

Implementing the energy efficiency first principle in European regions: insights from the REGIO1st Planning Framework

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Abstract

The energy efficiency first (EE1st) principle is a key element of the recast Energy Efficiency Directive that emphasises the prioritisation of energy efficiency measures in all energy planning and investment decisions. However, regional authorities often face challenges in putting the EE1st principle into practice, integrating it into regional energy strategies and balancing it with other energy-related needs. To address these challenges, the REGIO1st project, co-funded by the LIFE programme, focuses on raising awareness of the EE1st principle among regional governments and their agencies, and providing them with the necessary tools and guidance to integrate this principle into their energy planning and decision-making processes. A key feature of the project is the development of the REGIO1st Planning Framework. This framework is a comprehensive toolkit for integrating the EE1st principle into regional energy planning. It outlines a structured approach with different stages, each equipped with specific Excel and text-based tools. These tools facilitate data collection, stakeholder engagement, cost-benefit and multi-criteria analysis, ensuring a comprehensive planning process. The framework and its tools will be made available online in the first quarter of 2024, ensuring easy accessibility and usability. Currently, the REGIO1st Planning Framework is being applied in six European pilot regions. The pilots not only test the usefulness of the framework, but also adapt it to different regional contexts, demonstrating its versatility and effectiveness in practice. This paper introduces the REGIO1st

Planning Framework, exploring its purpose, methodological foundations, structure and the variety of practical tools it offers. It also discusses its current application in pilot regions, highlighting how it supports regional authorities in integrating the EE1st principle into their regional energy strategies.

Introduction

The ‘energy efficiency first’ (EE1st) principle has been gaining momentum in the European Union’s (EU) energy and climate policy. The principle is based on the idea that energy efficiency improvements in buildings, industry, transport and energy transformation are often the most sustainable and cost-effective means of meeting both consumers’ energy service needs (e.g. thermal comfort) and wider societal objectives (e.g. decarbonisation). Where this is the case, the EE1st principle suggests that energy efficiency solutions, including demand-side flexibility, should be systematically prioritised over the development of relatively inefficient energy generation, network and storage infrastructure for electricity, heat, hydrogen and other energy carriers. In this way, the EE1st principle can help lower overall energy demand, reduce the need for new infrastructure investment, cut greenhouse gas emissions, improve energy security and, ultimately, save consumers money (Mandel et al. 2022).

Starting in the mid-2010s with brochures from various non-governmental organisations (Bayer et al. 2016), the EE1st principle has become a key element of EU policy in a remarkably short time, including the Governance Regulation ((EU) 2018/1999), the Renewable Energy Directive ((EU) 2018/2001), and the TEN-E Regulation ((EU) 2022/869). A major milestone was the adoption of the recast Energy Efficiency Direc-

tive in late 2023 ((EU) 2023/1791). Article 3 of the Directive requires Member States to assess energy efficiency solutions in their planning, policy and investment decisions, to promote cost-benefit analysis methodologies, and to monitor and report on the application of the EE1st principle.

However, as highlighted by the ENEFIRST project (Broc et al. 2022), the practical implementation of the EE1st principle faces many challenges. These include limited awareness among decision-makers of the ‘multiple benefits’ of energy efficiency (Fawcett and Killip 2019), financial constraints on the implementation of energy efficiency solutions, and the lack of collaborative planning approaches to identify an optimal mix of energy savings and supply options. As a result, energy savings opportunities remain untapped, known as the ‘energy efficiency gap’ (Brown and Wang 2017), resulting in higher emission levels and energy costs across Europe.

Regions are an important administrative level for implementing the EE1st principle (Oikonomou and Eichhammer 2021).¹ They can generally support local energy efficiency and renewable energy projects and engage with stakeholders to promote energy efficient practices, while also having a comprehensive understanding of the local energy infrastructure, building stock and socio-economic landscape – all of which are essential for effective policy implementation. In addition, regions have access to dedicated EU funding for energy efficiency and sustainable development, such as the Cohesion Fund and the European Regional Development Fund.

Regional energy planning is increasingly being used by regional authorities to assess, design and implement measures and policies to improve energy efficiency, shift to renewable energy sources and reduce greenhouse gas emissions in their territories. Regional energy planning is widely recognised as an effective approach to managing a sustainable energy transition (Dobravac et al. 2021; Herreras Martínez et al. 2022). In particular, by engaging and involving community members in the planning process, regional and local energy plans can foster a sense of ownership and investment, ensuring that energy systems are in line with community needs and local priorities. Regional energy planning is further encouraged through the Covenant of Mayors for Climate & Energy (CoM) initiative, with more than 11,500 municipalities across Europe committed to develop Sustainable Energy and Climate Action Plans (SECAP) (Bertoldi 2018).

To raise awareness of the EE1st principle among regional governments and agencies and to support its application, the LIFE-funded project REGIO1st (“Implementing the Energy Efficiency First Principle in Regional Planning”) was launched in 2022.² A central part of this project is the development of the REGIO1st Planning Framework, a comprehensive, structured toolkit for regional energy planners in Europe to develop and implement sustainable energy strategies and plans in line with the EE1st principle. The framework is designed to identify cost-effective energy efficiency and supply solutions, taking into account the unique challenges and opportunities of each region. To this end, the framework provides specific Excel and

text-based tools to facilitate data collection, stakeholder engagement, and cost-benefit, among other aspects of the energy planning process. While individual tools already exist for each of these aspects, the REGIO1st provides a comprehensive approach that covers the entire planning cycle according to the EE1st principle in one integrated framework.

