. In a next step, starting in 2005, the focus was on improving the UK´s capacity for innovation. Already in this phase, Nesta has led to a widening of UK's policy on innovation, which at that time was limited to scientific research. From being a non-departmental public body firstly, Nesta became an independent charity in 2012, focussing mainly on innovation for public benefit (Nesta 2023). Since then, they are playing an important role for defining Social Innovation and supporting the common good in the United Kingdom. In doing so, they also close a gap and contribute to a rather weaker welfare state compared to Germany (Bohne et al. 2023). Thus, Nesta's SI activities compensate for a market failure in the provision of public goods, for example in the area of education.

The last major change in Nesta's strategy took place in 2019 with the new CEO Ravi Gurumurthy and is reflected in today's 10-year strategy until 2030 with three innovation missions (fairer start for every child, healthy life for all, sustainable future) to tackle society's biggest challenges. According to the last annual report from 2022[33], around £33 million was spent on charitable activities (Nesta 2022) It is funded by charitable income (£4.3m), investment income (£10m) and other types of income, such as rental or trading income and its own endowment.

Aside from Nesta, which is now a NGO, there are also other departments and agencies at the governmental level that carry out innovation policies, making the UK one of the most innovation-driven countries in the world according to the Global Innovation Index 2022 (World Intellectual Property Organization 2022). In these other departments, however, social innovation is either not pronounced or not used in the same sense, which is why in this case study, we will concentrate primarily on Nesta.

In this context, the criticism of the former Nesta CEO Geoff Mulgan describing the current situation of SI in the United Kingdom should be mentioned as well. According to him, while social innovation is becoming more visible and necessary in today's world, the large R&D investments in technologies are not matched by those in society in the United Kingdom, for example, in areas such as homelessness or isolation. With this general background, he specifically criticized UK Research and Innovation, a non-departmental public body, for not devoting specific resources to SI or social R&D. He sees no lack of creative ideas or projects, but of a system that centrally supports these ideas (Mulgan 2019).

[33] For comparison: In 2020, the amount spent on charitable activities was £42.1m, in 2021 £34,4m

3.3.2 The policy mix supporting Social Innovation

The three missions of Nesta mentioned above (fairer start for every child, healthy life for all, sustainable future) are related to the rationale of funding (social) innovation activities to address public goods.
Fairer start for every child (15 projects - 8 in progress) wants to close the existing gap between growing up in disadvantage and the national average. *Healthy life for all* (19 projects - 11 in progress) has the aim to explore loneliness and increase the average number of healthy years lived through tackling food environments by halving the prevalence of obesity. *Sustainable future* (27 projects - 12 in progress) has the target to reduce household carbon emission by 28 per cent from 2019 with a special focus on heat pumps and to get back on track to reach zero net by 2048.
The table below gives an overview of the missions, each with an example project.

Table 4.6: Categorization of Nesta´s missions

Innovation mission	**Fairer start for all**	**Healthy Life for all**	**Sustainable future**
Example project	Fairer start local	Healthy school meals	Visit a heat pump
Description	discovery projects with the city councils of Leeds, York and Stockport to eliminate school readiness gap (innovation partnerships)	find ways to increase meal take up and their healthiness in schools in Wales	familiarise people with a heat pump in real life and its functions to encourage a purchase
Objective	reduce, ideally eliminate school readiness gap between those born into disadvantage and their peers by 2030	reduce childhood obesity in Wales	supporting acceptance and uptake of sustainable technology
Target group	parents, children	schools, children	households in UK

Source: Own compilation according to Nesta data

While financial data is not yet available for "Healthy school meals" and "Visit a heat pump", "fairer start local" has signed a long-term partnership with Leeds, York and Stockport for three years with £1,5m for Leeds, York and Stockport together.
As mentioned, there are also other potential inroads to SI in the UK, but these are either not pronounced or not used in the same sense. UK Research and Innovation (UKRI), likewise a non-departmental public body, however funded by the Department for Science, Innovation and Technology focuses more on technology, as opposed to Nesta's social focus (Mulgan 2019). This focus is demonstrated by UKRI's five strategic themes[34], each supported with £75 million over 5 years. These themes address complex challenges, however, the ambition towards these themes is to address them by expanding UK's leading role in technology development, e.g., in heath and biotechnology (UK Research and Innovation 2023a).
Being one of UKRI´s main funds, the UK Strategic Priorities Fund (SPF) is a £830m fund, aiming to create multi- and interdisciplinary research across 34 programmes, organized under 8 themes. The establishment in 2017 is a response to a lack of strategic coordination of R&I investments across research councils and government organisations and the ability to react quickly to (societal) challenges (European Commission 2023, to be published). One of the objectives is to ensure that UKRI's investments link effectively with government priorities in research and innovation (UK Research and Innovation 2023b). An interim evaluation of the fund has already confirmed this (European Commission 2023, to be published). This would be one way to overcome the lack of a systemic approach to foster SI (Mulgan 2019). Therefore, a corresponding government policy in favor of SI could be implemented directly within the structure of this fund by UKRI.

[34] UKRI's 5 strategic themes: Building a green future, Building a secure and resilient world, Creating opportunities, improving outcomes, Securing better health, ageing and wellbeing, Tackling infections

In the SPF Business Case of 2019 it is also said that the intended and formulated objective of a multi- and interdisciplinary research can lead to better progress on social challenges in comparison to mono-disciplinary research. According to the classification used within the evaluation, 7 out of the 34 programmes relate to people (e.g. jobs) and places (e.g., prosperous communities) indicating a slight support of public goods although it is not entirely guaranteed that SI are being addressed (European Commission 2023, to be published).
The current national innovation strategy "Leading the future by creating it" from 2021 by the Department for Business, Energy & Industrial Strategy (BEIS) with its four central pillars: Unleashing Business, People, Institutions & Places and Missions & Technologies intends to further guarantee the dominance in the aforementioned areas, does not imply such a structure to systematically support SI at the moment.
BEIS got split up in February 2023 into three departments: Department for Energy Security and Net Zero, Department for Business and Trade, Department for Science, Innovation and Technology. The breakdown and resulting establishment of a separate Ministry of Innovation wants "to ensure the UK is the most innovative economy in the world and a science and technology superpower" (GOV.UK 2023). However, as the name of the ministry indicates, the main purpose is to combine and promote technological innovations, such as quantum, AI, engineering biology.

3.3.3 Learnings for Germany

The combination of public bodies (UKRI, BEIS, etc.) and a long-term strategy creates a well-designed spider's web that can approach innovation from various different angles and further maintain the leading role in areas like health or biotechnology in the United Kingdom. However, it is visible that this innovation policy has not focused on social innovation in recent years. With the UK Strategic Priorities Fund, there is the possibility of funding social innovation at UKRI directly through government priorities in the future, if desired.
Currently, Nesta represents the only clustering of resources to promote social innovation, even if there has also been a less explicit focus since the last strategy change in 2019. Nonetheless, they still have a strong influence and impact in this area.

3.4 Social Innovation policies in the Netherlands

3.4.1 Background

The development of social innovation in the Netherlands started in the 1980s with a policy-driven approach named *sociale vernieuwing*, dealing with social problems in the context of poverty and housing. With the beginning of the 21st century, the focus has shifted mainly to workplace innovation. This led to the funding of the Netherlands Centre for Social Innovation (NSIC) and the creation of sectoral policies to combine technological innovation with workplace innovation (Oeij et al. 2018).
The NSCI was founded in 2006 by employer organisations, trade unions, universities and TNO, Netherlands organisation for Applied Scientific Research. The constitution was supported as well by the National Innovation Platform that is chaired by the Prime Minister. (Pot and Vaas 2008). The activities were politically and financially - around 1 million € per year - supported by Dutch ministries. However, the political ambition was that social organisations, not the government, should run the NSCI (Pot and Vaas 2008). There is no more data on the NSCI and its innovation policy after the decade change, which means that its impact on social innovation is no longer existent.
This form of cooperation between various civil society and public actors, the *Dutch polder-model*, characterises the Netherlands in many policy areas, also in current innovation policy (van Dyck and van Saarlos 2017). The TOP Sectors[35] are one key initiative, formed by science, politics, administration and civil society. They are handled particularly intensive as innovation focus areas in order to implement measures that are as consistent as possible (Bohne et al. 2023). The TOP sector approach and Dutch R&I policy in more general are often referred to as a benchmark in international comparison. This is also visible in global

[35] At the moment there a 10 top sectoren who are all aligned along the economical focus: agriculture & food, chemistry, creative industry, energy, health, logistics, holland high tech, horticulture & raw materials, water & maritime, digitalisation

innovation performance measurement, where for example the Netherlands rank 5th in the Global Innovation Index, directly behind the United Kingdom (World Intellectual Property Organization 2022).
There was nevertheless also criticism in 2014 from the Dutch Advisory Council for Science, Technology and Innovation for the top sectors, which noted a one-sided focus on technological rather than social innovation (AWTI 2014). The revision in 2018 to a mission-oriented policy has led to a slightly stronger social focus. The revised policy targets in total 25 missions in four areas of societal challenges. These include: 1) Energy transition and sustainability; 2) Agriculture, water and food; 3) Health and healthcare; 4) Security. A concentration on the development of key technologies remains even in the revised form (Ministry of Economics and Climate Policy 2019). This means that today's SI policies, are still not as explicit as for example in Portugal.
The following section on the Dutch policy mix supporting SI will therefore present two examples, first, with Kennisland, a large social, non-governmental organisation, second, with the National Science Agenda (Nationale Wetenschapsagenda, NWA) a government initiative that promote social innovation in a more or less explicit way.

3.4.2 The policy mix supporting Social Innovation

Kennisland, founded in 1998, "has specialised in researching and designing social progress" (Kennisland 2023) and runs besides their current programs "education and youth", "care innovation" and "government in transition" also various social labs and incubators. Its major role for SI is evident in the organisation of the European Social Innovation Competition from 2013-2021 together with Nesta and other partners (Kennisland 2021). Each year, the EUSIC awards three innovative ideas with €50k for a specific challenge and serves as a flagship for social innovators.
In early 2022, Kennisland merged with CAOP, a larger organisation that combines research, science and policy on labor-related issues. Following the incorporation of Sardis, an organisation that is offering research and wants to create equal opportunities for children and young people, they form *Stichting CAOP* (CAOP Foundation), which aims to bring society closer together and contribute to the common good (Kennisland 2022).[36] All three organisations have the same thematic focus, however, the stronger focus of KL on innovation in practice and of CAOP on policy, results in a strengthened chance to exert a positive influence on SI policy for example by scaling up local initiatives to national levels.
The National Science Agenda (Nationale Wetenschapsagenda, NWA) was established in 2015 by the Dutch government to create a research agenda that responds to societal challenges and matches research priorities to the needs of society. It is based on a bottom-up process involving the public, as well as policy makers, researchers and companies. 12,000 questions were collected and classified into 140 cluster-questions and divided into 5 overarching themes: people, the environment and the economy, the individual and the community, disease and health, society and technology, and building blocks of existence. According to technopolis, €200m have been awarded to 190 projects ranging in size from €50k to €10m from the start of the programme until the end of 2021 (Technopolis 2023).
There is criticism that the number of (cluster) questions is too large and cannot keep up with the funding, even if the basic opinion is positive. The NWA has made the role of innovation in society more apparent, which is also due to the involvement of the various stakeholder groups (cf. *polder-model*) and the society itself (Technopolis 2023).
An example project that emerged from the NWA is the program *"Health Inequalities - Promoting the Health Potential of People with Lower Socioeconomic Status"* with a total funding of €4,835m. This program is based on the fact that, despite the average life expectancy has risen in the Netherlands, this is not applicable to people with a low socio-economic status (Broeders et al. 2019). This example project, like Nesta's three missions, is related to rationale of funding (social) innovation activities as a means to address public goods. Based on empirical research in different settings and a system approach, the aim is to address these so-called "socioeconomic health gaps" for the corresponding group of people. Specific projects already in progress deal for example with mental health and e-health (Dutch Research Council 2023).

[36] https://www.kl.nl/en/working-together-for-an-inclusive-society/

3.4.3 Learnings for Germany

The newly formed *Stichting CAOP* offers the potential to bring SI further onto the policy agenda due to its composition of three merged actors, each with different skills. Besides the National Science Agenda, this merger is a new example of the Dutch way of collaboration between different actors, the polder model, and it might become important for supporting social innovation processes, just like the successful TOP sectors are for technological innovation. Nevertheless, as the approaches remain separate, the opportunity for complementary techno-social innovation processes is reduced.

3.5 Social Innovation policies in Finland

3.5.1 Background

The current strong role of Finland in innovation is based on several developments in the 1990s.
Due to its late industrialisation, Finland did not become strongly dependent on old techno-economic development paradigms and was able to act more flexibly. Following an economic recession, the focus was mainly on the growing ICT sector (especially Nokia) and aspects such as economic efficiency, innovation and growth to remain competitive with foreign competitors (Heiskala and Hämäläinen 2007; Schienstock and Hämäläinen 2001). That is the reason why (technological) innovation in the 'national innovation system' (NIS) was mostly seen in relation to its worth for the Finnish economy. From an expert viewpoint, this economic crisis in the 1990s was a 'window of opportunity' for the following developments (Interview FI 01)[37].
There were different views on the specific definition of social innovation at that time in the academic debate. While on the one hand SI was seen as a means of social policy, on the other hand it was viewed as a broader concept that takes social aspects into account in all innovations (Hämäläinen and Heiskala 2007; Aro and Heiskala 2017).
In 1990 Finland was the first country to adopt a 'national innovation system' (NIS) thinking into its innovation policy, which in turn means to not only fund academic research, but to support various forms of knowledge generation and exchange between academic organisations and industry. Its beginning can even be traced back to the 1980s and the founding of Tekes, the Finnish funding agency for technology and innovation. Political continuity across governments and the implementation of long-term organisational plans were further supporting factors for developing Finland's strong innovation capacity. The NIS consists of various universities (e.g., University of Turku), public as well as private research institutes (e.g.; Finland Future Research Centre), business enterprises and three funding organisations, each belonging to different ministries (Sitra, Tekes, Academy of Finland) (Aro and Heiskala 2017). *Sitra*, Finland's Innovation Fund, is overseen by the Parliament, *Tekes* is part of the Ministry of Employment and Economy while the *Academy of Finland* is part of the Ministry of Education and Culture.
Like in other countries, a directionality shift towards sustainability has taken place in Finnish R&I policies. Because of the centrality of the NIS approach in R&I policy, the interviewed expert describes the NIS as being focused on sustainable transitions (Interview FI 01). In 2018, Tekes was merged with Finpro, a provider of internationalisation advisory services, to form "Business Finland". The aim of the government with this newly formed organisation was to strengthen the internationalisation of companies and thus demonstrates the already mentioned connection between technology and economy in Finland.
Nowadays, the general understanding of social innovation in Finland has two crucial aspects. First of all, the government does not use the specific term "social innovation" because it does not fit easily into the public discourse, which has historically been very technology oriented. However, the non-use of the SI-term does not automatically imply the absence of social innovation policies/instruments. As a result, this leads to the second point. According to evidence from an interview, SI is seen more local, which includes the various social enterprises that developed in Finland within the last decade (Interview FI 01). That is the reason why the following policy mix will present the "Finnish Social Enterprise Mark" as one initiative in that area. The funding organisation with the strongest focus on SI, Sitra, is being discussed as well.

[37] Finnish Social Innovation Expert at Sitra

3.5.2 The policy mix supporting Social Innovation

After initial criticism of a too strong economic orientation in the NIS at the beginning, social aspects were discussed and in early 2000s also included with an SI-project at Sitra and continued in the follow-up period (Aro and Heiskala 2017). Their current projects (Sustainability Solutions, Data, Democracy, Economy, Foresight, Learning) are similar to those of UKRI (UK) and Kennisland (NL). Besides that, they offer training programmes, carry out experiments and pilot projects and serve as well as an investor. This is the reason why they can be described as more than a pure think tank but as a "think do and connect tank" (Interview FI 01). They finance themselves by returns on investment assets from an endowment capital of approximately €840m that they got from the Bank of Finland and the Finnish Parliament. Thus, they are financially independent from government funding. The operational expenses amounted to €31m last year and give an approximate scope (Sitra 2023).

