Do Zero-Energy Building Requirements Motivate Use of Higher Efficiency Solar Cells?

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Market Diversifikation for PV: Integration
Double Use of Area in Urban Sites

Market: Environment covered with buildings
excellent grid structure available
→ decentralized, localized energy production;
Demand for “nice” modules;
higher cost per kWh, but additional functionalities

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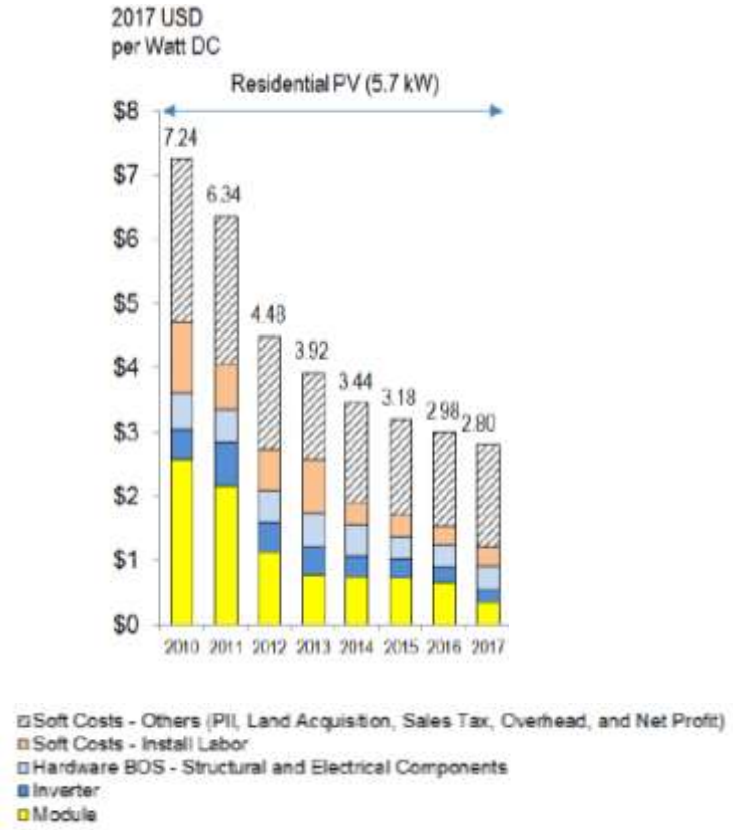
Value of Efficiency

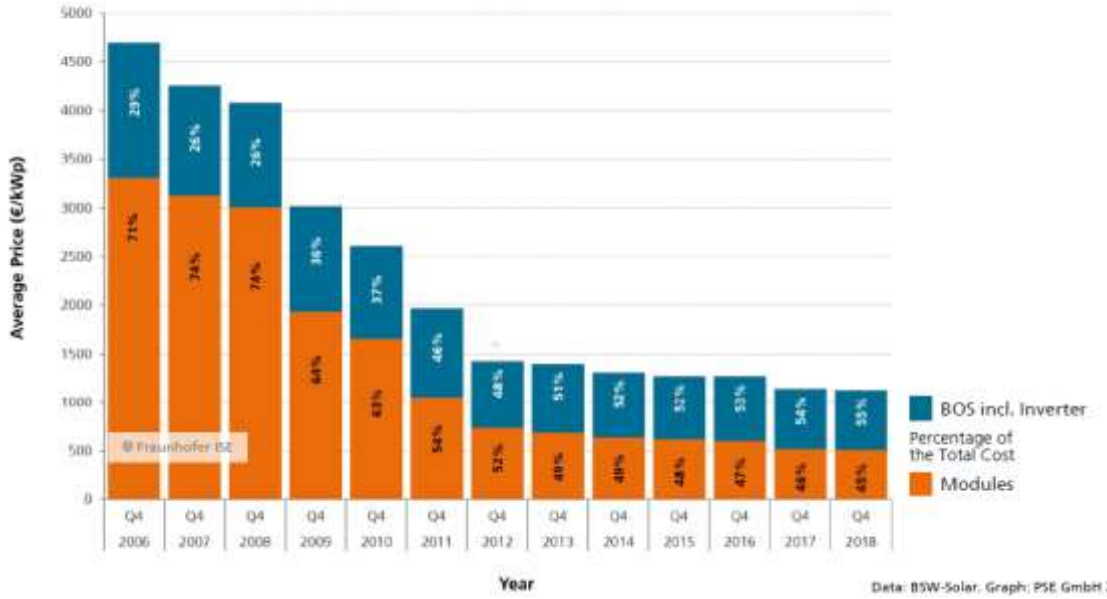
1. **Eta improvements save resources (Ag, Si, energy, CO_2 emissions), in particular relevant for a TW scenario**