To test its usefulness and adaptability in different regional contexts, the framework is currently being applied in six EU pilot regions: Medjimurje (Croatia), Western Macedonia (Greece), Carlow, Kilkenny, Wexford, Waterford (Ireland), Liguria (Italy), Ormoz and Slovenska Bistrica (Slovenia) and Asturias (Spain). Later, in cooperation with the CoM initiative, the framework will be extended to over 100 regions across Europe. The objective of this paper is to present the REGIO1st Planning Framework, exploring its scope, methodological foundations, structure and the variety of tools it offers. It also discusses its current application in the six pilot regions, highlighting how it supports regional authorities in integrating the EE1st principle into their regional energy strategies.

Foundations of the REGIO1st Planning Framework

The REGIO1st Planning Framework is a novel approach that focuses on aligning regional energy planning with the EE1st principle. However, the development of the framework has not been done in isolation. It has been informed by two main sources: insights from regional authorities and a review of existing frameworks for local and regional energy planning in the EU.

A comprehensive survey, supplemented by interviews with representatives of regional authorities, was conducted to understand how regions typically approach energy planning and what challenges and needs they face in implementing the EE1st principle. In particular, the survey looked at the stages of planning, the responsibilities of relevant bodies and departments, planning methodologies and assessment procedures, priority setting and monitoring structures. This approach provided a clear perspective on whether and how the EE1st principle is integrated into regional energy strategies.

The key findings of these activities, detailed in the dedicated REGIO1st project report by Stavrakaki and Konstantopoulos (2023), show that the EE1st principle is not systematically integrated into existing regional strategies and plans. Explicit comparisons between energy supply infrastructure and energy efficiency solutions are rare, and the assessments informing the planning process vary widely, ranging from basic qualitative elements to detailed regional analysis. Furthermore, the report highlights the lack of true co-creation in energy plans, with stakeholder and community engagement often limited to mere public consultation. As such, the surveys and interviews underline the need to effectively communicate the importance of integrating EE1st planning into regional governance. This is critical to gaining acceptance from policy makers, industry stakeholders and communities. The report also highlights the need for funding streams and financial resources to support energy efficiency interventions.

The second foundation involved a comprehensive review of existing frameworks for local and regional energy planning in the European Union in order to derive best practices and design features. This review recognised the existence of numerous frameworks from which lessons could be drawn. Through

1. The EU Nomenclature of Territorial Units for Statistics (NUTS) defines regions at three different levels (NUTS 1 to 3) based on population size and administrative structures, which vary from country to country (European Union 2018).

2. <https://fedarene.org/project/regio1st/>

snowball sampling and input from the REGIO1st project partners, a total of 15 existing frameworks for local and regional energy planning were identified. These included peer-reviewed research articles, such as the methodology for sustainable local energy planning developed by Neves et al. (2015), and practically designed frameworks, such as Catapult's (2022) guidance on developing a local energy plan.

This review found that all of the frameworks emphasise the importance of stakeholder analysis and engagement, highlighting their critical role in successful planning. In addition, frameworks such as the U.S. Guide to Community Energy Planning (DOE 2013), which provide comprehensive coverage of all identified stages, were identified as useful reference points for the REGIO1st framework. However, the emphasis on baseline analysis, data collection and cost-benefit analysis varied between the frameworks, indicating a clear need for guidance in these areas within the REGIO1st framework.

Taken together, these foundational elements highlight the need for a user-friendly, analytical and effective framework that addresses the specific needs of EU regions while being consistent with the EE1st principle.

Walkthrough of the REGIO1st Planning Framework

The main purpose of the REGIO1st Planning Framework is to provide practical guidance on the application of the EE1st in regional energy planning, taking into account the diversity of objectives and preferences of regional stakeholders. The primary target groups of the framework are regional government officials and regional energy agencies.

As outlined in Figure 1 and detailed in Figure 2, the REGIO1st Planning Framework is organised into eight *stages*, which represent the key building blocks for incorporating the EE1st principle. These stages range from planning inception, through stakeholder engagement and baseline analysis, to cost-benefit analysis, definition of concrete measures, monitoring and review. Each stage in turn contains specific *steps* that are key to the process. For example, the cost-benefit analysis stage includes steps ranging from technical assessments to energy system modelling, monetisation of wider impacts or multiple benefits, and sensitivity analysis. Finally, the framework also includes a

set of readily available *tools* (Excel, PDF, etc.) designed to assist planners at different stages of the process. These tools support data collection, analysis, scenario modelling, multi-criteria analysis and other key tasks. By using these tools, planners can streamline the planning process, ensure thorough and accurate analysis, and make informed decisions in line with the EE1st principle. The different stages and steps are described below.