One example project from the field of education is called "Bildung+". The goal of the project is both, to better meet the current societal challenges and to be better prepared for the future societal transformation (megatrends). This included, for example, discussions and incubators about traditional education and new narratives in the field. In this showcase project the prominent foresight component of Sitra can also be seen. According to evidence from the interview, ideational paradigms need to change to lead to a transformative and cultural change in society. (Interview FI 01). Foresight is understood as a means to build reflexivity and to question implicit assumptions in policymaking and society. Through a future committee in the Finish parliament and a national foresight network, an attempt is being made to slowly raise this component to an institutional level.

The government itself, as noted above, does not use the specific term social innovation in public discourse. Although there has been no fundamental change from a social democratic to a conservative government, the government in general is facing a large deficit of €10bn and has to cut public expenditures. Nevertheless, the national objective of investing 4% of GDP in research, development and innovation remains in place until 2030. The goal is to create the most attractive and competitive environment for experimentation and innovation (Business Finland 2021).

Another initiative worth to be mentioned in this context is the "Finnish Social Enterprise Mark". The idea, which originated in the UK, was introduced in Finland in 2011 and was meant to strengthen social entrepreneurship. The mark is awarded to companies that support a social or environmental good, which is the primary criterion, and dedicate a large part of their profits (at least 50%) to it. The mark increases public awareness of social enterprises and is financed by a fraction of the net profit that the member companies of the Association for Finnish Work pay each year. The latter is also responsible for the organisation. Furthermore, it is supported by the Ministry of Employment and the Economy as well as Sitra for marketing and communication (OECD 2016b). From originally 17 social enterprises in 2011 there are now 295 companies that carry this label, indicating a success.

3.5.3 Learnings for Germany

Social Innovation in Finland, as in Portugal, underlines the importance of a persistent policy as support mechanism. Another success factor can be seen in the cooperation of people between the different organisations mentioned, which share the same objective – which in turn can be viewed as rendering the NIS much more effective.

However, there is a tendency towards a lack of cultural debates due to the size of the country. This lack of diversified thinking can be problematic because only adapting societies will prosper. With Business Finland and its new international strategy, Sitra, a future committee in the parliament and a national foresight network, there is an attempt toward a future orientation that tries to do exactly that. Although crises offer a "window of opportunity", the general goal is to proactively initiate a structural change, for which foresight is essential.

3.6 Comparative analysis

While this study has been written, the German federal government published the first German national strategy for social innovation and social enterprises (public interest enterprises = "gemeinwohlorientierte

Unternehmen"). When the strategy was launched, it was mentioned that Portugal served as an inspiring example for the strategy and policy developments in Germany. Moreover, the strategy gives a detailed overview on the policy mix in place in Germany and some planned policy initiatives, in order to create more favourable framework conditions for social innovation and social enterprises in Germany. In the phase of strategy development, many stakeholders could engage in the process. Hence, there are overall positive reactions to the strategy from different stakeholder groups.

Inspirational learnings for Germany from these four brief and rough sketches of social innovation policies can only be drawn in a granular way and with a future-oriented perspective on what might or could be expected from a national SI strategy and a coherent policy approach.

- Following the experience of Portugal, establishing a policy approach for social innovation by way of launching a national SI strategy seems promising. There, the strategic approach has paved a way for a continued government focus on SI, which also survived major changes in government composition after national elections.
- The German SI strategy focuses on social enterprises and on value creation from social innovation. With this approach, Germany follows a similar path and rationale like Portugal and Finland. As not all SI are creating economic impacts, it is nevertheless important to acknowledge the variety of SI and to establish an ecosystem for other types of social innovation that could create positive externalities.
- The UK and Dutch approaches shed light on the potentially inclusivity-enhancing effects of social innovation and other social benefits, although in very different policy contexts, which are both not comparable to the German situation (reduced state action in the UK and 'polder model' in the Netherlands). What these approaches have in common (as well as Portugal and Finland) is the acknowledgement of the place-based nature of social innovation and the need to acknowledge the challenges of the generalisation processes, when the knowledge is appropriated to other social and local contexts.
- Although we tried to categorise the four cases along the three contexts of social innovation for societal transformation as the conceptual backbone of this study, we find them rather implicitly represented by the cases, except for the case of crises. Portugal builds its rationale for SI policies on the experience of the financial crisis of 2009/10, and the Netherlands' approach to SI, at least historically, refers to pressing social crises resulting in poverty and homelessness.
- The challenge of emerging technologies and how they might be framed by social innovation is somehow relevant in the context of digitalisation, for example in the Netherlands and in Finland. While there is an acknowledgement in these countries – and now also in Germany – that technological innovation should go hand in hand with social innovation, it is less clear how this could be supported by a favourable framework, which also fosters the necessary institutional changes. The decision of the German federal ministry for Education and Research to open its research funding programmes to different types of innovations should be evaluated in due course to see whether it can act as a lever for new R&I projects with a more integrated and transdisciplinary character.
- Despite the turn towards more directional R&I policies for sustainability in many countries, it seems there is so far less experience in leveraging the potential of SI for transformative (system) change. In the case of Finland, the turn towards a broad institutionalised foresight approach might offer space for reflections about major transitions involving a large number of stakeholders. It is one of the few, but major criticisms of the new German SI strategy that it underestimates the transformative power of SI and the value of participatory and collaborative approaches to transitions.
- All countries studied have tried out new organisational arrangements or reformed the set of national agencies, which fund and support R&I. This has various consequences for unleashing the potential of SI, as the cases show. For the discussion in Germany on the governance and reform of R&I funding in order to facilitate transformative or mission-oriented policies, the implications for the role of SI should be considered more seriously.

CHAPTER 5: SOCIAL INNOVATION MEASUREMENT

By Liu Shi, Knut Blind, Stephanie Daimer, Matthias Weber, Attila Havas, Doris Schartinger

1 INTRODUCTION

In previous chapters, we have introduced the concept and theoretical model of SI with an emphasis on the generalization process and the transformative role of SI in the broader socio-technical system (Chapter 2, and conducted multiple case studies on the workings of SI and policy implications (Chapter 3)), and identified various failures as justification for policy intervention (Chapter 4). Social innovation as a research field is arguably nascent and diffuse. Against a plethora of conceptual and theoretical developments in SI research is the under-development of SI measurement towards valid empirical study, especially to operationalize and capture SI across different socio-economic and political contexts (Krlev and Terstriep 2022). Though there has been a growing body of studies dedicated to developing workable SI indicators, our review of this line of research indicates that so far these efforts are largely exploratory, experimental and fragmented. The fact that SI is understood, operationalized and measured differently poses challenges to developing and testing theoretical propositions regarding important questions associated with SI. It is thus the objective of this chapter to review the state-of-art of SI indicators and measurement in academic literature and research projects (Havas 2016; Mulgan et al. 2023; Terstriep et al. 2021; Unceta et al. 2016), assess the accomplishments and deficits in measurement attempts to date, derive some first insights on the workings of SI in different geographical contexts, and propose fruitful directions for future research.

The "methodology" of this review and assessment is not a systematic literature review *per se*, nor do we intend to provide an exhaustive list of SI indicators already developed and applied. Instead, we base our review on the synthesis of existing literature, and major projects devoted to SI indicator and measurement, and abstract, analyse and evaluate available methodological approaches. In our endeavour, we do not examine SI indicators in isolation, but relate these diverse measurements and indicators to the implicit or explicit conceptual underpinnings of SI, attached to the indicator system, and draw attention to the context by which indicators are designed and applied.

Through the review, we find that there is a growing body of work carried out to operationalize, capture and compare SI, which clusters into three broad methodological approaches:

- the broad "input" approach, including the conventional factor endowments as the input of innovation (finance, workforce, etc.), and the framework conditions and capacities that are conducive to SI;
- the "throughput" approach, i.e., a focus on the process and activities of SI, for example, SI projects and initiatives; and
- the effect or the broad "output approach", including the conventional output of innovation activities such as products and services, but more importantly, the impact, social value creation and wider societal outcome of SI.

Following this review at the general level, we also clarify the level and unit of analysis covered by major SI measurement projects. Further, we derive insights from two relatively comprehensive and mature datasets: SI-DRIVE and ESID, to show, partially, what such datasets hold to offer for rigid empirical analysis given their status quo.

We argue in this chapter that although researchers commonly recognize the non-linearity of SI and stress the systemic character, concrete indicators (and indicator systems) have largely failed to capture these dimensions, and proposed methodological frameworks have not been concretized and operationalized. Some attempts to characterize the inner working of SI activities, practices and initiatives, are limited to the mapping of state-of-art of SI, on the global level. In sum, almost none of the existing approaches have been well developed or positioned to enable robust empirical analysis and international comparison.

This review chapter proceeds as follows. Section 2 presents the major methodological approaches to measure SI so far, with reference to important research projects, mostly EU-funded or BMBF-funded in Germany. Section 3 pins down the levels of analysis of afore-mentioned approaches and projects. Section 4 takes a closer look at SI datasets and presents some selected findings from SI-DRIVE and ESID data. Section 5 summarizes the core insights from the review and presents our assessments, and section 5.6 closes with several guiding principles for the outlook of potentially successful SI indicators and suggests future directions of research.

2 METHODOLOGICAL APPROACHES TO SI INDICATOR AND MEASUREMENT: A CRITICAL REVIEW

2.1 Measurement of innovation

2.1.1 Technology-based measurements

"Traditional" innovation indicators, i.e., those focusing on profit-oriented (business) innovation, are well developed (Dziallas and Blind 2019). Single or composite indicators can be widely seen in cross-country statistics, for example, in the *European Innovation Scoreboard (EIS)*, *Summary Innovation Index (SII)*, *Global Innovation Index (GII)*, *International Innovation Index (III)*, to name a few (Mihci 2019). However, these portfolios of indicators are overwhelmingly dependent on R&D, publications and patenting activities, which are inadequate to capture social innovations. The reasons are threefold. First, a fundamental problem is that the embedded and tacit nature of knowledge and learning (Senker 1995; Tsoukas 2005) in social innovation is not well reflected in these "traditional" indicators. Second, either input measurement of innovation (R&D, investment, etc.), throughput (patents) or output measurement of innovation (products) assumes a linear model of innovation, while the innovation activity itself remains a black box. Third, taking a step back to look at these measurements, there has been no measurement on investment in social innovation that can be differentiated from other investments (e.g., public expenditure on social welfare). Therefore, these indicators can only apply to a limited range of actors in the SI ecosystem, particularly enterprises that provide goods and services at least partly serving societal purposes, or social enterprises. Other actors, such as NGOs, cooperatives, grassroots movements and so on, are important knowledge providers and resource orchestrators, but largely ignored in conventional innovation measurement and statistics.

2.1.2 Measurements beyond profit-oriented (business) innovation

The third edition of the Oslo Manual provides a holistic definition of innovation that incorporates both technological (goods, production process) and non-technological (organizational, financial, marketing, managerial, marketing, and business model) innovation (OECD and Eurostat 2005). Its most recent fourth edition further mentions social innovation as "defined by their (social) objectives to improve the welfare of individuals or communities" (OECD and Eurostat 2018). These non-technological aspects of innovation and diverse actors involved resonate with the conceptual peculiarity of SI. According to the typology of social innovation developed in Chapter 2 of the report, and because of the multi-dimensionality of (Nicholls et al. 2015a), indicators of SI should account for participation, behaviours, procedures, as well as products, services, processes, organization, either among social enterprises or beyond (Djellal and Gallouj 2012). Such expanded understanding of innovation hence raises challenges to the pressing task of SI measurement. However, such dedicated conceptual framework is still nascent in its development, and operationalization, measurement and empirical studies specific to SI have been under-developed so far.

2.1.3 Tacit knowledge and the DUI mode of innovation

An approach informed by the expanded and holistic understanding of innovation is the differentiation between two innovation modes, i.e., scientific and technologically based innovation (STI) and the mode based on learning by doing, using and interacting (DUI) (Jensen et al. 2007). The latter touches on the non-technological facet of innovation and stresses the importance of practices, interaction and exchanges that generate synergetic knowledge. It is hence particularly relevant to SI in this regard, although this conceptual framework has been devised to analyse business innovations. for example, the study of innovation activities among small- and medium-sized enterprises (SMEs) due to their relatively limited possibility to rely on an internal R&D unit compared to large firms (Hervas-Oliver et al. 2021; Parrilli et al. 2023). We do see exploratory steps taken to develop a set of SI indicators based on qualitative data drawn from interviews. For example, the InDUI project developed 47 indicators to capture DUI innovation activities that characterize SMEs in the regions of south Lower-Saxony, metropolitan Hanover and Erfurt/Weimar/Jena in Germany (Alhusen et al. 2019; Thomä 2017; Thomä and Zimmermann 2019). This forms a preparatory step towards the development and design of large-scale surveys. However, while the focus on non-technological innovation activities is relevant, it is not specifically designed to study SI, not to mention the context-specific characteristics of this qualitative data. The conceptual potential indicated by the DUI mode of innovation is yet to be explored and exploited by SI researchers.

2.2 Conditions of SI

Another methodological approach to measure SI is the focus on framework conditions of SI. It targets the favourable conditions that generate or are conducive of social innovation, as seen in the SI DRIVE and IndiSI (and IndiSI +) projects (for a detailed introduction of the projects and their ideas see Section 2.6). For example, the IndiSI project (based on the SI-DRIVE project) includes regional framework condition as one of the three conceptual pillars of its SI model. In the model, regional framework conditions are interpreted as consisting of three elements: a) the awareness of the need to act on social challenges, b) the intention to act on those challenges, and c) the ability, i.e., the capacity to act on those challenges. These three elements are interconnected. Based on such conceptual framework, the project team measures these three dimensions using a tailored set of indicators that builds on a wide variety of previous surveys.[38]

2.3 Capacity of SI

Similar to the condition approach is the capacity approach, which identifies and assesses a portfolio of capacity, understood as the potential, that breeds and supports the emergence of SI in certain socio-economic contexts. Drawing from innovation studies literature, innovation capacity is defined as the ability, resources and skills, etc., that produce and exploit new products, services or processes (ways of doing things) over long periods of time by an innovation entity at certain level of analysis (Brix 2019; Furman et al. 2002; Prajogo and Ahmed 2006).

One prominent example of measuring SI from a capacity perspective is the *Regional Social Innovation Index (RESINDEX)* project carried out by the Basque Innovation Agency (BIA). The approach was focused on *agents* of innovation - businesses, non-profit organizations, universities and technological centres, whose *absorptive capacity*, both potential and actual, determined the level of social innovation at the regional and organizational level. The project conducted surveys to collect data on the correspondingly constructed systematic indicators. As a pilot project, RESINDEX is only experimental. The project results elicited some interesting facts in a particular geographical location (Spain), but whether the methodological framework is generalizable remains to be tested.

Another notable project focusing on the "potential" of SI is the model of "*social innovation regime*" (Unceta et al. 2022). The central concept is "vulnerability", with the hypothesis that the more a region is vulnerable, the greater possibility of emergence of SIs there is. The concept of "regional vulnerability" is further disaggregated into four aspects, i.e., social, economic, institutional, and environmental vulnerability. However, this project did not lay out concrete SI measurements, but instead proposed a methodological framework that provided alternative understanding of (regional) SI capacity and guided the design of operationalized indicators.

2.4 SI activities from a "throughput" perspective

A strand of literature observes and measures SI from a "throughput" perspective, i.e., the activities and processes of SI, at least as claimed in the research agenda. The unit of analysis is often a certain SI-related or SI-specific project, initiative, and case, where different types of activities (social entrepreneurship), actors, networks and learning behaviours together form an integral part of this model. The "Social Innovation - Driving Force of Social Change" (SI-DRIVE) project is representative of this approach. Before setting out for the exercise of EU and global level of SI mapping, the authors propose an SI conceptual and theoretical paradigm that elaborates on "five key dimensions of social innovation that fundamentally affect the potential of social innovations, their scope, and their impact"[39] (Figure 5.1). The conceptual foundation of empirically tested SI is therefore understood as "a means to empower people, reduce poverty gaps and influence ongoing societal changes toward smart, sustainable and inclusive growth" (Silander 2019). From this angle, the SI-DRIVE project can be also viewed as an attempt to develop a systematic methodological framework to measure SI (section 2.6).