2. **System with limited space and high energy demand**
   - VIPV, reduce charge cycles, improve cruising range
   - What about BIPV?
     - Costumer: “BIPV product has to be cheaper”
       BIPV manufacturer: “I have got an idea, we save one row of solar cells within the module”,
       Costumer: “Excellent, let’s do it!”
       → BIPV is (also) cost driven

3. **Eta is beneficial for systems with higher BOS costs; reduces specific cost ($/$W_p$)**

Eta Improvements Reduce Specific Cost ($/Wp)





Source: U.S. Solar Photovoltaic System Cost Benchmark: Q1/2017, NREL, 2017 (left), BSW-Solar, PSE GmbH 2019 (right)

- High Eta helps more to reduce cost in the US than in Europe
  - → BOS + soft costs in the US (>2.30 $/$W_p$) more expensive than in Europe (Germany, ~0.70 $/$W_p$)

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A Trial to Reveal a Business Case for PV-Facades

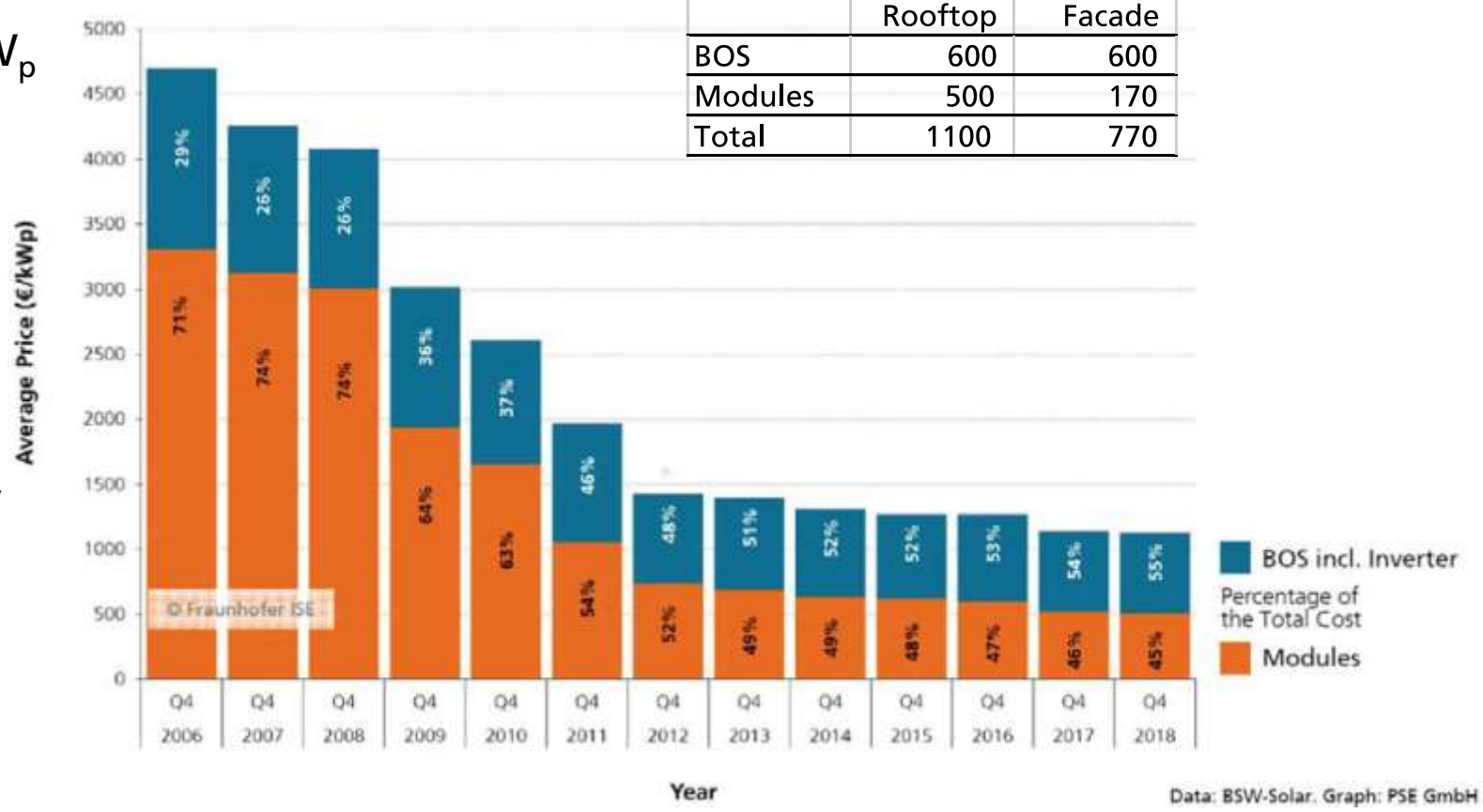
Background: A Glance Towards Roof-Mounted (10-100 kW_p) Systems