STAGE 1 PREPARATION

Stage 1 is important for laying the foundations of a successful regional energy plan. This stage involves a series of steps to define the geographical area and scope of the planning, define roles and responsibilities, review existing regional energy plans and starting the process for developing the plan.

The first step is to define the spatial boundaries and key aspects of the energy system for the planning process (**Step 1.1**). Planners are tasked with identifying the geographical area that the regional energy plan will cover. This area could range from a specific group of municipalities to the entire region. In addition, the scope of the plan needs to be defined, possibly including specific sectors such as buildings, industry, transport and different energy sources such as electricity, gas, hydrogen and heat.

It is then important to assign roles and responsibilities to the members of the planning team and stakeholders who will play a leading role in the planning process (**Step 1.2**). Planners should identify key departments within the region and key stakeholders, such as regional energy agencies, and define their roles and responsibilities. The establishment of structures to support the planning process, such as a steering committee or working group with a defined mandate, is also recommended.

The third step involves a comprehensive review and assessment of past and ongoing energy planning efforts in the region, as well as other relevant planning documents (**Step 1.3**). This review should include strategies and plans focusing on sustainable energy, infrastructure development, transport, waste and other relevant urban and rural activities. The aim is to identify potential synergies, overlaps and gaps in the current planning landscape to inform the development of a new or revised regional energy plan. Considering the successes and challenges of previous planning efforts provides valuable insights and lessons for the new plan.

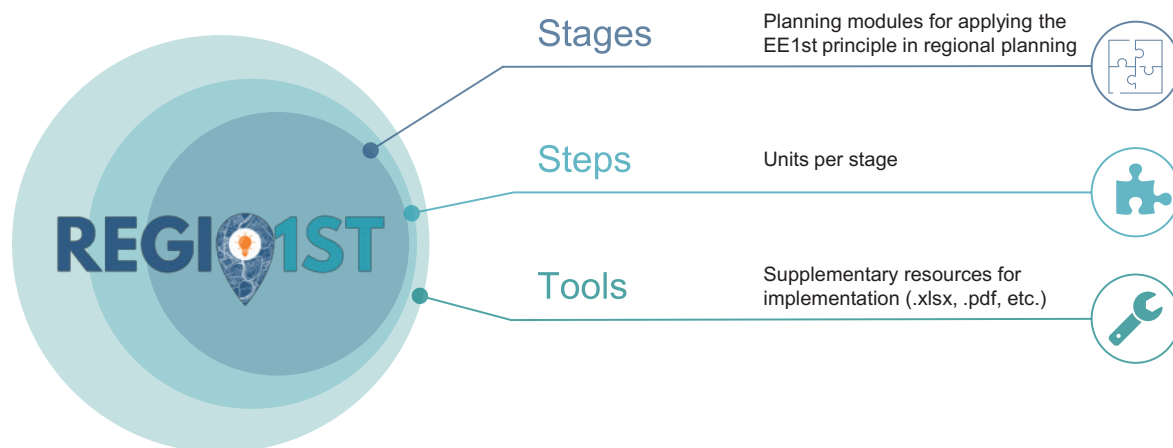


Figure 1. Stages, steps and tools in the REGIO1st Planning Framework.











Stage		Steps		Tools
01	Preparation	1.1 Determine the geographical area and scope of planning	1.2 Determine roles and responsibilities	 Roles and Responsibilities Matrix
		1.3 Identify and review existing regional energy plans	1.4 Set up the framework for developing a regional energy plan	
02	Engaging stakeholders and building partnerships	2.1 Identify key stakeholders	2.2 Develop a stakeholder engagement plan	 Stakeholder Identification and Analysis Template  Stakeholder Engagement Plan Guidance
03	Reviewing energy objectives and targets	3.1 Review national visions and targets	3.2 Review regional visions and targets	 National and Regional Targets Comparison Template  Participatory Priorities Ranking (PPR) Tool
		3.3 Set and define new regional objectives and targets	3.4 Discuss visions and targets with stakeholders	
04	Exploring the current regional energy system	4.1 Collate data to understand the current energy system	4.2 Analyze energy consumption by sector	 Energy Data Collection Template
		4.3 Evaluate existing energy infrastructure	4.4 Review the current system with stakeholders	
05	Cost-benefit analysis	5.1 Assess the potential of energy efficiency solutions	5.2 Assess the potential of renewable energy resources	 Technology Catalogue Tool  Cost-Benefit Analysis Tool
		5.3 Agree on modelling approaches with stakeholders	5.4 Model future techno-economic options	
		5.5 Monetize wider impacts	5.6 Identify least-cost combinations of solutions	
		5.7 Assess the sensitivity of the analysis		
06	Assessing the practical feasibility of least-cost energy solutions	6.1 Assess distributional impacts	6.2 Evaluate supply chain readiness for proposed solutions	 Multi-Criteria Decision Analysis Tool
		6.3 Assess the workforce capacity for the implementation	6.4 Organize stakeholder consultations to review options	
07	Defining actions and developing the regional energy plan	7.1 Prioritize energy interventions and develop the regional plan	7.2 Establish a monitoring and evaluation system	 Monitoring Template
		7.3 Pursue public acceptance and finalize the plan		
08	Implementation, monitoring and review	8.1 Develop detailed implementation plans	8.2 Establish partnerships to support implementation	
		8.3 Implement actions and communicate successes	8.4 Review and update the regional energy plan	

Figure 2. Outline of the REGIO1st Planning Framework.