Following the conceptual and methodological framework, the SI-DRIVE project has the merit of capturing the inner workings of SI, as well as multiple facets surrounding SI such as governance frameworks, process dynamics, and the conditions and barriers of SI generalization that bear important policy implications. The

[38] To view the survey and results, please visit: https://www.si-metrics.eu/media/d2.2_regionale_innovationskapazitaeten.pdf
[39] Source: https://www.si-drive.eu/concepts/

output of the project features two empirical phases. The first empirical phase, baseline mapping, consists of a database of 1,000+ SI cases globally. The second empirical phase is a further multiple, in-depth case study on 82 SI cases, which, adopting a mixed method approach, uncovers the dynamic interrelation between social innovation, the practice field and various mechanisms of social change. These efforts result partly in the interactive *Social Innovation Atlas* as illustrated below (Figure 5.2), and a variety of reports on key dimensions of SI. Despite these strengths, such as wide-coverage, richness and attention to dynamics and contexts, the information-provision and data visualization of worldwide SI initiatives makes itself more of a mapping exercise by nature, as it claims, than concrete measurement that enables meaningful international comparison and guides empirical analysis. SI indicator projects adopting a multi-dimensional and holistic understanding of SI suffers from the similar problem that systemic indicators such as in TEPSIE do (Section 2.6).

Figure 5.1: The conceptual and theoretical framework of the SI-DRIVE project (Source: SI-DRIVE)

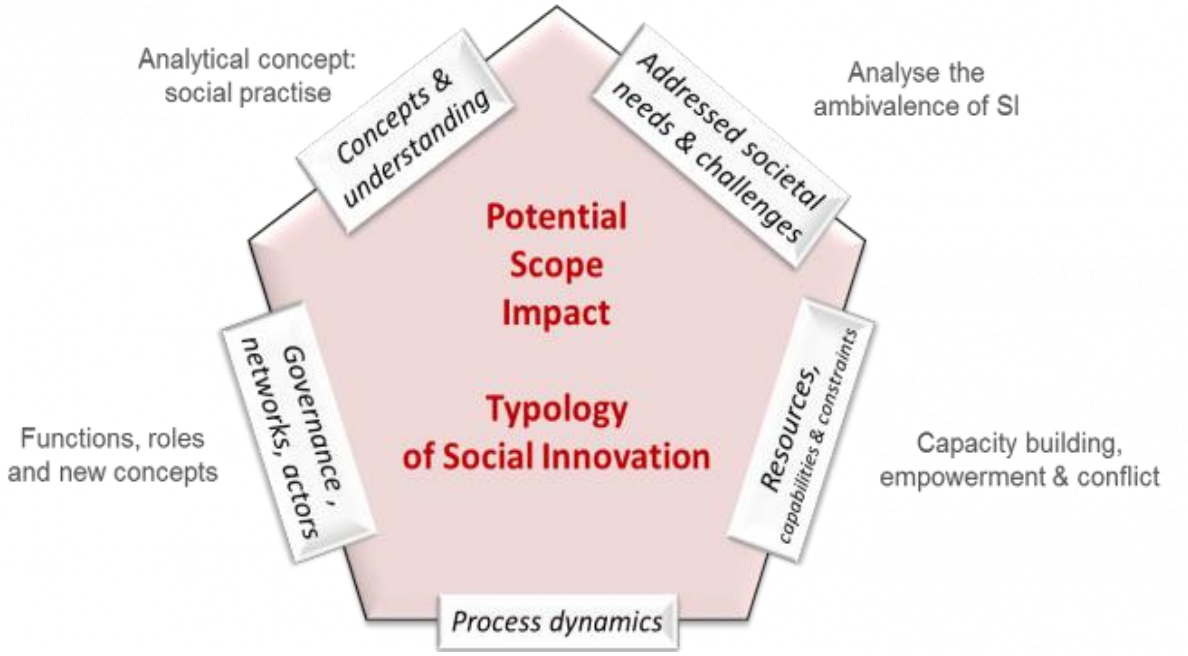
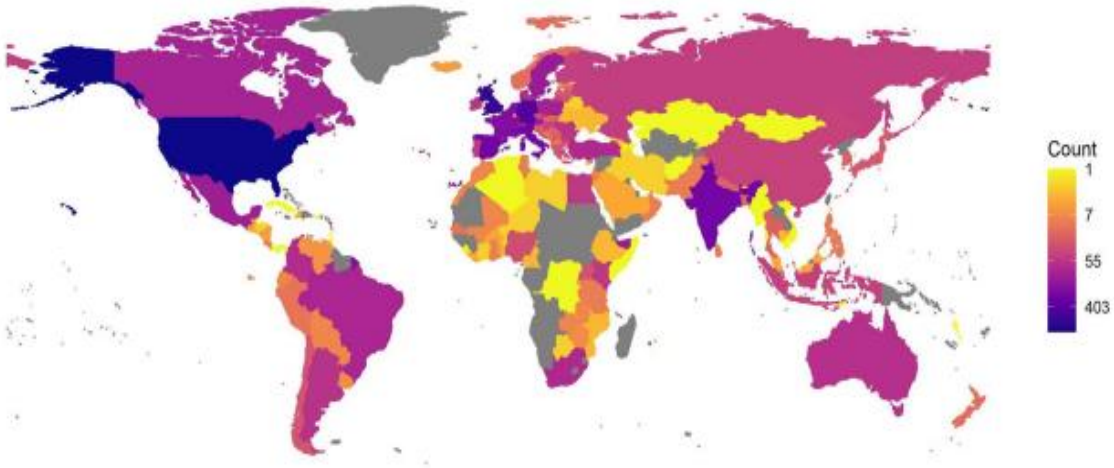


Figure 5.2: A snapshot of the SI Atlas from the SI-DRIVE project (Source: SI-DRIVE)[40]

[40] In the snapshot, the number refers to SI initiatives in a geographical location.

Another notable effort in SI measurement with a global coverage of SI projects is the building of the European Social Innovation Database (ESID) project by Gök and colleagues (Gök et al. 2022). Understanding SI broadly as "technological and non-technological new products, services or models that simultaneously meet social needs and create social relationships or collaborations" (European Commission et al. 2011), the authors do not adopt a single existing definition of SI, but drawn on a multitude of concepts and definitions from the literature, which helps ensure that a broad scope of possible manifestations of social innovations is captured. Ultimately, they incorporate four aspects or dimensions of definitions from the literature: a) objectives; b) actors and interaction; c) output and outcomes; and d) innovativeness. Again, this in a sense reflects the systemic understanding of SI in its eclectic and flexible conceptual framework. The authors collect information on these four elements in SI projects worldwide and develop a dataset. Features such as SI dimensions (as mentioned above), project locations, summaries, and topics, etc., are extracted using advanced machine learning techniques. The ESID project dataset includes 11,468 projects from 159 countries (Gök et al. 2022)., and a snapshot of geographical coverage of SI projects and the frequency is presented below (Figure 5.3). "Positive" projects with most information account for 6,640 in total. Despite a clear unit of analysis at the project level and wide coverage, this is not necessarily suitable for cross-country comparison, because the concrete indicators are highly contextualized in the country where SI projects operate, and the different temporality of SI projects included in the dataset. Moreover, the identification and selection of projects cannot claim to be representative of the total population of SI activities in a country.

Figure 5.3: Geographical score of SI projects worldwide in the ESID project



Source: Gök et al.(2022)

These two projects to some extent reflect the paradoxical situation of attempts to capture SI based on a systemic understanding of SI and a focus on SI activities. The theoretical underpinning is undoubtedly legitimate, yet the very process of SI is still missing in the data and remains as a black-box, despite efforts to characterize actors and their interactions, governance, and resources and capabilities. In addition, the more a measurement attempt goes in-depth into the inner-working of SI, the more challenging for this data to be structured and quantified for analytical purposes, which makes the alleged "measurement" objective to some extent reduced to mapping exercise. However, secondary analytical efforts can build on these mapping exercise, and SI-DRIVE and ESID project represent two distinct solutions ensuing "mapping": SI-DRIVE's second empirical phase conducts in-depth case studies to unpack interactions and mechanisms, with a clear foresight and policy orientation; ESID, instead, develops a method to calculate SI scores in order to let the data tell something statistical about SI project characteristics in different region and countries and concerning different sectors. In either case, strictly speaking, "mapping" does not constitute measurement, but a compilation of the state-of-art of SI practices subject to change over time. Secondary research effort based on first-order mapping strives to yield certain analytical results, whereas because the data collection does not guarantee representativeness of the sample, the empirical part suffers from a generalization problem that could not be resolved by these projects alone in their current shape.

2.5 Social value, impact, and outcomes

Apart from assessing the conditions or capacity for SI generation, or the "throughput" activities, another line of methodological effort focuses on the broad effect of SI, including its output, impact, outcome, and its value creation role in society. Output refers to the immediate result from SI, e.g., the provision of products and services, or the creation of social enterprises. This is partly captured by some conventional innovation indicators, or sometimes understood as the "activities" of SI. All other three aspects, i.e., social value creation, impact, and outcome, look beyond the immediate result of SI activities and explore the broader, direct and indirect consequences of SI and its output. Outcomes normally refer to effects on the target group, whereas impacts refer to effects on wider society. The assessment of social value creation covers both aspects depending on the specific research question asked in the impact assessment.

The approach of impact assessment of SI initiatives are well-established based on the broader impact assessment methodological design. A study carried out by Eurodiacona (2012) is dedicated to SI value measurement that is intended to be applied by organizations. It follows a definition of social value that refers to wider non-financial impacts of programs, organizations, and interventions, including the wellbeing of individuals and communities, social capital and the environment. The measurement of these aspects is driven by the impulse to evaluate cost efficiency against scarce financial resources. There are several mature and widely adopted approaches to calculate and measure the value of SI, with predominant models including: cost-benefit analysis (CBA) as a technique used to inform decision-making, social accounting that is often used in corporate social responsibility (CSR), social return of investment (SROI) mostly for funders from public and private sectors, and basic efficiency resources (BER) analysis as a simple cost effective framework for evaluating complex programs piloted by Oxfam GB (Mulgan 2010).

Some social innovation scholars do not assess the societal outcome of SI following the impact assessment tradition but attempt to explore the theoretical base for measuring the value of SI. With a focus on sustainability, Dainienė and Dagilienė (2015) review the existing conceptual and methodological literature and draw our attention to the social, economic, and environmental dimensions of SI. In doing so, they put forward the triple bottom line (TBL) approach as a guiding framework to identify SI indicators. While this is allegedly useful for evaluating the role of organizations in creating societal value from a comparative perspective, the temporary absence of indicators prevents the framework from being empirically verified and utilized to further our understanding of the value of SI. By contrast, research on social value creation forms a distinctive body of literature (Kroeger and Weber 2014). Often discussed in development studies, social value encompasses dimensions including financial, reputational, ethical value, as well as consumer surplus, positive externalities, and the enhancement of human capabilities (Auerswald 2009). However, when it comes to indicators and measurement, it seems that they eventually boil down to social impact assessment methodologies (Mulloth and Rumi 2022).

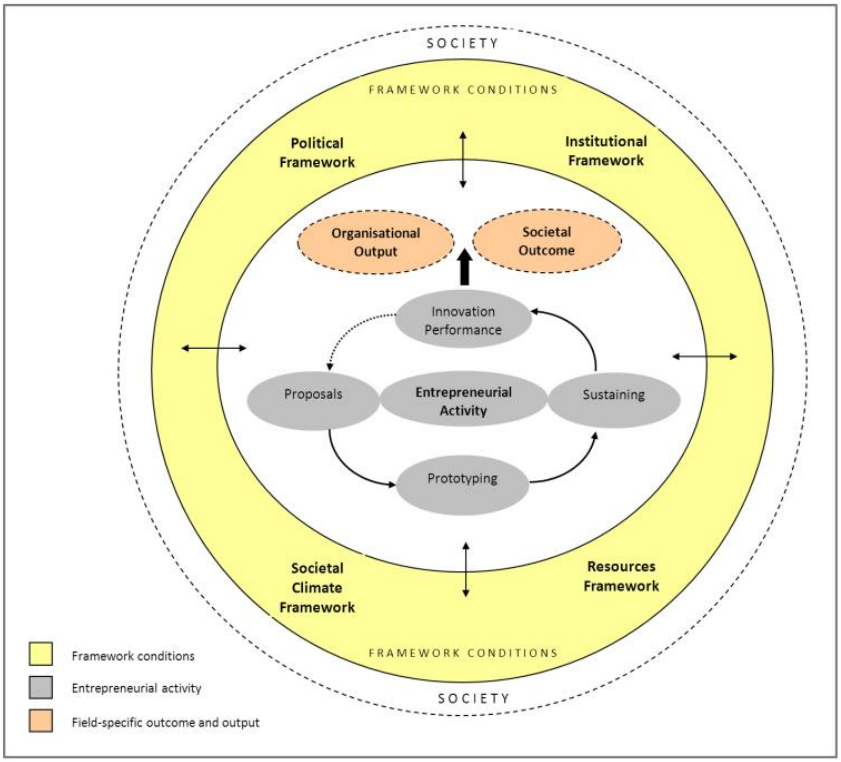
These diverse "output" approaches so far have not explicitly addressed the transformative capacity of SI, i.e., its role in the transformation of socio-technical systems, although some selected aspects are studied in empirical literature under the label of impact and societal outcome. Existing measurement approaches have not systematically considered and exploited the SI - transformation linkage, with only very few exceptions (the SI-DRIVE project is aware of transformative capacity, but it is more of a conceptual framework than concrete measurement). Transformative social innovation literature points out transformative learning and (dis-)empowerment as two critical mechanisms of change (Avelino et al. 2019; Yee et al. 2019), which are neglected in the design of SI indicators or methodological frameworks so far. Moreover, those impact-based approaches, while aware of the economic, social, and environmental consequences, fail to address the "generalization" of SI in its transformative role. The evolutionary, qualitative change process is not well reflected in existing technical-economic and rationalized assessment.

2.6 Integrated, systematic and comprehensive SI measurement

The last category of methodological approach to SI measurement is an indicator system that attempts to overcome the deficits involved in more conventional SI indicators (linearity, partiality, etc.) and hence develops a comprehensive conceptual framework, methodological principles, tools, and portfolio of indicators that provide an over-arching architecture for measurement of SI. The most prominent example is the *TEPSIE* (Theoretical, Empirical and Policy Foundations for Social Innovation in Europe) project funded by the 7th Framework program for research and innovation of the European Union (Tepsie 2014). The indicator system

integrates three important dimensions about SI (Figure 5.4): a) framework conditions that enable the occurrence of social innovation processes; b) entrepreneurial activities; and c) outputs and societal outcomes (Schmitz et al. 2013). Each of these three dimensions is further decomposed into sub-indicators, eventually totalling over one hundred single indicators.

Figure 5.4: The TEPSIE social innovation framework model



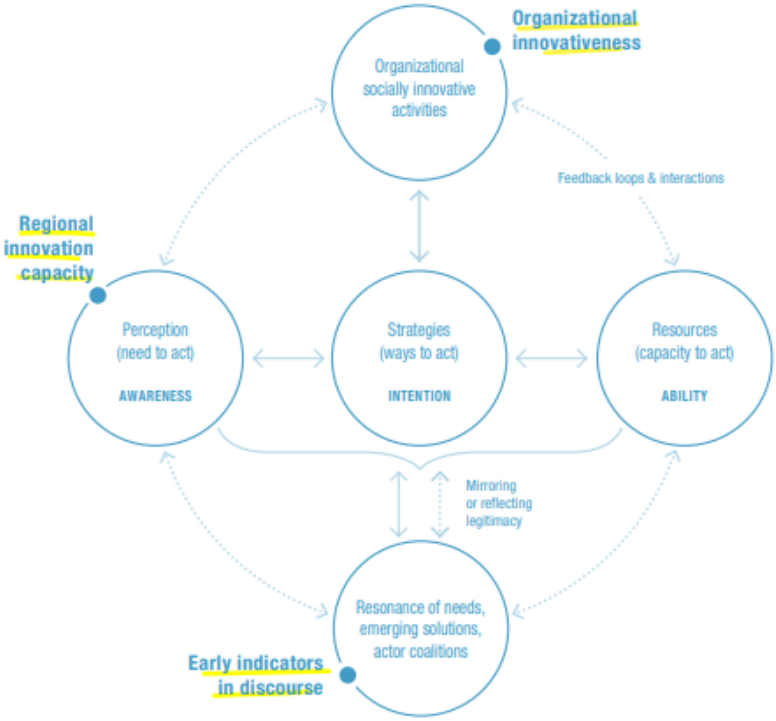
Source: (Schmitz et al. 2013)

Though the indicator system aims to develop an appropriate methodological framework that is distinguishable from profit-oriented (business) innovations, the way that SI is conceptualized still has not broken away from the linear understanding of innovation given its input-activity-output focus despite trying to be comprehensive. Moreover, the indicator system relies on a tremendous number of standalone indicators based on various innovation statistics - including conventional innovation indicators - resembling innovation scoreboards or indices. Hence, it constitutes a more or less mechanical way of integrating SI dimensions, not one that well captures the systematic characteristics and dynamic process of SI.