- In Germany exist business cases for roof mounted systems with 1.1 €/W_p turn-key costs
  → Module cost 0.5 €/W_p
  → BOS cost 0.6 €/W_p

- Facades: 30% reduced irradiation
  → allowable system cost 0.77 €/W

  → allowable additional cost for PV integration into the façade: 0.17 €/W_p

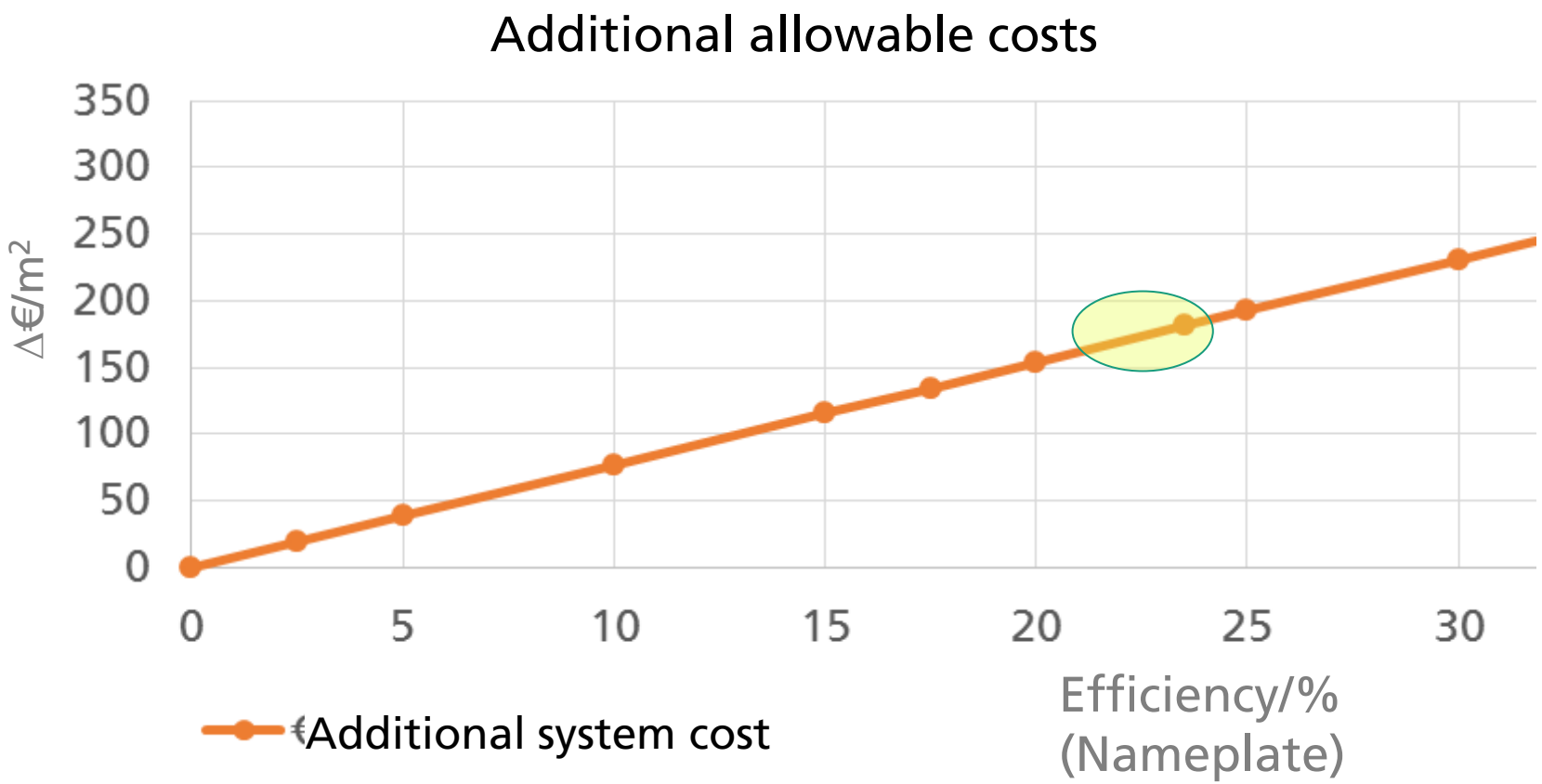
	Rooftop	Facade
BOS	600	600
Modules	500	170
Total	1100	770