The final step in Stage 1 is to define the planning process, timeline, budget and resources for developing the plan (**Step 1.4**). This involves establishing the planning and decision-making processes of the regional authority. It may be necessary to outsource some of the work, for example to consultants or regional energy agencies. This requires following the regional authority's procurement process and obtaining the necessary approvals and resources, which may include funding, staff and access to technical expertise and data.

Accompanying Stage 1 is the Excel-based *Roles and Responsibilities Matrix*, designed to help planners identify and assign roles and responsibilities. This tool ensures that all necessary tasks are covered, facilitating a well-coordinated and efficient process. It helps to define the roles and responsibilities of stakeholders actively involved in the planning process and produces a visual matrix to improve communication and collaboration between planning team members.

STAGE 2 ENGAGING STAKEHOLDERS AND BUILDING PARTNERSHIPS

Stage 2 of the REGIO1st Planning Framework is dedicated to outlining the stakeholder engagement process, which includes identifying key stakeholders and developing a comprehensive stakeholder engagement plan.

The first step in this stage requires planners to identify relevant stakeholder groups and understand their interests, strengths, limitations, influence and potential impacts (**Step 2.1**). Key stakeholders in the regional energy planning process can be a diverse group, including utilities, businesses, industry representatives, local authorities, community organisations, environmental groups, energy experts and citizens. The identification of these stakeholders and a thorough understanding of their priorities, interests, strengths, limitations, influence and potential impacts is vital. This understanding ensures that the regional energy plan responds to local and regional needs and empowers all relevant parties to actively contribute to the region's just energy transition. Methods such as stakeholder mapping exercises, informal meetings, workshops or focus group discussions can be used to gain insight into the different perspectives, needs and expectations of stakeholders. This approach not only helps to develop a comprehensive understanding of stakeholder dynamics, but also facilitates the establishment of a participatory energy planning process.

Following stakeholder identification and analysis, the next step is to develop a strategy for effectively involving stakeholders in the planning process (**Step 2.2**). This stakeholder engagement plan should detail how stakeholders will be involved

throughout the planning process, the tools to be used, and the timing and frequency of engagement activities. Key elements of the stakeholder engagement plan include ensuring transparent, inclusive and meaningful participation of all stakeholders, including marginalised and under-represented groups; facilitating open and constructive dialogue between stakeholders, fostering trust and cooperation; providing opportunities for stakeholders to influence decision-making and shape the regional energy plan; and communicating the progress and outcomes of the planning process to maintain stakeholder interest and support. Various engagement methods such as workshops, focus groups, public consultations, surveys, online platforms and social media can be used, depending on the specific context, objectives and resources available.

Two key tools are provided to support this stage: the *Stakeholder Identification and Analysis Tool* (Excel) and the *Stakeholder Engagement Plan Template* (PDF). The Stakeholder Identification and Analysis Tool is a structured approach to help planners identify and analyse key stakeholders for the regional energy plan. It helps categorise stakeholders by influence and interest, and provides tailored recommendations for engagement strategies ranging from frequent direct contact to occasional meetings and newsletters. The Stakeholder Engagement Plan Template is a comprehensive guide to help formulate an effective engagement strategy to ensure that all relevant stakeholders are appropriately involved. This template facilitates the creation of a detailed, actionable stakeholder engagement plan that is integral to the success of regional energy planning.

STAGE 3 REVIEWING ENERGY OBJECTIVES AND TARGETS

Stage 3 of the framework is central to ensuring that regional energy planning is consistent with broader national and regional visions. This stage engages various stakeholders to develop a common and well-informed approach to setting energy goals and targets.

The first step, reviewing *national* visions and objectives, requires planners to look at national energy policies, strategies and targets (**Step 3.1**). These may include targets for greenhouse gas emission reductions, renewable energy deployment, energy efficiency improvements, transport infrastructure development and energy security. National Energy and Climate Plans (NECPs) are a key resource in this regard. Understanding the national context is important to align the regional energy plan with the wider policy framework and to ensure coherence with national priorities.

Next, planners should review existing *regional* visions, strategies and objectives related to energy and other relevant policy areas (**Step 3.2**). This includes regional development plans, energy master plans, urban mobility plans, waste management plans and other strategic documents that have an impact on energy policy. This process helps to identify synergies, gaps and potential conflicts at the regional level and between different levels of government, and to ensure that the regional energy plan is consistent with and builds upon existing plans.

The next step is to define new or revised regional objectives, priorities and targets (**Step 3.3**). This step involves taking into account existing national, regional and local objectives and strategies. Objectives should include aspects such as economic development, long-term energy independence, environmental protection, and improvements in quality of life and health.

Identifying appropriate indicators for these objectives is also necessary for a more precise definition.

Engaging stakeholders to discuss these visions and goals is a critical part of this phase (**Step 3.4**). The objectives of this dialogue are to identify potential barriers and opportunities to achieving the identified objectives, to ensure that regional needs and stakeholder concerns are adequately reflected, to build consensus on the regional energy vision, objectives and targets, and to rank the importance of the objectives in order to establish priorities. Stakeholder engagement methods may include workshops, meetings or online consultations, depending on available resources and stakeholder preferences.