Based on the methodical setup of the TEPSIE project, another BMBF-funded project, IndiSI (and the IndiSI+ afterwards), a comprehensive indicator set for social innovations is developed and tested in the Rhine-Ruhr pilot region (Figure 5.5). The measurement is related to three sub-sets of indicators: a) organizational socially innovative activities; b) regional innovation capacity and c) resonance. For the first time, this method introduced "resonance" into innovation measurement, which aimed to capture how perceived social needs resonate with other actors, i.e., how awareness about them is raised, how their legitimacy and solution strategies are formed, and how resources for their implementation are mobilized. Social discourses extracted from social media data are therefore used to reflect the perception of social needs and identify proposals for new solutions and actors driving them.[41]

[41] For a detailed description, visit the project website: https://www.si-metrics.eu/en/indisi/.

Figure 5.5: The IndiSI (IndiSI+) conceptual and theoretical framework



Source: (Terstriep and Rehfeld 2022)

2.7 Assessment: Different approaches at different levels of analysis

The measurements and indicators proposed by existing literature and projects point to multiple levels of analysis. In this section we illustrate this characteristic of SI indicators by mapping out major projects according to their coverage of micro, meso and/or macro level of analysis (Table 5.1). By "level of analysis", we refer to both the unit and level at which SI is measured, and that is compared across SI observations. For example, the SI-DRIVE project measures SI using cases and initiatives but aims for global comparison.

Table 5.1: The level of analysis in selected SI measurement projects[42]

	Example projects						
Level of measurement	ISTARI	RESINDEX	Social innovation Regime	SI DRIVE	ESID	TEPSIE	IndiSI
Micro level	x	x		x	x	x	x
Meso level		x				x	x
Macro level			x	x	x	x	x

A simple mapping of existing major SI measurement projects shows that many of them are level-spanning. Micro level measurements are often seen in company- or actor-oriented studies from the "input" or "throughput" perspectives (Tracey and Stott 2017), including both organizations and projects/ initiatives as the unit of measurement. Apart from SI projects above, another example in this category is the approach presented by ISTARI, which captures company-level SI activities using webAI to analyze and evaluate millions of company websites' contents.[43] Meso level measurements frequently consider regions as the unit of analysis, given the exploratory nature of these measurement initiatives and the availability of region-specific data (Castro-Spila et al. 2016). Framework conditions and capacity of the region are considered as important parameters, and the interaction between these meso-level parameters with organizational factors form the core of the model. Macro level measurement often adopts the country as the unit of analysis and comparison, and sometimes incorporates socio-economic conditions as part of the methodological framework. This includes

[42] Authors' compilation from existing project profiles.
[43] https://istari.ai/

both "conventional" index, e.g., the Social Innovation Index (SII) (Nagy and Somosi 2022), and index or indicators constructed using advanced AI-based tools, e.g., the ESID project. It seems that indicators that adopt a systematic and integrated approach to characterize and capture SI are largely associated with multiple-level measurement. Except projects that set out to measure organizational activities or input, most of the other projects span at least two levels, partly because of the systemic characteristics of SI and its broader societal impact within their conceptual frameworks.

It remains an open question whether there is a "best" level of measurement of SI. On the one hand, this depends on the research question and objective of measurement. On the other, while there is no consensus on the optimal level of analysis, SI scholars tend to agree that if a SI study is to include both the private sector and actors in the "third sector" to capture the SI activities, processes and societal outcome, then a higher level of aggregation would be preferred (Krlev et al. 2014). [44]

[44] The problem is that we have different actors involved which makes it difficult to identify the unity of the observation, because neither company nor individuals work, therefore the project level could be appropriate but this data is not collected across countries and in the long-term. This is the challenges faced by the SI-DRIVE and ESID project. Similar problems with user innovation statics exist.

3 INSIGHTS FROM SELECTED SI DATASETS

Given the numerous attempts to define, operationalize and measure SI, a number of indicators and datasets are already available. Despite that there is no lack of publications as output of these projects, their potential for solid empirical analysis remains ambiguous. In this section, we take a closer look at major SI datasets and explore preliminarily to what extent they offer prospect for empirical research. We are aware that these datasets are largely experimental and do not intend to claim statistical representativeness. Hence, we first review the specificity of major SI datasets and evaluate their applicability. Then we conduct some descriptive analysis based on two relatively large, well-developed datasets: SI-DRIVE and ESID. The analysis shows the status quo of what is available in the datasets and what they stand to offer, and it provides some first insights on the distribution and characterization of SI initiatives worldwide. The descriptive analysis that follows will demonstrate a gap in SI indicators and datasets that limits empirical research on SI, especially quantitative studies based on large-scale datasets.

3.1 A content review of major SI-focused datasets

This subsection provides a critical review of major SI datasets that are part of the result of the aforementioned research projects to develop methodological frameworks and indicator (systems) to capture and measure SI. We are interested in the definition of SI adopted in each dataset which reflects a particular conceptual underpinning, what is available about SI measurement in the dataset, and the potential caveats when considering data analysis. All information is compiled from the official website of each dataset, its project website, code manual (if available) and publications from the projects (Table 5.2). Where available, the web link to each dataset and related materials are provided in the table as well.

Table 5.2: The content review of major SI datasets[45]

Project/ database	Data source	Understanding of SI	Main assets of the dataset	Critical assessment
ESID	The project and dataset: https://rcf.risis2.eu/dataset/13/metadata The interactive map: https://esid.shinyapps.io/ESID/ The link to part of the raw data: https://figshare.com/articles/dataset/ESID/19583299	Social innovation is widely defined as technological and non-technological new products, services or models that simultaneously meet social needs and create new social relationships or collaborations. It does not claim a particular definition but insists on the diversity of SI definitions and criteria.	The project uses advanced machine learning techniques to extract features such as social innovation dimensions, project locations, summaries, and topics, among others. It covers currently includes 11,468 projects from 159 countries. ESID data is available freely and also presented in a web-based app.	The project-based focus of SI measurement following consistent methodologies has the potential to provide comparative insights. However, the timeframe of the projects is limited, and cross-country comparison of SI projects does not mean comparison of SI.
SI-DRIVE	The project: https://www.si-drive.eu/ The database: https://mapping.si-drive.archiv.zsi.at/	Its working definition: SI is a new combination or figuration of practices in areas of social action, prompted by certain actors or constellations of actors with the goal of better coping with needs and problems than is possible by use of existing practices.	The database, Atlas of Social Innovation, features a collection of 1,005 SI cases (project or initiative and related social practice field) worldwide. The data was collected in 2015/16 utilizing an online questionnaire of a set of 50 open ended and standardized questions, mainly structured by the key dimensions. Overall, the cases cover a wide range of policy fields and are concentrated in Europe.	It was not intended to conduct a statistically representative survey. Despite the alleged global coverage, the majority of cases are in Europe. In terms of measurement, the mapping may be biased due to the experts' understanding of social innovation, their knowledge and the dependence of publicly available information on social innovation cases.

[45] Authors' compilation based on open-source data.

IndiSI / IndiSI+	https://www.si-metrics.eu/en/	The research project and dataset emphasize the plurality of SI and actors and interactions. “Social innovation relates to new forms of interaction, cooperation, governance and knowledge generation. Compared to commercial innovation, it comprises a broader variety of actors and hybrid business models.”	A well-defined conceptual framework, with a focus on SI in regions. Indicators and a codebook for three-level measurements (organizational innovativeness, regional innovation capacity, and discourse in social media) are available. Bears policy relevance with regards to mission-oriented innovation policy.	The indicator was developed and tested in the Rhine-Ruhr pilot region, and in the second round, it is projected to expand to more regions. Empirical application is constrained so far, and a region-focus bears limited relevance to international comparison.
TEPSIE	TEPSIE (2014) Social innovation theory and research: a guide for researchers. A deliverable of the project: “The theoretical, empirical and policy foundations for building social innovation in Europe” (TEPSIE), European Commission – 7th Framework Programme, Brussels: European Commission, DG Research	Social innovations are new solutions (products, services, models, markets, processes etc.) that simultaneously meet a social need (more effectively than existing solutions) and lead to new or improved capabilities and relationships and better use of assets and resources. In other words, social innovations are both good for society and enhance society’s capacity to act.	The SI metric for quantitative measurement offers an integrated approach, by measuring the framework conditions, entrepreneurial activities and organizational outputs and societal outcomes. The proposed measurement is at the national level.	The complex, integrated metric system is yet to be empirically applied and tested, and the systematic indicator makes meaningful comparison a challenging task. Though the indicator system is designed at the national level, so far cross-country comparison has been limited.
ISTARI	https://istari.ai/topics/social-innovation/	Social innovations are innovations that improve human interaction in many areas, for example, how people work, organize their leisure time, shop, live or how they are mobile. ISTARI.AI follows the current working definition as it is currently being elaborated by OECD and Eurostat: Social innovation also described as the emergence, implementation and diffusion of new social practices in the societal domain that are directly related to the search for viable and sustainable solutions to societal problems and challenges. If a company has introduced such a social innovation in the last three years through changes in the company or brought it to market as a new or improved product or service, then it is considered a social innovator.	ISTARI uses a traditional company-level indicator based on a questionnaire-based innovation survey (Community Innovation Survey Germany) to train webAI with the websites of socially innovative and non-innovative companies. In doing so, ISTARI uses survey waves from several years to identify companies that answered positively to questions related to social innovation. During this training webAI learns independently how the websites of socially innovative and non-innovative companies differ. After the training, ISTARI applies webAI to any other company website. Based on the textual content, webAI then calculates how likely it is that the company under investigation is innovative.	The approach covers all companies in Germany, which have a web page, i.e., more than one million. The results of webAI are trained by survey data, which is not necessarily focused on social innovation. Furthermore, the attributed probability with which a company should be socially innovative, has not been manually validated.
RESINDEX	https://sinnergiak.org/2014/06/30/resindex-regional-social-innovation-index/?lang=en	“Practical application of ideas for the development of new and improved products, processes, methods and/or services which offer better alternatives to those that	An indicator system is available that focuses on potential and realized capacity of SI agents in regions. This is further composed of more detailed	The indicator system needs more validation, and its complexity makes it challenging to measure and compare. Due to a regional focus, its potential for

		currently exist, for the resolution of social problems structured as unsatisfied social demands in the areas of education, health, employment, culture, environment and/or social services.	indicators. A Social Innovation survey was designed and applied to 282 regional agents in the Basque Autonomous Community, with a confidence level of 95% of the sample.	measurement and comparison at the national level is limited.
Social Innovation Regime	https://sinnergiak.org/2014/06/30/resindex-regional-social-innovation-index/?lang=en	A novel combination of ideas and distinct forms of collaboration that transcends established institutional contexts with the effect of empowering and (re-) engaging vulnerable groups either in the process of social innovation or as a result of it.	Approach social innovation in regions from the perspective of vulnerability. This is discomposed into social, institutional, environmental and economic dimensions, each having possible indicators suggested. It offers a conceptual framework to capture SI at the regional (meso) level.	An indicator system is not maturely developed. A focus on vulnerability is novel but could at the same time be partial. More development in the indicator toward valid measurement is needed. A regional focus constrains its potential for international comparison.
CRISES	https://crises.uqam.ca/anglais/	Intervention initiated by social actors to respond to an aspiration, meet a need, provide a solution or take advantage of an opportunity for action in order to change social relations, transform a framework for action or propose new cultural orientations.	As of January 1, 2021, it has integrated 152 case studies, encompassing 5,109 organizations, 560 territorial frameworks, 3003 collective actions, 164 collective struggles, 198 legal frameworks, 338 public policies, 9619 interactions and 273 social innovations (primarily using interviews and document analysis) Aim of the dataset is to link social innovation with social transformation The dataset has 4 main areas: the interplay between social innovations and social justice in policies and practices, the role of territories and living environments in addressing global challenges, the impact of social and collective organizations on social and environmental justice, and the evolution of work and employment in the face of modern socio-economic shifts.	Data Source Variability: Case studies were conducted using different analytical and conceptual (poor existing theoretical basis of some social concepts) frameworks that evolved over time Data Filtering by Researchers: The data has been selected and filtered based on specific research objectives Limited Generalizability: Due to the non-random sampling and the regional focus on Québec the results from analyses cannot be generalized to all social innovations in Quebec or other foreign regions

The table above shows that these datasets together reflect the state-of-art of SI measurement and indicators as far as data collection is performed or formally considered. Several projects and datasets are case-based and provide a rich stock of information that guides through various SI projects and initiatives. One advantage of this approach is relatively comprehensive information covering actors, interactions, activities, societal outcome, etc., and can also contain valuable contextual knowledge. The caveat lies exactly on the opposite side of the same coin; such an approach makes “measurement” itself very tricky, with data presenting more of a mapping or catalogue of SI activities than of analysable data. Besides, much of data collection is managed by a large project team of a consortium of experts, whose understanding of SI, SI cases and reporting and handling of data may exhibit different degrees of subjectivity. The majority of case-based datasets are limited

in scope and scale and lack representativeness in sampling. Though they have made already remarkable attempts on SI indicators and fulfilled the objectives of the projects, the aforementioned limitations undoubtedly have restricted the add-value for empirical research. Some datasets, such as RESINDEX, may perform well in evaluating the social innovativeness of a selected region, but the conceptual model and methodological framework raises the question of generalizability. Two exceptions in the list are ISTARI and ESID, which adopt techniques of big data analytics to extract large-scale data from various sources. Yet, as the table suggests, the ISTARI dataset does not necessarily focus on social innovation. The ESID dataset is dedicated to measure SI with a focus on SI projects worldwide, but the sample still lacks statistical representativeness, and the treatment of projects may also have problems that will be discussed later.
Still, these datasets are valuable in providing in-depth information on SI within the projects' scope. In the text that follows, we select two well-developed datasets, i.e., SI-DRIVE based on cases, and ESID based on SI projects, and conduct some descriptive analysis based on open accessible data to gain insights on SIs and how the datasets could be potentially for analytical and policy purpose used despite representativeness problem with the data.

3.2 Insights based on SI-DRIVE project results

The SI-DRIVE dataset consists of information of 1,005 SI cases (projects or initiatives related to social practice) worldwide, with a focus on Europe. It builds on a consistent and comprehensive working definition of SI as "a new combination or figuration of practices in areas of social action, prompted by certain actors or constellations of actors with the goal of better coping with needs and problems than is possible by use of existing practices. An innovation is therefore social to the extent that it varies social action, and is socially accepted and diffused in society (be it throughout society, larger parts, or only in certain societal sub-areas affected)" (Dhondt and Oeij 2014, p. 122). This definition and the associated theoretical framework guide the methodological design of the SI mapping and subsequent in-depth case analysis.
While the SI-DRIVE case dataset does not intend to provide representative statistics for international comparison, the data on the seven policy fields in the focus of SI-DRIVE offers an avenue to develop useful insights on barriers, motivations, governance frameworks, and performance of SI among those cases. The seven policy fields are: education, employment, energy supply, environment, health, poverty and transport. These include conventional fields of long-lasting voids (e.g., poverty), fields of public goods nature (e.g., education), as well as those relating to "grand challenges" (such as energy and environment). Each of these policy fields is further sub-divided into several (social) practice fields, which provide a direct link to the definition of social innovation as cited above. We now present selected results of a descriptive analysis regarding SI initiatives in the seven policy fields carried out during the project lifetime 2014-2017.

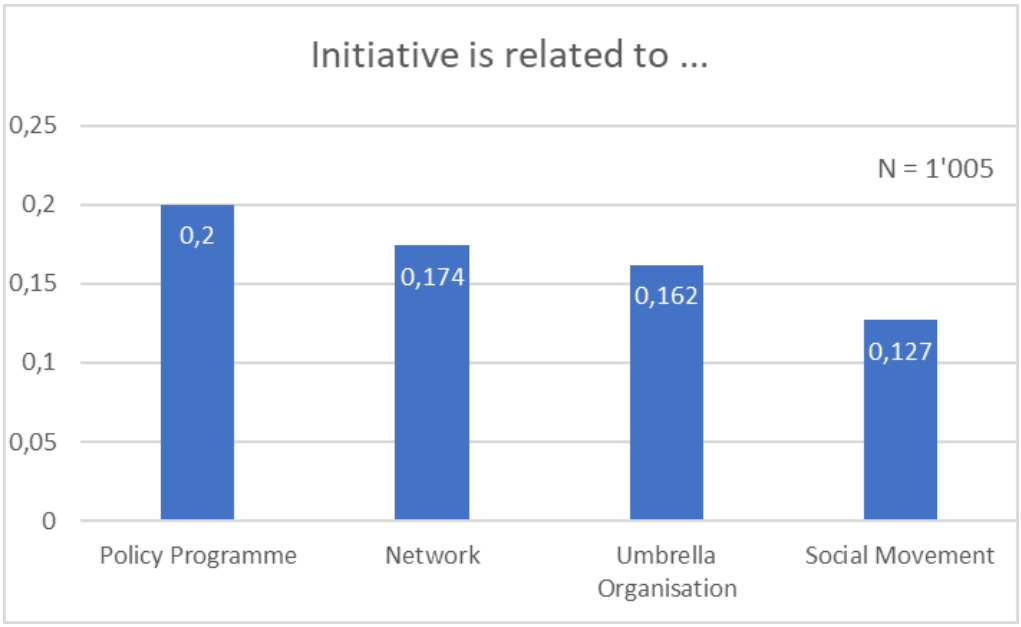
1) Governance framework

The 1,005 initiatives relate to various governance frameworks in terms of the major sector undertaking the initiative, and the organizational format. Four types of governance frameworks are differentiated:

- policy programs, implemented by a public body and combining/coordinating several policy actions for achieving a specific policy objective
- networks, which can be informal or formal and consist of several independent individuals, groups or organisations, which cooperate on a common issue.
- umbrella organization, is a formal association of thematically/functionally related organisations, who become members of the umbrella organisations to advocate a common interest
- social movements, large groupings of individuals and organisations, which focus on specific political or social issues

The summary of the statistics (Figure 5.6) indicates that the four types of governance frameworks are distributed relatively evenly among the collected SI initiatives. However, it can still be seen that SI projects undertaken as policy program or networks exceeds those as social movements. To some extent this shows that, as far as it concerns the SI initiatives included in the dataset, the public, formal sector plays a more pronounced role than the societal, informal sector, despite the latter is unneglectable.

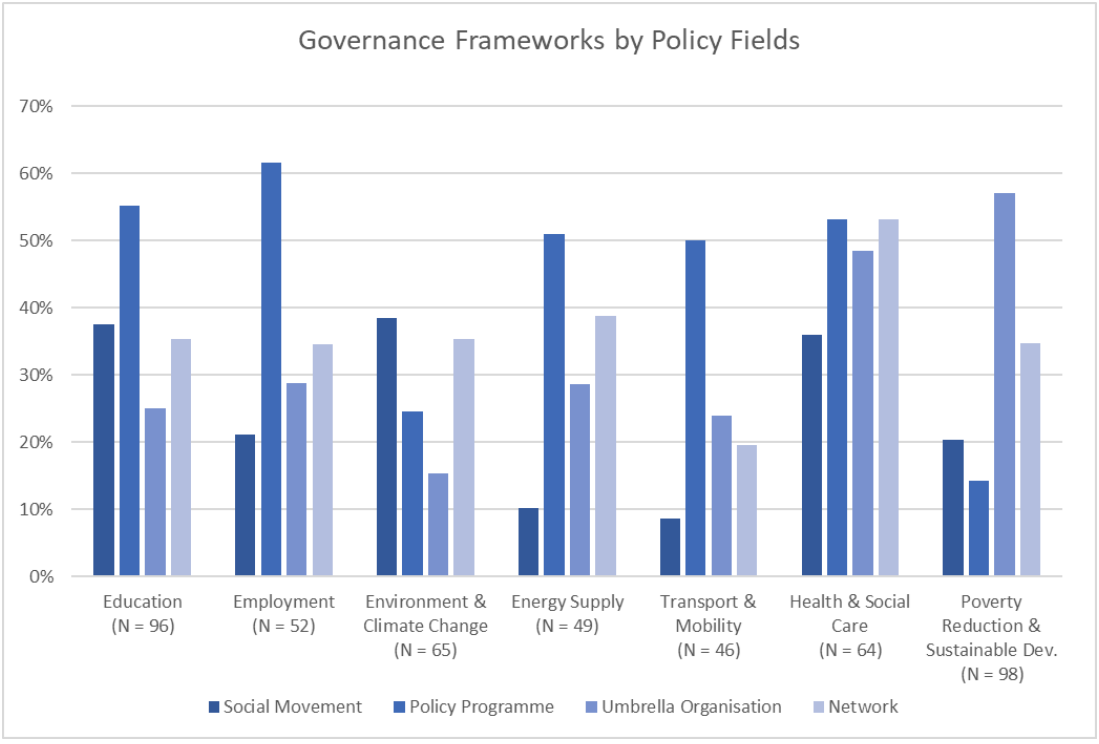
Figure 5.6: Governance frameworks of SI initiatives, difference to 100% due to non-availability of data



Source: SI-DRIVE

Switching to the broken-down statistics by policy fields (Figure 5.7), this is again apparent in realms of education, employment, energy supply, transport & mobility, areas of public goods nature and conventional targets of policy intervention and regulations by the public sector. Notably, in the field of environment and climate change, social movement and network formats of governance framework dominate, reflecting strong bottom-up, more distributed features and certain scope of collective action in the societal sphere. The health & social care field sees a more equal distribution of all the four types of governance frameworks, and the poverty reduction & sustainable development field instead is overwhelmingly governed by umbrella organizations.

Figure 5.7: Governance frameworks of SI initiatives by policy fields

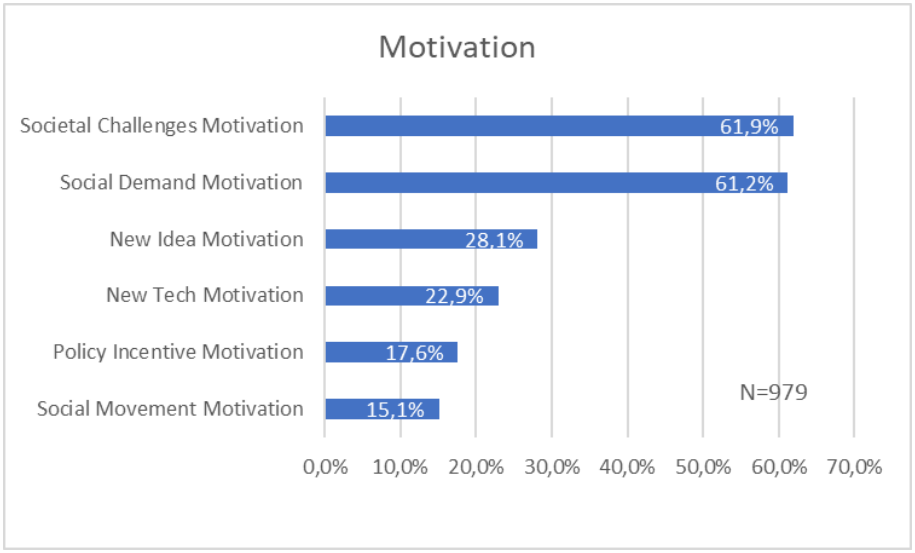


Source: SI-DRIVE

2) Motivations

Among the sample of 979 cases (i.e., valid responses only), the majority of them are societal challenge-led or social demand-driven, representing 61.9% and 61.2 % respectively (Figure 5.8). The motivation for SI initiatives is less driven from the "supply side", with new idea generation and new technology motivation taking up 28.1% and 23% respectively. Public policy also plays an important role, where 17.7% of SI initiatives are motivated by policy incentives to address certain societal voids or meet societal needs. And social movements take up a notable 15.1% share, reflecting again the relevant role of bottom-up initiatives.

Figure 5.8: Motivations of SI initiatives, multiple responses possible

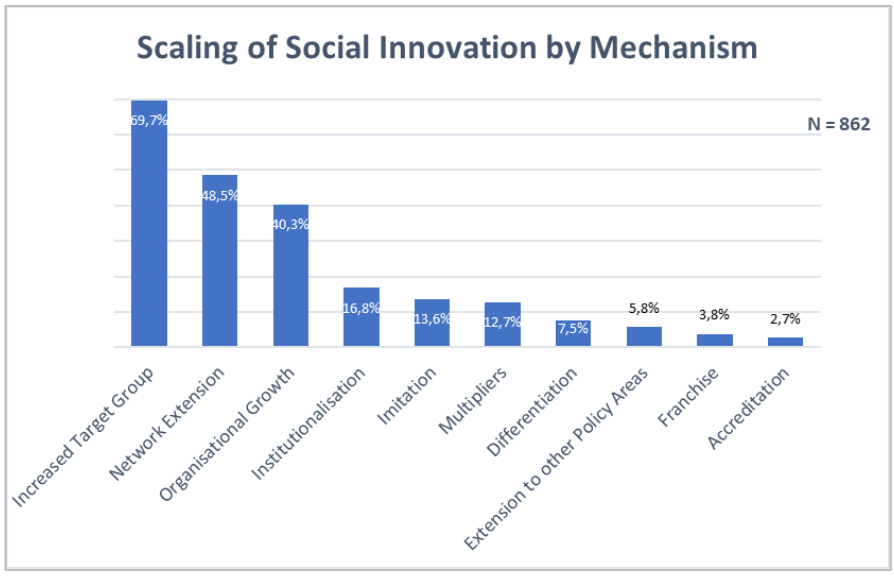


Source: SI-DRIVE

3) Mechanisms of scaling.

A total of 862 cases contains information on the mechanisms of the scaling of SI initiatives in diverse patterns (Figure 5.9). Three mechanisms are dominant: increased target group (69.7%), network extension (48.5%), and organizational growth (40.3%). They are all concerned with the notion of "scale", the expansion of SI initiatives in terms of supply side or demand side, or network mechanisms. More diverse and unconventional mechanisms also exist, for example, through multiplier effect (12.7%), or differentiation (7.5%), but these latter mechanisms are far less frequently seen in the scaling of SI initiatives in their past and current status.

Figure 5.9: Scaling mechanisms of SI initiatives

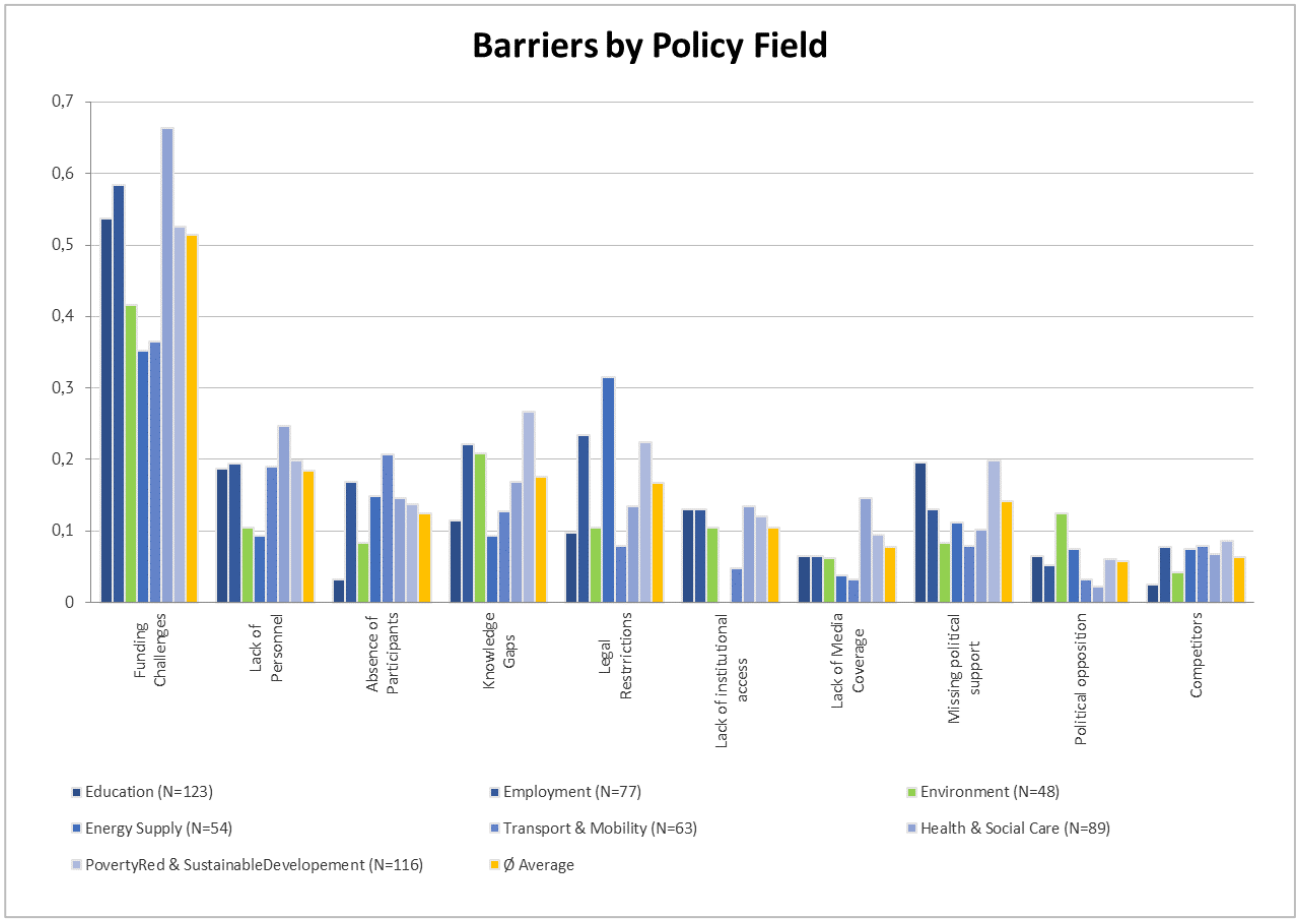


Source: SI-DRIVE

4) Barriers

Experts report a variety of barriers encountered by SI initiatives during their generative and generalisation/scaling phases (Figure 5.10). On average, funding challenges (51.4%) are a major problem afflicting SI initiatives, stressing the criticality of financial resources in supporting SI projects. Other resource or capability gaps are also present, for example, lack of personnel (18.4%) and knowledge gaps (17.5%) figure prominently. These reflect the plurality and multi-dimensionality of resources and capacities required for SI initiatives to be successful. In addition, lack of institutional access (10.5%), missing political support (14.2%) and presence of legal restrictions (16.7%) pose considerable challenges to SI initiatives, which necessitate efforts in the SI ecosystem to create a more benign legal, regulatory, political and institutional environment for SI.