Two tools are provided to facilitate this stage: the *National and Regional Targets Comparison Template* (Excel) and the *Participatory Priorities Ranking* (PPR) tool (Excel). The National and Regional Targets Comparison Template helps planners to systematically compare regional energy targets with national and international targets. It includes columns for each type of target, such as greenhouse gas emissions reduction, renewable energy share, energy efficiency, and rows for national, regional and international targets. This comparison helps to identify gaps and areas that need attention or revision.

The PPR tool provides a transparent framework for the selection, evaluation and prioritisation of identified priorities. It encourages open communication, promotes stakeholder ownership and buy-in, and fosters a shared understanding of regional planning. Users work together to weigh up the importance of each priority, taking into account factors such as EU and national policies, social acceptance and other regional strategies. This inclusive approach ensures a more robust assessment and ranking of priorities, leading to informed and balanced decisions that meet collective needs and aspirations.

STAGE 4 EXPLORING THE CURRENT REGIONAL ENERGY SYSTEM

Stage 4 of the framework focuses on collecting and analysing data about the existing energy system. This stage covers energy use patterns, infrastructure and other key aspects, providing a baseline understanding.

The first step in this stage is to collect data to understand the current regional energy system (**Step 4.1**). Planners need to gather quantitative information on regional energy production and energy consumption by sector and energy source. Data sources are diverse, including regional and national statistical agencies or offices, utilities, industry reports, research institutions, up to the use of proxies where primary data is not available. The importance of accurate and comprehensive data cannot be overstated, as it provides the basis for developing a baseline energy inventory, understanding current energy dynamics, and setting realistic targets in the regional energy plan.

Once the necessary data has been collected, the next step is to analyse energy consumption patterns by sector, including the residential, commercial, industrial and transport sectors (**Step 4.2**). This analysis should look at aspects such as energy demand, energy intensity and the types of energy sources used in each sector. Understanding these sector-specific energy consumption patterns is central to identifying opportunities for improving energy efficiency, switching to alternative fuels, and implementing demand-side measures.

In addition, planners should evaluate the existing energy infrastructure in the region (**Step 4.3**). This evaluation includes

assessing the age, condition, capacity and efficiency of energy production, distribution and storage facilities. It should also examine the availability and accessibility of renewable energy resources. This assessment is important for identifying infrastructure-related constraints and opportunities, which could include the development of new renewable energy projects, and should be integrated into the regional energy plan.

A critical step in this phase is to review the current energy system with stakeholders (**Step 4.4**). Once a comprehensive understanding of the regional energy system has been established, planners should engage with stakeholders to discuss the findings. This may involve organising workshops, meetings or other engagement activities to present the data and analysis, gather feedback and gain insights from stakeholders. This step is important for validating the information collected, ensuring comprehensive consideration of relevant issues, and building consensus on the key challenges and opportunities within the regional energy system.

The *Energy Inventory Data Collection Template* (Excel) is provided to support Stage 3. This is designed to assist planners in systematically collecting and organising relevant inventory data, such as energy production and consumption, as well as key infrastructure information, including existing renewable energy production capacity. The template also serves as a checklist to guide planners in identifying key sectors and energy sources for data collection. It also facilitates the development of a greenhouse gas inventory for the region, an essential component in understanding and addressing the region's energy and environmental challenges.

STAGE 5 COST-BENEFIT ANALYSIS

Stage 5 of the framework is a comprehensive stage that evaluates different energy options, both on the demand and supply side of the energy system, and identifies cost-optimal solutions, taking into account wider multiple benefits and uncertainties. The first step in this stage is to assess the technical potential of energy efficiency solutions (**Step 5.1**). Planners need to evaluate opportunities for energy savings and efficiency improvements in different sectors, such as buildings, transport and industry. This assessment should take into account technical feasibility and the corresponding potential for energy savings and greenhouse gas emission reductions.

Following the assessment of energy efficiency solutions, planners should also evaluate the technical potential of renewable energy resources available in the region (**Step 5.2**). This assessment could include resources such as solar, wind, biomass, hydro and geothermal. Factors such as resource availability, technical feasibility, environmental impact and potential for regional economic development should be considered. This step is key to identifying promising renewable energy options for inclusion in the regional energy plan.

Before carrying out the cost-benefit analysis, it is crucial to agree on modelling approaches and scenarios with stakeholders (**Step 5.3**). This step involves discussing appropriate analytical tools, identifying key assumptions and defining different future scenarios, such as business-as-usual and energy efficiency-focused scenarios. Stakeholder involvement at this stage ensures transparency and credibility of the analysis. Using agreed modelling approaches and scenarios, planners should then model future techno-economic options (**Step 5.4**). This

involves carrying out a cost-benefit analysis under different scenarios, taking into account the potential of renewable energy resources and energy efficiency solutions, as well as direct and indirect costs.

In addition, the cost-benefit analysis should monetise benefits and wider impacts, including job creation, local economic development, and public health benefits (**Step 5.5**). This comprehensive approach helps planners capture the full value of different energy options and inform decision making. Dedicated external models, such as the MICATtool (Suerkemper et al. 2022) can further enhance this process.³ Next, planners should identify optimal combinations of renewable energy resources and energy efficiency solutions that offer the lowest costs to meet the region's energy goals and targets (**Step 5.6**). Finally, it is important to assess the sensitivity of the cost-benefit analysis to uncertainties such as fluctuations in technology costs, energy prices and policy frameworks (**Step 5.7**). This assessment helps planners to understand the robustness of the analysis and to identify potential risks and opportunities associated with different energy options.

Two tools are provided to facilitate this stage: the *Technology Catalogue Tool* and the *Cost Benefit Analysis Tool*, both in Excel format. The Technology Catalogue Tool helps planners assess the potential of different solutions by providing indicative information on renewable energy sources and energy efficiency solutions. It helps to understand the costs (capital, operational and maintenance costs, etc.), efficiencies, and emission intensities for the supply side, as well as potential energy and cost savings for energy efficiency solutions.

The cost-benefit analysis tool enables planners to assess the costs, benefits and selected wider impacts of different energy solutions, with a particular focus on the building sector. It includes inputs for key variables and outputs for costs and selected wider impacts (e.g. greenhouse gas emissions), helping to compare different energy options, such as building renovation and district heating systems. It also facilitates sensitivity assessments to uncertainties, helping planners to identify robust and resilient energy solutions in different circumstances.

STAGE 6 ASSESSING THE PRACTICAL FEASIBILITY OF LEAST-COST ENERGY SOLUTIONS

Stage 6 of the framework is dedicated to examining the distributional impacts, supply chain readiness, workforce capacity and public acceptability of the identified cost-optimal energy options. This phase is critical to ensuring the viability and sustainability of the proposed cost-optimal energy solutions within the regional context.

The first step in this stage is to assess the distributional impacts of energy options on different groups within the region, such as residents, businesses and particularly vulnerable populations (**Step 6.1**). Planners need to consider factors such as access to energy, affordability, and potential job creation or displacement. This assessment is essential to identify and address potential inequalities and ensure that the regional energy plan promotes social equity and has broad community support.

Following the assessment of distributional impacts, planners should evaluate the readiness of supply chains for the proposed

3. <https://app.micatool.eu/>

energy technologies and solutions (**Step 6.2**). This includes assessing the local, regional, and supra-regional availability of necessary equipment, materials and services, as well as the technological maturity and market readiness of these technologies. Understanding the supply chain landscape is critical to identifying potential bottlenecks, risks and opportunities, and informing the selection and prioritisation of energy options. In addition to supply chain considerations, assessing the labour capacity required to implement the proposed energy options is critical (**Step 6.3**). This includes assessing the availability of skilled labour, and the need for training and capacity building programmes.

The final step in Stage 6 is to organise stakeholder consultations to gather feedback and review the different energy options (**Step 6.4**). These consultations should involve a wide range of stakeholders, including businesses, local authorities and other interested parties, possibly including the public. Various forms of stakeholder consultation can be used, such as workshops, focus groups, online surveys and meetings. The purpose of these consultations is to present the results of the cost-benefit analysis and the practical feasibility assessment, to obtain feedback on the proposed energy options, to address concerns, to answer stakeholder questions, and to build stakeholder support and buy-in for the regional energy plan.

The *Multi-Criteria Decision Analysis (MCDA) Tool* (Excel) is provided to support this stage. This tool helps planners to obtain feedback from stakeholders on the prioritisation of different energy options. It allows planners to apply criteria weights to objectives, such as job creation, and impacts, including distributional impacts, to determine stakeholder preferences. This process helps to derive aggregated scores and rankings that identify the most feasible energy options for the region. The MCDA tool helps to ensure that the selected energy solutions are not only economically viable, but also environmentally consistent with current regulations and socially equitable and widely accepted within the regional community.

STAGE 7 DEFINING ACTIONS AND DEVELOPING THE REGIONAL ENERGY PLAN

In Stage 7 of the framework, specific actions are selected and a robust regional energy plan is formulated. This stage ensures that the selected interventions are impactful, provide net benefits and are aligned with stakeholder priorities.

The first step in this phase is to prioritise energy interventions and develop the regional plan (**Step 7.1**). Planners are tasked with selecting the most appropriate energy solutions and interventions, taking into account their potential impact, cost-effectiveness and how well they align with the priorities of different stakeholders. This is followed by the development of a detailed plan outlining specific actions and interventions. Each aspect of the plan should include scope, responsibilities, timelines, estimated implementation costs, expected impacts and likely funding sources or mechanisms. In addition, demonstration projects should be identified. These projects can demonstrate the feasibility and benefits of innovative energy technologies or approaches. They serve as valuable learning experiences for the local community and help to build public support, attract investment and stimulate local markets.