Figure 5.10: Barriers to SI initiatives by policy fields



Source: SI-DRIVE

3.3 Insights based on ESID project and dataset

The ESID dataset was initially created and developed as part of EU-funded project named KNOWMAK and further developed as part of the EU-funded RISIS 2 project. The ESID dataset is built on numerous existing datasets on SI, including SI-DRIVE, and lots of other data, and operates based on a robust search algorithm to further collect large-scale data from online sources. It departs from existing datasets by offering a thematically more comprehensive, large-scale dataset on SI that is conceptually consistent and methodologically sustainable, without relying on human input. Its wide coverage (11, 468 projects from 159 countries) allows for certain degree of comparison. However, we are aware that these SI projects do not provide a representative statistic of the SI activities and dynamics in a country. Besides, the different project time frames may also affect statistical analysis. Therefore, in this section we perform some descriptive analysis based on the resource portfolio provided by the ESID project to gain insights on how the dataset promises to offer, and how SI and its multiple features are present in different parts of the world and across different topics, keeping in mind that these insights do not lead to robust statistical inference.

1) Key Enabling Technologies and Societal Grand Challenges

In terms of topics related to observed SI projects, Gök and Antai 2021) make a distinction between those concerning key enabling technologies (KETs) and societal grand challenges (SGCs). KETs further consist of technological fields such as nanoscience, biotech and so on, and SGCs further consist of fields such as health, transport, etc., to some extent similar to the seven SI-DRIVE policy fields. ESID project counts by this two-level topic system are shown in the table (5.3) below:

Table 5.3: Key Enabling Technologies and Societal Grand Challenges in ESID

	Topics	Frequency counts	
		Full Dataset	Curated Dataset
Key Enabling Technologies (KET)	Industrial Biotechnology	767	442
	Nanoscience and Technology	425	237
	Optics and Photonics	47	32
	Micro-and Nano-electronics	1	1
	All Projects with a KET	1,240	712
Societal Grand Challenges (SGC)	Society	3,479	2,141
	Bioeconomy	23	15
	Transport	249	126
	Health	147	97
	Climate change and the Environment	268	171
	Energy	33	24
	All Projects with SGC	4,199	2,574

Source: Gök and Antai (2021)

It can be seen that among projects with detailed information, the majority of them are related to SGCs in the fields of society, climate change and the environment, transport, etc. KETs are also represented in the dataset, with industrial biotechnology, nanoscience and technology making up an impressive count.

2) SI score: the conceptual approach and methodology

SI projects are made comparable by calculation of SI scores. Recall in section 2.4 that SI is defined as flexibly reflecting four dimensions of SI definition in existing literature. Correspondingly, these four elements constitute four criteria for assessing whether existing projects are indeed to be considered as social innovations:

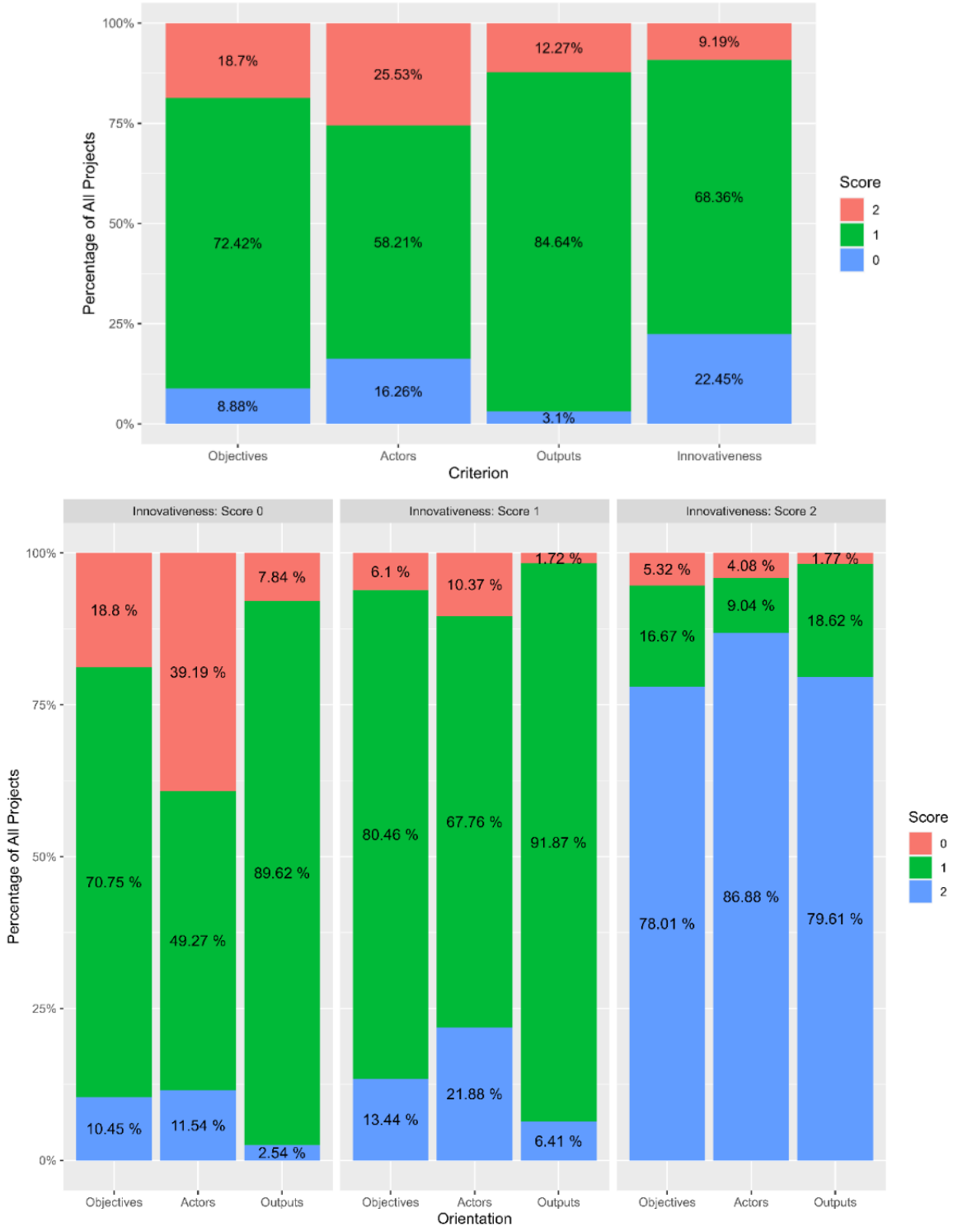
- **Objectives**, i.e., the extent to which a SI project primarily or exclusively satisfies (often unmet) social needs;
- **Actors and their interactions**, i.e., the extent to which diverse actors are involved in a SI project, and that the project creates collaboration between different actors in different combinations;
- **Outputs/Outcomes**, i.e., the resulting change, short-term or long term, brought about by the SI project;
- **Innovativeness**, i.e., the extent to which a SI project involves "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" Gök and Antai 2021).

Against each of these four criteria, the ESID project assigns an SI score (0-2) to a project according to the extent that a project's feature satisfies a certain criterion. Taking "objectives" for example, "2" means that a project fully satisfies the meaning of the criterion, "1" means partially satisfying, and "0" means that there is no indication at all in a project's information about this criterion. The same can be said about the other three criteria. Each project thus has an SI score on each of the four criteria respectively. For instance, out of the 6,138 fully valid projects in the dataset, 1,378 projects score 0 (22.45% of all) for innovativeness, 4,196 (68.36 %) score 1 and 564 (9.19 %) score 2 (Figure 5.11, upper).

The four dimensions of SI in the projects are not isolated but somehow interrelated. The authors have conducted a statistical test using "innovativeness" as the dependent variables, and using predictors including the other three SI dimensions and contextual characteristics in economic, social and policy realms of a country

(Milosevic et al. 2018). [46] Even though the correlation between innovativeness and the other three dimensions (objectives, actors, outputs) is not high (Spearman r (1376) =0.34-0.44, p<0.05), there is a moderate degree of overlap between them for the middle and higher levels (Figure 5.11, lower). Besides, it is found in the research that institutional, economic and social contexts provide important conditions for the innovativeness of SI projects (Gök et al. 2023).

Figure 5.11: ESID SI scores



Source: Gök et al. 2023

[46] For technical details, please refer to the paper Milosevic et al. 2018.

3) SI scores in major regions worldwide

The calculation of SI scores results in different orientations observed from SI projects covered in the dataset, in terms of the four dimensions and their combinations (Table 5.4). Specifically, if an SI project scores high only in one dimension, for example, output, then it can be said that the SI project is output-oriented. More often than not, an SI project can score medium or high for more than one dimension, for example, being highly societal-needs-driven, and showing a high level of innovativeness. In such cases, the SI project shows multiple orientations. Further, if an SI project scores medium/high for all of the four dimensions, then it can be said that the SI project shows a balance of orientations (all medium/all high).

Table 5.4: ESID typology of SI according to its orientations

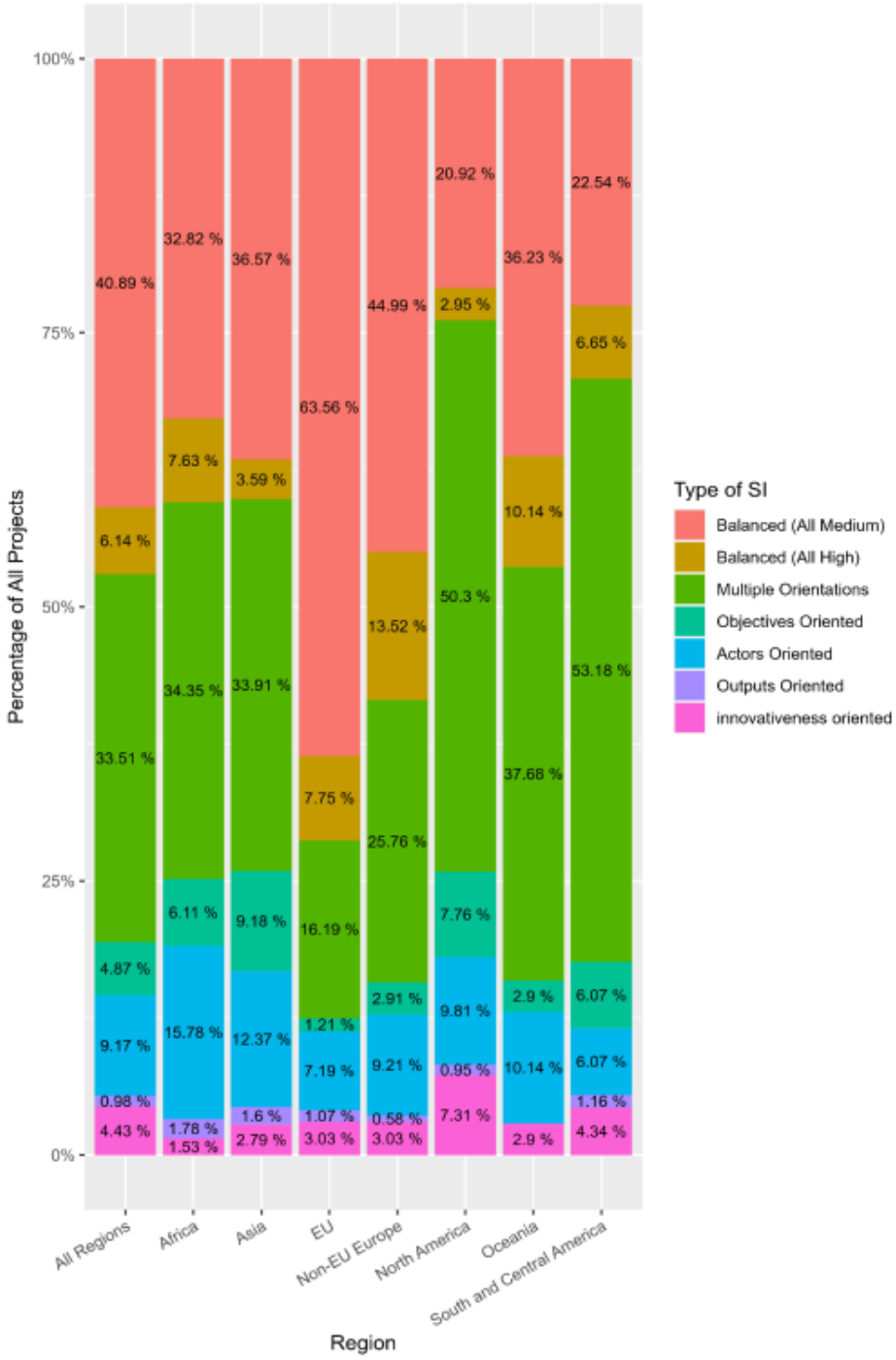
Six SI Types	Element / Criteria			
	Objectives	**Actors**	**Outputs**	**Innovativeness**
1. Objectives Oriented	Main Feature			
2. Actor-Interaction Oriented		Main Feature		
3. Outputs Oriented			Main Feature	
4. Innovativeness Oriented				Main Feature
5. Multiple Orientation	SI features combinations of two or three definitional elements/criteria			
6. Balanced	SI features all of the definitional elements/ criteria			

Source: (Gök et al. 2023)

With this specification, it is now possible to explore at an aggregate level the SI orientations observed in different parts of the world. The SI scores exhibit geographical heterogeneity worldwide. For all the regions covered in the ESID dataset, two types of SI orientations are dominant: multiple orientations, and balanced orientation of all four dimensions at medium level (Figure 5.12). This reflects the status quo that SI projects are multi-dimensional, and it captures the systemic character of SI activities. No single orientation is dominant in all of the regions. Among the single orientations that take up only a minor proportion in each region, SI projects are found to be mostly prominent in filling societal needs, involving multiple actors and facilitating collaborations among them. By contrast, the degree of innovativeness of these SI projects is less apparent, as are their outputs and outcomes.

Nuances can be found among world regions. SI projects in the EU disproportionally feature a balance of the four SI dimensions (at the medium level), while those in North America and South and Central America exhibit multiple orientation of SI (hence only 2 or 3 dimensions). Asia and Africa see a similar distribution of SI scores, where the ratio of multiple orientations approximates that of balanced orientation (at the medium level). Interestingly, SI projects in non-EU European countries show the highest degree of balance among the four dimensions, being either at the medium or high level.

Figure 5.12: SI scores by major regions worldwide

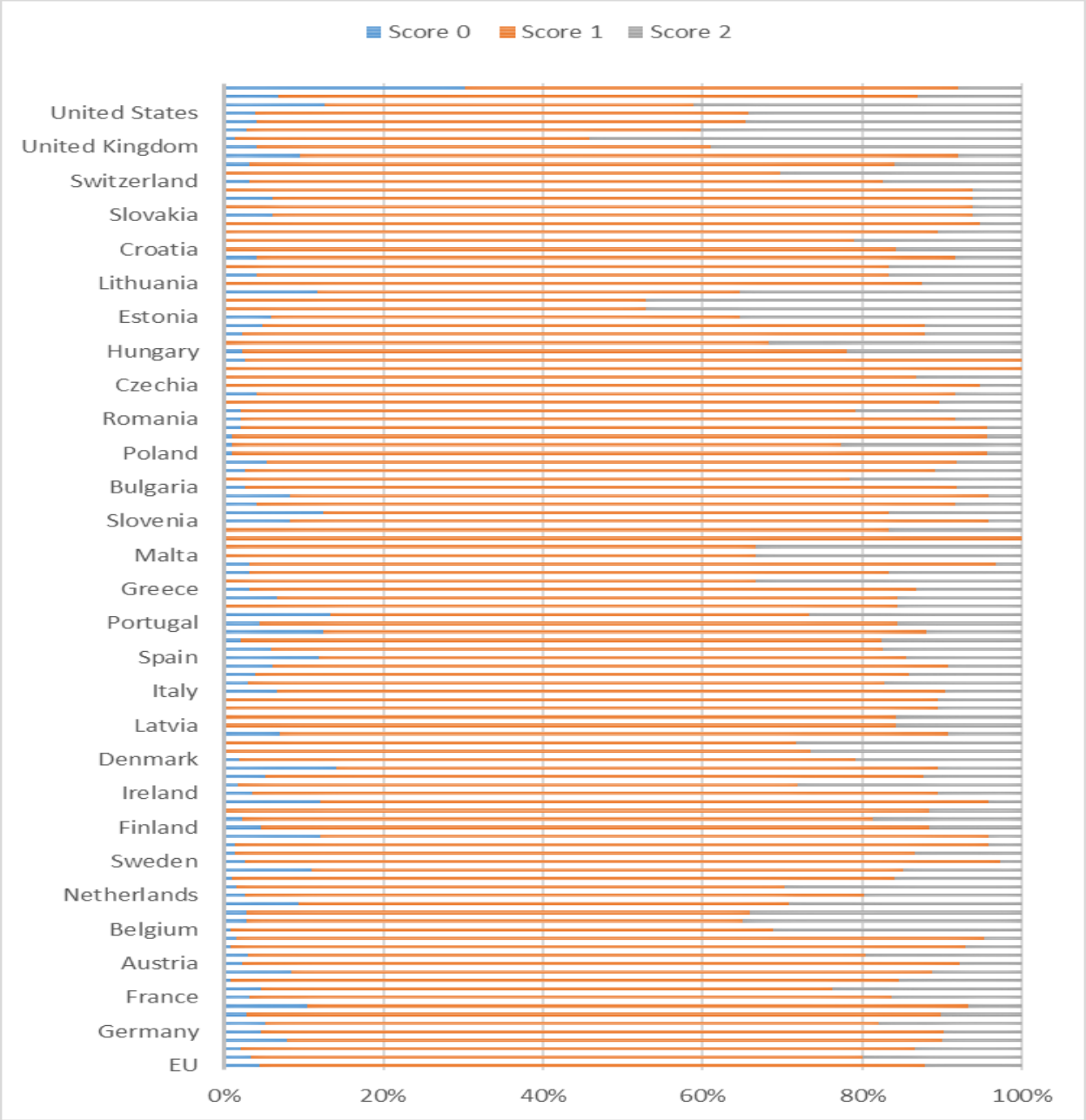


Source: (Gök et al. 2023)

4) SI score: a comparison of Germany in the global context

We compile the data from the ESID portal on SI scores in Germany and other EU countries, and important non-EU countries including Switzerland, United Kingdom and United States. SI scores of the four dimensions are displayed in the table 5.5 below. Because SI orientations are calculated at the project level, and we do not have the original data on all project-level orientations in each country, therefore it is beyond the scope of this sub-section to compare SI orientations across countries. However, it is still possible to get a general sense of what SI projects look like in Germany compared to other countries in the list. Because the dataset is not a representative sample of SI projects in each region and country, we need to be cautious about the message extracted from the data analysis. We are not in the position to draw affirmative conclusions about SI scores from a comparative perspective nor statistical inference; what we derive is only speculative and tentative observations based on SI projects identified in the dataset.

Table 5.5: SI Scores in major countries: a comparison (ESID)[47]



First, it can be seen that SI scores in Germany are quite close to those at the EU level. The majority of SI projects identified in Germany indicate a plurality of SI dimensions at the medium level, which seem to be rather balanced. Similar to the EU level, actor-and-actor-interaction orientation is slightly less apparent in projects identified in Germany compared to the other three dimensions.

Second, situating projects identified in Germany among EU countries, SI projects identified in Germany still exhibit strong multiplicity and balance across the four SI dimensions. In terms of SI projects indicating the feature of meeting societal needs and fulfilling a societal purpose, such SI projects identified in Germany take up a higher proportion than projects identified in countries like Spain, Italy, Spain, Slovenia, Slovakia and Estonia, yet lower than countries such as France, Austria, Belgium, Netherlands, Denmark, etc. In addition, the bulk of these SI projects identified only partially indicate societal needs, unlike Belgium, Hungary, Malta, Estonia and Denmark where over 20% SI projects fully indicate societal needs. In terms of the actors and actor interactions dimension, identified German projects stay close to a lot of EU countries including France,

[47] Authors' compilation from the ESID database: https://bit.ly/ESIDapp. Note: due to the limitation of space in the figure, we do not show the four dimensions of SI. In the figure, each country has four lines, and from the top row to the bottom row downwards, each row represents objectives, actor and actor interaction, output/outcome, and innovativeness, respectively.

Austria, Finland, Spain, Italy, etc. Still, there is a gap between Germany and countries such as Belgium, Netherlands, Denmark, Ireland, Greece, etc., in terms of the proportion of SI projects fully exhibiting actor diversity and collaborations in the current version of the data base. Switching to outputs/outcome dimension, projects identified in Germany do not seem to be more output-oriented. What is worth noting is that projects identified in countries such as Finland, Denmark, and so on, generally have partially or fully brought about changes. Last, switching to the innovativeness dimension, the proportion of identified SI projects exhibiting innovativeness in Germany is higher than that in Netherlands, Sweden, Finland, Spain and Estonia, yet lower than that in other EU countries. It is unclear whether this points to a general higher innovativeness of German SI projects or a selection bias in the German projects identified. Notably, the majority of these SI projects again score 1, in stark contrast to Belgium and Estonia where around 30% SI projects score 2.

Third, Germany differs from representative non-EU countries in several ways. Both Switzerland and the UK have a higher proportion of SI projects identified fulfilling partially or fully the criterion of four SI dimensions in total. Compared to the U.S., Germany tends to include a higher proportion of SI projects in the actor and actor interaction, outputs/outcomes and innovativeness dimension in terms of the proportion of SI projects scoring 1 or 2, yet worse in objectives. However, a nuanced comparison shows that the proportion of SI projects fully indicating societal needs, actor diversity and collaboration is much higher in the projects identified for the U.S. than for Germany.

Taking all these together, it can be said that SI projects in Germany have relatively equally and moderately exhibited strong characteristics in meeting societal needs, involving multiple actor interaction and collaboration, yielding positive changes, and displaying innovativeness. However, though its SI scores are high, it cannot be concluded to take a lead in each of these dimensions compared to other countries in EU or representative countries outside of EU due to lack of representativeness of the data.

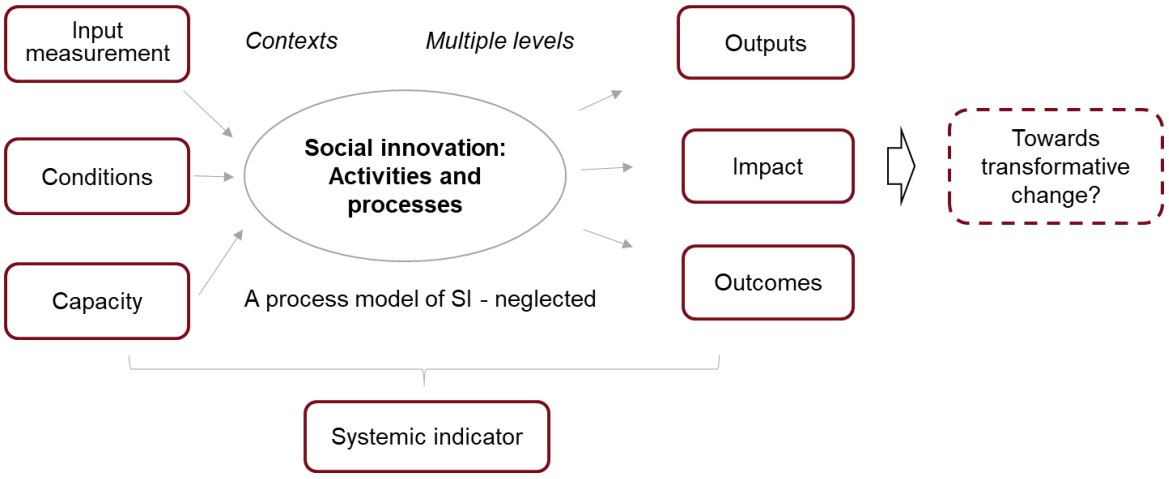
4 SUMMARY

Generally, researchers are aware of the limitations of traditional indicators of innovation in measuring and capturing social innovation, and attempts have been made to account for the specificity of SI at multiple levels, as can be seen in a growing number of EU funded projects and related publications. While the number of exploratory and experimental initiatives increases, which suggests the growing academic and policy recognition given to SI in bringing about transformative change (van der Have and Rubalcaba 2016), a critical review of existing approaches leads us to draw the tentative conclusion that SI indicators have not been well developed for a process-based conceptual model of SI and one that enables meaningful comparison across countries. Specifically, we conclude with the following observations:

1) The landscape of SI measurement: Direct and explicit measurement of SI is scarce

The majority of alleged measurements of SI are not SI itself, but often its antecedents, e.g., framework conditions and capacity, or outcome of SI on target groups in the narrow sense, and the societal impact in the broader sense (Figure 5.13). We have seen very few indicators, if any, that directly and explicitly measure SI. Indicators that intend to capture SI activities, e.g., actors and projects, face the challenges of accuracy, transferability and meaningful measurement and comparison. Despite the endeavour to open the black box of SI, the development in measurement approaches so far have seen arguably no major breakthroughs. There are some emerging methodological frameworks (e.g., the triple bottom line (TBL), social innovation regime, etc.) that are yet to be empirically tested and potentially generalized.

Figure 5.13: Summary diagram of major approaches of SI indicator[48]



2) Under-conceptualization of SI underlies measurement challenges

The diverse yet unsatisfactory indicators of SI are to a large extent due to the under-conceptualization of SI. The definition of any concept presides over its measurement. As Mihci (2019, p. 16) put it, "... without adequately identifying the conceptual framework of the research agenda, obtaining misleading and/or dead-end results is almost unavoidable". Despite numerous attempted definitions, ambiguities, and vagueness dominants the literature, whereas what exactly refers to social innovation and how to analytically identify it (and exclude non-SIs) has no consensus across different disciplines and research programs. This poses tremendous challenges for measurement, theoretical development, and empirical studies on social innovation. Because of this reason, different methodological approaches seem to propose their own frameworks and pursue their own research agendas in parallel, adding to the list of indicators and frameworks, each being highly contextualized (e.g., in terms of framework conditions and data used), without pointing to the direction what workable and generalizable SI indicators could be developed.

[48] Authors' elaboration based on literature review and interpretation.

3) Systematic indicators: a gap between realization and ambition

Partly due to the under conceptualization of SI, existing attempts to develop systematic indicators that try to be comprehensive and holistic exhibit more mechanical and linear conceptual underpinning of SI than systematic, organic and processed, as suggested by our ad hoc interpretation of *TEPSIE* project results (sub-section 2.6). The claimed ambition has not been matched with the extent to which it is realized. Another problem with such an indicator system approach is that once some of the standalone indicators lack usable data in a geographical context, then the possibility of such indicator system to be transferrable and generalizable is in question.

4) SI indicators are diverse, yet largely exploratory and unprepared for "measurement"

The SI indicators proposed in the literature and the growing body of research projects can be largely categorized into three types: quantitative indicators, qualitative indicators, and conceptual and methodological frameworks that guide the design of indicator (systems). Quantitative indicators, including conventional innovation indicators, and SI-specific composite indicator systems that try to capture different aspects of SI, are frequently seen in literature and research projects. As mentioned before, many of them are at the stage of indicator (systems), not necessarily applicable for genuine "measurement". Another category are methodological frameworks that aspire to propose alternative measurement systems. These methodological frameworks are guided by legitimate conceptual and theoretical developments in SI, but have rarely gone beyond the presentation of frameworks towards operationalization and application. A further category is qualitative "indicators" informed by the tacit and process-based aspect of SI concepts. On such basis, they derive selective aspects of SI from interview questionnaires and surveys, and then utilize them to inform a larger-scale survey design.

Overall, conventional innovation indicators are well-developed and readily comparable, yet are agreed to not to fully capture SI; SI-specific indicator systems, methodological frameworks and selective qualitative variables, on the other hand, have largely remained at an exploratory stage. There is a distance between existing indicators and concrete, testable and empirically usable measurement of SI for theoretical development, testing and generalization.

5) Challenges also lie in data availability

Admittedly, the lack of appropriate data to capture different dimensions and aspects of SI is an important factor leading to the under-development of SI measurement and empirical research. Most existing indicators are not designed specifically for SI. This is especially problematic when it comes to systematic measurement of SI that use composite indicators, because these separate indicators often come from different sources and databases, each having its contexts and limitations, and taken together may be mismatching or even misleading. SI measurement trying to use surveys to collect SI-specific data is at a pilot stage and very limited in scope. Besides, these explorations can be context-sensitive as regards the socio-economic, political and cultural conditions of the place where surveys are designed, hence generalization becomes a further challenge.

6) International comparison: not well fulfilled

Accompanying the underdevelopment of SI measurement and indicator is the lack of data for international comparisons. If the macro level is an important level of SI measurement considering its wider societal impact, spill-overs and transformative change, then this task is imminent. However, a lot of available indicator systems incorporate framework conditions and contextualized capacity at the micro and meso-level, e.g., regional resonance, which makes international comparison less viable.

7) Measurement of SI for transformation: absent and pressing

The emerging academic attention to the role of SI as playing an important role in the transformation of socio-technical systems, and the efforts to define, operationalize and measure SI, are isolated. Few methodological studies have thought about SI indicators from the perspective of transformative change. While the traditional impact assessment and social value creation research partly touches upon different facets about societal outcome of SIs, the notion of transformation and its implications for outcome-focused measurement has not been systematically explored. This should be a pressing task if SI is perceived to play a transformative role. Yet the methodological development still follows the conventional conceptual and cognitive frameworks.

6 HOW SUCCESSFUL SI INDICATORS MAY LOOK LIKE? TOWARDS A RESEARCH AGENDA

Having reviewed major methodological approaches to measure SI and develop indicators to capture the multi-dimensional characteristics of social innovation, and assessing the status-quo of this field, now it is possible to turn to future research agenda by putting forth several guiding principles for what pertinent SI measurement may look like. This should address the gaps and challenges listed above, strive for clarity and coherence between conceptual and methodological frameworks, and strike a balance between SI peculiarity and innovation measurement in general.

1) An explicit, well-defined conceptual framework is essential

Any credible measurement should start with a clearly defined concept that lays out the analytical dimensions. A workable definition of SI is important before anyone sets out operationalizing and measuring it, which, however, has been a problem plaguing the conceptual, theoretical and empirical development of SI research. We should be aware that while SI is systemic, it does not mean that systematic indicators are naturally superior approaches than others. What matters is that the concept should be explicitly sharp that enables meaningful operationalization, and that methodological approaches always are consistent with the conceptual frameworks. One possible direction to work on is to probe further into the process model of SI and related indicators; then the design of indicators should be based on the implications of the process model and keep consistency throughout the research. A focus on the process of SI characterized as an ecosystem implies that indicators should look for different innovation and learning activities by different actors and their constellations. This requires a return to the "input" of SI, not in the sense that factor endowments are calculated, but that innovation activities are concretely captured to open the black box of SI. In sum, a shart conceptualization (e.g., Chapter 2) that may capture only selective aspects in a sense serves our purpose better than conceptualization effort that tries to be all encompassing but could be misleading, especially when the research field is very nascent.

2) A balance between simplicity, contextualization and generalization

Social scientists interested in measuring SI have long struggled with the peculiarity of SI activities and innovation in general. Compared to profit-oriented innovation, SI is often more sensitive to the context and social relations it is embedded in, where tacit knowledge is created and social practice is based. The process-oriented perspective and a focus on generalization naturally implies a multiple-actor and multiple-level nature of SI activities, which makes measurement towards meaningful comparison an extremely demanding task. Therefore, future work should strike a balance between the context SI operates in, and the needs for simplicity and generalization if more theoretical developments and empirical studies are to be accomplished.

3) Specify and balance the appropriate levels of analysis

The third principle is to specify the appropriate levels of analysis. We have demonstrated that SI is a boundary-spanning and level-spanning phenomenon, and this renders any effort to look at one level of analysis solely yet to draw generalized conclusions incredible. Therefore, it depends on what research question is raised on the process and influence of SI. To put it another way, the appropriate level of measurement and analysis should be decided based on the specific question and research objective. If the inquiry goes beyond actors in the SI ecosystem, for example, social enterprises, citizens, etc., then a higher-order level observation is often desired considering the systemic character, interactive learning, diffusion and generalization of SI.