The next step is to establish a robust monitoring and evaluation system (**Step 7.2**). This system is essential to track the

progress of the implementation of the regional energy plan and to assess its performance against the objectives and targets set. Regular data collection, analysis and reporting on key performance indicators, such as energy consumption, greenhouse gas emissions, renewable energy generation and energy efficiency improvements, are key components. The monitoring and evaluation process should also include regular reviews and assessments of specific projects and measures to identify challenges, successes and lessons learned. The final step is to seek public acceptance and finalise the regional energy plan (**Step 7.3**). The plan should be submitted for public consultation to gather feedback from stakeholders to ensure public acceptance and buy-in. After careful consideration of the results of the public consultation, the plan should be finalised and published.

To support this stage, the *Monitoring Template* (Excel) is provided. This tool helps planners to monitor the implementation of the actions and measures included in the regional energy plan. It enables planners to report on progress, assess the impact of actions and interventions and evaluate their effectiveness. This systematic approach to monitoring and evaluation is critical to ensuring the success and adaptability of the plan, allowing for ongoing improvements and adjustments based on real-world performance and stakeholder feedback.

STAGE 8 IMPLEMENTATION, MONITORING AND REVIEW

Stage 8 of the framework is the final stage where the regional energy plan is put into action, its progress is tracked, and it is periodically reviewed and updated to ensure its relevance and effectiveness.

The first step is to develop detailed implementation plans for each action or solution included in the regional energy plan (**Step 8.1**). These plans should outline specific steps, allocate resources, assign roles and responsibilities, and define timelines and key milestones. Securing funding is essential for the implementation of actions and projects. Planners should explore different sources of funding, including public funds, private investment, grants and loans, and identify the most appropriate options for each action and project. This should also address potential risks and include mitigation measures to ensure successful implementation.

Establishing partnerships with key stakeholders is crucial to the successful implementation of sustainable energy actions and projects (**Step 8.2**). These partners may include utilities, businesses, research institutions, non-profit organisations and other relevant entities. Partnerships can provide resources, expertise and networks to support project implementation, facilitate knowledge exchange and foster collaboration. They can also provide in-kind contributions such as land, expertise or equipment to support projects.

Throughout the implementation phase, it is important to communicate successes to stakeholders and the public to maintain support and commitment (**Step 8.3**). Regular updates on the progress and impacts of sustainable energy actions and projects can build public trust and enthusiasm for the regional energy plan. Communication efforts can include press releases, newsletters, social media updates and public events.

The final step is to periodically review and update the regional energy plan (**Step 8.4**). This process should include a comprehensive assessment of the plan's progress towards its

goals and targets, evaluation of the effectiveness of specific actions and projects, and consideration of outcomes and lessons learned. It should also assess the changing energy landscape, technological advances and stakeholder priorities. Based on this review, planners should identify areas for improvement and revise the plan accordingly. This may include updating sustainable energy actions and projects, adjusting targets and objectives, and refining implementation plans.

Launch of the framework and practical experiences

Following positive initial responses from regional authorities, preparations for the public launch of the REGIO1st Planning Framework are underway. This includes carrying out quality checks to ensure the reliability and accuracy of the tools within the framework and producing detailed user guides and tutorials, complemented by 5–10 minute demonstration videos for each tool. The REGIO1st Planning Framework will be available online by April 2024 and will have an intuitive interface and interactive elements to increase user engagement.

Six European regions are currently adopting the framework to develop their regional plans, integrating decisions on both energy demand and supply in line with the EE1st principle. Initial steps in these regions have included stakeholder engagement, data collection on regional energy balances and dedicated workshops with regional decision-makers. To further support this process, a series of online training modules covering the eight phases of the planning framework are planned to run in the Spring and Summer of 2024. Completion of the planning process in these regions is expected within 2025, at which point the effectiveness of the REGIO1st Planning Framework will be evaluated by monitoring prospective outcomes such as energy savings achieved.

Several challenges have emerged during the early adoption of the framework. For example, the region of South-East Ireland and the Medjimurje county in Croatia pointed to the lack of a national legal obligation to implement the EE1st principle and a general lack of awareness among local authorities. A common challenge across all regions has been the lack of knowledge and information about EE1st and its implementation among technical and political staff of local and regional planning bodies.

Despite these challenges, initial good practices are emerging. For instance, the Principality of Asturias in Spain has successfully created a multi-stakeholder regional working group for energy planning and for better monitoring and implementation of actions. Another good practice is from the Liguria region in Italy that has used an energy efficiency scenario as a starting point in its planning process.

Looking ahead, the framework will need to respond to evolving regional needs. Adjustments and improvements will be made based on practical experience and feedback. Efforts are being made to translate best practices and lessons learned into easily accessible materials such as briefings, infographics and webinars. The potential for the future uptake of the framework by more regions is promising, with plans to establish a community of practice for EE1st in collaboration with the CoM. The ultimate aim is for the framework to be used by more than 100 regions across Europe, demonstrating its scalability and adaptability to different regional contexts.

Conclusion

The EE1st principle is rapidly gaining momentum in EU energy and climate policy, providing a strategic approach to meeting the needs for energy services in a sustainable and cost-effective way. By prioritising energy efficiency improvements across different sectors, the principle addresses key societal objectives such as decarbonisation, improving energy security and reducing consumer costs. Its rapid rise from an emerging concept to a central element of EU legislation underlines its importance. However, the implementation of the EE1st principle poses challenges, particularly at regional level. Given the complexity of regional energy systems in Member States, there is a clear need for comprehensive planning tools to facilitate this process.