4) Measurement approaches should be accompanied with a clear agenda on credible data

Last but not least, the design of an SI indicator system should not propose yet another highly conceptual methodological framework that leads to nowhere. It is important to bear in mind the operationalizability of the suggested SI indicators, the availability of reliable data is equally important. With the development of advanced tools, such as machine learning and natural language processing, etc., social scientists are equipped with stronger capacity to collect and extract data to capture social economic phenomenon that conventional methods can hardly accomplish. These innovative methods, techniques and tools expand the potential of SI data collection. In practical terms, it is critical to keep the entire process transparent, consistent, and trackable, so that different indicators can be meaningfully integrated, compared and aggregated to fulfil the SI measurement objective, and avoid misleading and incompatible indicator systems.

CHAPTER 6: CONCLUSIONS

By Matthias Weber, Stephanie Daimer, Attila Havas, Knut Blind, Susanne Giesecke

1. MAIN ACHIEVEMENTS

Social innovation has become an important policy target in Germany in recent years, as recognised, for instance, in the Hightech Strategy, the new Future Research and Innovation Strategy of BMBF and the recently published National Strategy for Social Innovation and Public Interest Companies. Social innovations are regarded as particularly important for better addressing major societal challenges. However, in spite of widespread programmatic support, **it is still difficult to give social innovation an appropriate place in the design and implementation of government policies**, both in R&I and in relevant sectoral policy fields.
This is due to a limited understanding of the specificities, drivers, and impacts of social innovation, the diversity of both social innovation and societal challenges, and the difficulties of making social innovation effective for wider systemic and directional change, geared towards tackling major societal challenges.
In light of these research challenges, the project has resulted in seven main contributions. It has:

1. Developed a **comprehensive conceptual framework** that comprises a definition of social innovation, a typology of innovations in terms of their principal purpose and nature, in which social and well as other forms of innovation can be positioned, and a typology of social innovations in terms of their origins and scope.

2. Proposed a **process model of how social innovation contributes to system innovation and transformative change**, for which we have drawn on concepts from sustainability transition research and recent findings from major, mainly EU-funded, research on social innovation.

3. Introduced a differentiated perspective on the role of social innovation for addressing societal challenges, by proposing three different types of transformative contexts:
   - The first context refers to **socio-technical system transformations**, and it is illustrated by the example of energy communities.
   - The second context refers to **disruptive technologies**, and it is illustrated by the case of autonomous driving.
   - The third context refers to responses to **situations of crises**, either abrupt ones (illustrated by the case of COVID-19 warning apps) or persistent ones (illustrated by the case of social housing in Austria).

4. Developed an **analytical grid for studying social innovation for societal challenges** that is based on the conceptual framework and the process model. The usefulness of the framework and process model was illustrated for four cases studies on examples of social innovations, which cover the three types of transformative contexts. We have shown that the framework provides a useful set of concepts and pattern of analysis to help understand how and why social innovation emerge and generalise.

5. Further advanced the current state-of-the-art of **rationales for policy intervention in (social) innovation for societal challenges**, by taking into account the specificities of social innovation. The framework and process model provided the foundation for a better-informed debate about R&I (and other) policies to enhance the contribution of social innovation to addressing societal challenges, inspired also by examples from a selection of policy instruments and programmes specifically addressing social innovations. On these grounds, we argue that

   - the prevailing rationales underpinning R&I policies need to be amended in order to take into account the specificities of social innovation for societal challenges, and we have proposed a revised failures framework accordingly;
   - this enhanced set of rationales has already been adopted – explicitly or implicitly - in policies for social innovation in other countries that we have studied;
   - the measurement of social innovation and its effects continues to be a major challenge but needs to be addressed in order to trace and monitor its contribution to system innovation and societal changes, and thus evaluate the effects of policy measures in support of social innovation.

6. Discussed **possibilities to remedy one of the long-standing deficits of social innovation research**, namely the lack of satisfactory data, measurement approaches, and indicators that would allow tracing the development of social innovation in a comparative way and – in the longer-term – make possible the assessment and evaluation of the effects of policy measures on that evolution.

7. Pointed to **policy implications for further consideration in future policy mixes** for supporting social innovation for societal challenges, and for R&I policy in particular.

2. POLICY IMPLICATIONS

The final step in this journey consists of suggesting general policy implications as derived from the conceptual and empirical research conducted, and more specifically for R&I policies:

1. The growing policy attention to social innovation for better addressing societal challenges is part of a more fundamental change in R&I policies, which is characterised by i) a **broader understanding of what innovation is about**, implying a tight intertwining of various innovation dimensions (that is, the purpose of innovation: profit-oriented, social, and hybrid; and the object of change: goods and services, technologies, , business models, organisational solutions, institutional set ups, social practices, etc.), ii) therefore also a need for **broader take on innovation in R&I policies**, which goes hand in hand with higher and even transformative ambitions of R&I policies, requiring an ever closer interaction with demand-side sectoral policies, iii) the **recognition of the ambivalence** (i.e., of dark as well as bright sides) of innovation, and thus the need for directional guidance by R&I and other policies, and iv) as a result, a **growing complexity of such comprehensive, directional and transformative mixes of R&I policy strategies, instruments, and governance** processes, aiming to explore and experiment with novel systemic configurations rather than addressing narrowly defined innovations.

2. It is important to concentrate on the **progression of social innovations towards system innovations for societal challenges** and accommodate policies to the specific requirements of the different phases of their innovation life cycle until social innovations are fully consolidated and institutionalised. In terms of our typology of innovations, the **character of social innovation may change over its life cycle** and move from a purely social purpose towards a hybrid mix of social and profit-oriented purpose, or from purely social nature to a technologically inter-twined nature. Hence, the role and specification of policy needs to follow course. In line with the three stages of the proposed process model of social innovation, the objectives and the levels of complexity are likely to differ, and so will the policies targeting these different stages:
   - At the early stage of **niche formation**, government policy may well support innovation activities driven by societal needs, independently of whether they are scientifically-technologically inspired (which is very common) or led by social initiatives and experimentation (for which there is limited public support only). Both can be justified on grounds of market failure, e.g. insufficient private incentives to contribute to a public good. More importantly, in this early stage the formation of SI can be hampered by system failure, e.g. lack of an adequate organisational and institutional framework and by transformation failure, e.g. a lack of directionality or reflexivity.
   - At the **maturation stage**, it becomes essential to take into account that innovations pursuing a social purpose often evolve into hybrid (or and profit-oriented) innovations, and that technological and non-technological features complement in each. This suggest that R&I policies should better rely on integrated support strategies that pay particular attention to the social purpose of innovation and their 'hybrid' technological and non-technological nature. In other words, policies targeting social innovations alone seem to be less suitable at the maturation stage. In addition, advanced experimentation ('deep demonstrators') with new innovative solutions needs to be connected with adjustments of the organisational and institutional framework conditions determined by policies beyond R&I, i.e. in particular sectoral policies. This **move towards more sophisticated policy mixes is justified by the system and transformation failures** that may otherwise occur at this maturation stage, which are more demanding than those in the earlier niche formation state. In particular, **policy coordination failures** are an important concern at the maturation stage, which may block the further advancement of social innovation, and thus require particular attention.
   - When it comes to far-reaching **institutional and regime changes**, the influence of sectoral policies becomes even more important and is decisive for whether transformative and directional ambitions associated with social innovation will be achieved or not. Even more so than in the maturation stage, the focus shifts from R&I policies towards sectoral policies, and the interactions between them, in order to feed insights on institutional experimenting into policy design and devise frameworks for monitoring progress towards resolving societal challenges.

- These observations imply that in particular for the phases of maturation the gap between R&I and sectoral policies needs to be closed and interactions be intensified. For maturating social innovations beyond creating niches, policy mixes are needed through which the boundaries between R&I and sectoral policies get blurred and better alignment is essential. This is also a precondition for enabling a regime change, which is mainly determined by sectoral policies, but requires developing the necessary capacities and capabilities in the course of the maturation stage.

3. As part of the process model of social innovation for societal challengers, we prefer to speak of **generalisation rather than diffusion.** The notion of diffusion is suitable for product, process, or service innovations, but in the case of social innovation for societal challenges, we are dealing with **novel systemic configurations of social, organisational, technological, and behavioural changes ('system innovations').** Their uptake and embedding is based on mechanisms beyond those at work in diffusion processes.
   - In particular, system innovations with a strong social innovation component are often **tailored to specific local conditions** and escape attempts of simple replication and scaling up. This implies that not every social innovation needs to diffuse widely beyond the local scale to be successful, as long as it gets consolidated and institutionalised locally, but if a social innovation is meant to evolve into a system innovation that could help address societal challenges at a larger scale, then **more sophisticated mechanisms of generalization are needed**. What needs to spread as part of a generalisation process is the knowledge underpinning such system innovations, which – from a societal perspective – should be accessible in other places and inspire local system solutions elsewhere, drawing on the initial models but adapting them to local conditions and contingencies. This happened, for instance, in the cases of social housing and energy communities.
   - This does not exclude, however, that under other circumstances, in which national or even international standards matter as in the cases of autonomous driving and COVID-19 warning apps, it is appropriate to speak of the diffusion of social innovations. So, it is the **context specificity and the systemic nature of a social innovation that matter for whether it is appropriate to speak of diffusion or of generalisation**. In the latter case, promoting the generalisation of social innovations for societal challenges points to policies beyond established scaling- and diffusion-oriented policies (which may work better for traditional product and process innovations), and address also place-based replication-adaptation of new solutions and knowledge on system innovations.

4. Transformation pathways together with the underlying generalisation processes require **high levels of reflexivity** in order to be adapted along the path. In light of new findings and ongoing experiences, strategic intelligence, spaces for reflection and iterative learning processes are needed in order to adjust problem understanding and possible solutions as part of a truly "agile" R&I policies for social innovation (cf. the Finnish approach to institutionalising foresight in its R&I policy).

5. The study has provided indications that the range of organisations for which social innovation matters **is widening**, showing that
   - Social innovations are not just enacted by heroic non-profit/CSO entrepreneurs, but equally **important in organisations with a profit-seeking business model (with reinvestment of profits),** as long as such a profit-seeking business model is **embedded in a vision and ambition of striving for a social purpose**. In line with the German SI strategy, this perspective takes into consideration social enterprises aiming at value creation from social innovation. With this approach, Germany follows a similar rationale like Portugal and Finland. From a policy perspective it is therefore important to acknowledge the variety of social innovation business models and establish SI ecosystem that leave room for both models of social innovation, as long as they promise to create positive social effects. This is an important lesson from a policy perspective, because it stresses the need to expand the target group of social innovation-promoting policies beyond the group of non-profit and civil society organisations that are usually associated with social innovation. At the same time, it points to the importance of taking social purpose and ambition into account when funding innovation activities of profit-seeking organisations.

- **Non-profit, civil society organisations may nevertheless be confronted with additional barriers** (as compared to social innovators with a profit-oriented business model) when it comes to generalising social innovations. In this case, additional rationales for public support can be identified, possibly even calling for permanent public support and thus blurring the boundaries between public and third sector. This is the case, for instance, if – as in the UK – non-profit CSOs address social needs that the retreat of the State leaves unaddressed, and which in other political cultures may well fall under the widely accepted responsibilities of the State.

6. Given the **distributed character of many social innovations**, centralized governance is often at odds with their specific characteristics. In fact, social innovations often emerge under highly contingent local conditions. This suggests that supporting **social innovations requires a less hierarchical, less centralized and less dirigiste approach than for other types of innovation**. In other words, for social innovations to flourish, the forces of self-organisation in society need to be nurtured and supported through mechanisms of **distributed coordination ('Kontextsteuerung')**.

7. Our initial assumption that social innovations fulfil clearly defined functions in relation to the three types of societal challenges (i.e., a key role of system transitions, accompanying role of disruptive technologies, and compensating role in crises) cannot be sustained in a straightforward manner. **Social innovations rather help address different types of failures that occur frequently in the three contexts**. This concerns, for instance, the compensation of market failures such as the provision of public goods or the internalisation of external effects. As an example of addressing system failure, social innovations also help build specific capabilities that are needed for systemic change to happen. Through their origin in social needs, social innovations also represent a response to demand articulation failure as an example of transformational system failure. As indicated before, the relative importance of public support for social innovation in responding to failures also depends on the stage of advancement and maturity, pointing to a variable balance between structural and transformational system failures. Still, some more differentiated observation regarding policy interventions in different contexts can nevertheless be made:
   - The challenge of emerging technologies and how they might be framed by social innovation is somehow relevant in the context of digitalisation, for example in the Netherlands and in Finland. While there is an acknowledgement in these countries – and now also in Germany – that technological innovation should go hand in hand with social innovation, it is less clear how this could be supported by a favourable framework, which also fosters the necessary institutional changes. The decision of the German BMBF to **open its research funding programmes to different types of innovations** should be evaluated in due course to see whether it can act as a lever for new R&I projects with a more integrated and transdisciplinary character.
   - Despite the turn towards more directional R&I policies for sustainability in many countries, it seems there is so far less experience in **leveraging the potential of SI for transformative (system) change**. In the case of Finland, the turn towards a broad institutionalised foresight approach might offer space for reflections about major transitions involving a large number of stakeholders. It is one of the few, but major criticisms of the new German SI strategy that it underestimates the transformative power of SI and the value of participatory and collaborative approaches to transitions.
   - In situations of crises, social innovations can indeed play very important roles in compensating the lack of preparedness and adequate technological solutions to crises management, be they abrupt (like in the COVID-19 case, or persistent like in social housing). It is the combination of bottom-up initiatives and political support to the nurturing of such initiatives, which can make an important difference in alleviating the effects of crises.

8. Relating social innovation to societal challenges raises further issues for policy that are common to all three types of contexts. Given the fact that these contexts refer to future social needs from which requirements for social innovation are derived, the **anticipation of future social needs plays an important role in identifying 'directional' policy actions** beyond generic support to social innovation. Similar to current debates about transformative and mission-oriented policies, this implies rethinking the rationales for policy intervention. Rather than referring to 'failures' that suggest a reactive policy approach, **a turn towards 'proactive' rationales to justify the need for policy intervention** is called

for. This turn is crucial if appropriate conditions shall be put in place to **address future and emerging societal challenges in a timely manner with the help of social innovation**, for instance to prepare for possible crises, overcome path-dependencies to enable longer-term system transformation, or anticipate possible threats and opportunities arising from disruptive technological developments and shape alternative pathways accordingly.

9. International experience shows that new policy mixes (in terms of combinations of strategies, instruments, and processes) have been developed in some leading countries in recent years. While keeping in mind the specificity of national cultures and policy styles, the four countries analysed point to four important issues:
   - the importance of persistent support for social innovation in a corresponding ecosystem, that **endures over several legislative periods** and ensures in particular the availability of '**patient' social investment funding** (Portugal, Finland);
   - the coverage of early 'niche' development of social innovation as well as later stage 'maturation' by a suitable mix of instruments (Portugal, UK));
   - the need to **integrate social innovation in existing instruments and programmes** to ensure complementarity with other types of innovation (Portugal, UK); and
   - the advantages of integrating support instruments for social and other forms of innovation **in 'one-stop-shops' for (social) innovators**, possibly focused on specific areas such as education, labour, or health (the Netherlands, UK).

   Overall, these four issues to enhance the role and contribution of social innovations should be taken into account in the current debates in Germany regarding the **governance and reform of R&I funding systems aiming to operationalize the transformative and mission-oriented policy** approach underpinning major parts of the new Future Strategie for Research and Innovation.

10. The **measurement of social innovation continues to be a major challenge**, for conceptual, as well as methodological reasons. This entails problems for assessing the outcomes and impacts of social innovation, and hence for legitimising public support for social innovation. in general. While efforts have been made in recent years to develop new approaches to measurement and indicator design (for an overview see Chapter 5), there are **hardly any data available for comparative analyses across countries**, and those that exist either show major methodological flaws and inconsistencies or are focused on specific sub-categories of social innovation only. **Data are often not representative and dependent on the ability to identify social innovation cases**, either by traditional surveys, like the Mannheim Innovation Panel or the European Social Entrepreneurship Monitor, or by the increasingly used web mining techniques. For the advancement of our understanding of social innovation and its impacts, it is of utmost importance not only to invest into the **development of new approaches**, but in particular into the **harmonisation of definitions** and the **harmonisation of data collection** procedures across countries, drawing on **sound categories and process models** of (social) innovation, inspired by frameworks such as the one developed in this report (see Chapter 2).

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