The REGIO1st Planning Framework provides a structured and comprehensive methodology for regional authorities to integrate the EE1st principle into their energy planning processes. By offering a step-by-step approach that covers stakeholder engagement, data collection, cost-benefit analysis, practical feasibility assessments and decision-making, the framework enables a thorough and inclusive planning process. This process places a strong emphasis on integrating energy efficiency as a priority in regional energy planning.

The ongoing practical application of the framework in six pilot regions illustrates its potential to shape regional energy plans and strategies. Challenges such as capacity constraints, knowledge gaps and the need to raise stakeholder awareness have been identified. These are being actively addressed through extensive capacity building and training activities, as well as adaptations to the framework. As such, the REGIO1st Planning Framework represents a significant step forward in operationalising the EE1st principle at the regional level, facilitating the transition to an efficient, sustainable and equitable energy system.

The adaptability of the framework allows it to evolve in response to feedback and changing regional needs, ensuring its relevance and effectiveness in different contexts. As more regions across Europe adopt and implement the framework, more experiences and best practices will emerge that can further enhance its applicability and impact. The prospect of establishing a community of practice for the EE1st principle, in cooperation with the Covenant of Mayors, could make a significant contribution to the collective effort to achieve the EU's energy and climate goals.

References

- Bayer, Edith; Bowie, Randall; Cowart, Richard; Fong, Patty; Genard, Quentin; Holmes, Ingrid et al. (2016): Efficiency First: A New Paradigm for the European Energy System. Driving competitiveness, energy security and decarbonisation through increased energy productivity. Berlin/Brussels: European Climate Foundation.
- Bertoldi, Paolo (Ed.) (2018): Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP)'. Part 1 – The SECAP process, step-by-step towards low carbon and climate resilient cities by 2030. Brussels: Joint Research Centre (JRC).
- Broc, Jean-Sébastien; Pató, Zsuzsanna; Mandel, Tim; Fabbri, Mariangiola; Oikonomou, Vlas (2022): Putting Energy Efficiency First into Practice. Final Report. Brussels:

- ENEFIRST Project. Available online at <http://enefirst.eu>, checked on 2/11/2023.
- Brown, Marilyn A.; Wang, Yu (2017): Energy-efficiency skeptics and advocates: the debate heats up as the stakes rise. In *Energy Efficiency* 10 (5), pp. 1155–1173. DOI: 10.1007/s12053-017-9511-x.
- Catapult (2022): Guidance on Creating a Local Area Energy Plan. Birmingham: Energy Systems Catapult.
- Dobracev, Viktorija; Matak, Nikola; Sakulin, Christian; Krajačić, Goran (2021): Multilevel governance energy planning and policy: a view on local energy initiatives. In *Energy, Sustainability and Society* 11 (1). DOI: 10.1186/s13705-020-00277-y.
- DOE (2013): Guide To Community Energy Strategic Planning. Washington, D.C.: United States Department of Energy (DOE).
- European Union (2018): Regions in the European Union. Nomenclature of territorial units for statistics – NUTS 2016/EU-28. Edition 2018. Luxembourg: Publications Office of the European Union.
- Fawcett, Tina; Killip, Gavin (2019): Re-thinking energy efficiency in European policy: Practitioners’ use of ‘multiple benefits’ arguments. In *Journal of Cleaner Production* 210, pp. 1171–1179. DOI: 10.1016/j.jclepro.2018.11.026.
- Herreras Martínez, Sara; Harmsen, Robert; Menkveld, Marijke; Faaij, André; Kramer, Gert Jan (2022): Municipalities as key actors in the heat transition to decarbonise buildings: Experiences from local planning and implementation in a learning context. In *Energy Policy* 169, p. 113169. DOI: 10.1016/j.enpol.2022.113169.
- Mandel, Tim; Pató, Zsuzsanna; Broc, Jean-Sébastien; Eichhammer, Wolfgang (2022): Conceptualising the energy efficiency first principle: insights from theory and practice. In *Energy Efficiency* 15 (6), pp. 1–24. DOI: 10.1007/s12053-022-10053-w.
- Neves, Ana Rita; Leal, Vitor; Lourenço, João Carlos (2015): A methodology for sustainable and inclusive local energy planning. In *Sustainable Cities and Society* 17, pp. 110–121. DOI: 10.1016/j.scs.2015.04.005.
- Oikonomou, Vlas; Eichhammer, Wolfgang (2021): Energy efficiency first principle in the regional governance. In *eccee Summer Study Proceedings* 2021, pp. 325–334.
- Stavarakaki, Andriana; Konstantopoulos, George (2023): Regional development planning cycles and procedures. Deliverable D2.1 of the REGIO1st Project (Implementing the Energy Efficiency First Principle in Regional Planning). Brussels: REGIO1st Project.
- Suerkemper, Felix; Xia-Bauer, Chun; Vondung, Florin; Thema, Johannes (2022): The Conceptual Framework of MICAT and its Relevance for Policymakers. Policy Brief. Brussels: MICAT Project (Multiple Impacts Calculation Tool).