The Value of Eta for BIPV Glass Facades

Allowable Additional Costs for PV Integration in Δ€/m² as Criterion

- multi-functional building envelope components
- additional function: solar energy harvesting



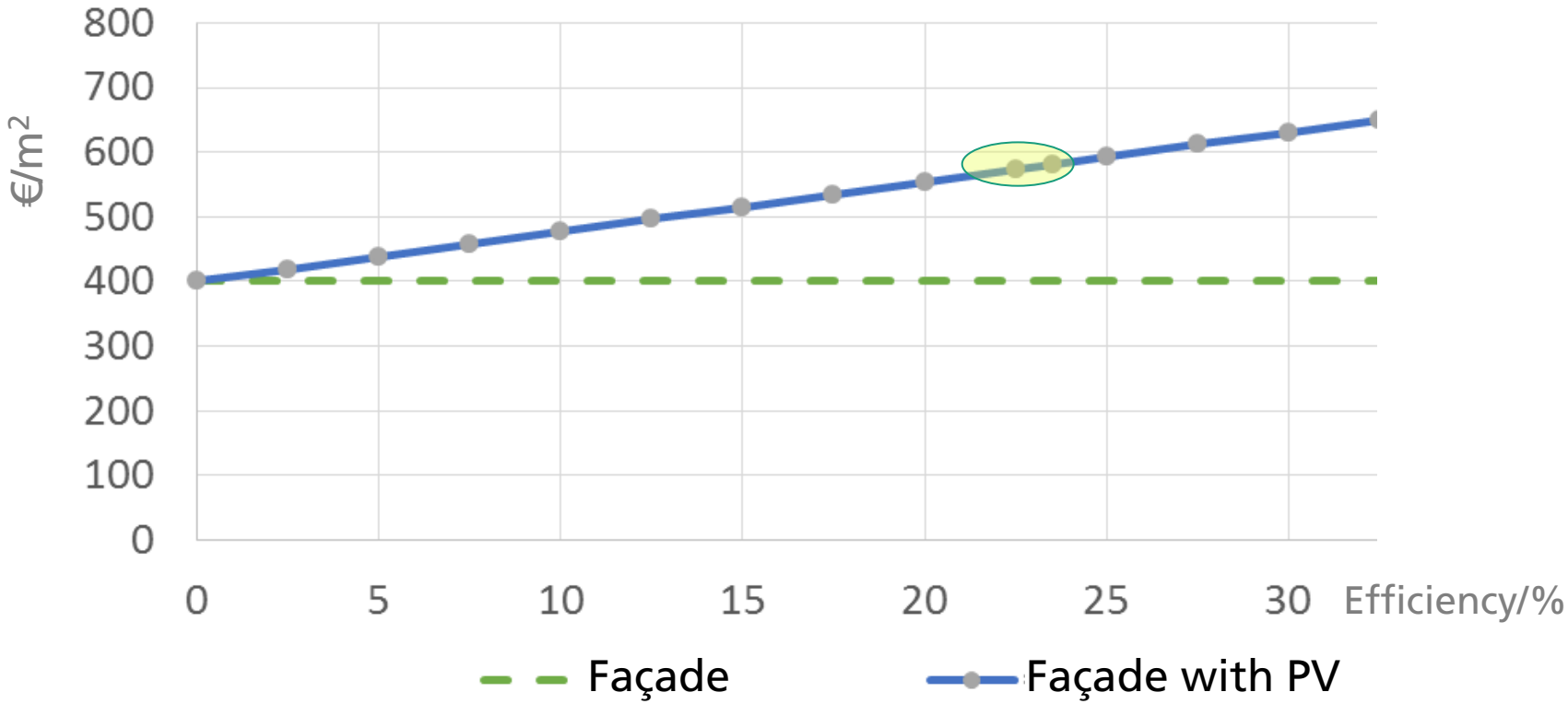
The Value of Eta for BIPV Glass Facades

Allowable Costs for Rear Ventilated Glass Facades [€/m²]

- multi-functional building envelope components
- additional function: solar energy harvesting
- Example: glass façade with 400 €/m² cost

→ Eta matters!

Typical allowable cost for glass façades
with or without BIPV function



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(Nearly) Zero-Energy Buildings

- In Europe, Directive 2010/31/EU on the energy performance of buildings:

  As of 31 December 2020 new buildings in the EU will have to consume 'nearly zero-energy'

  'Nearly zero-energy building' means a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

  Each Member State has to define its detailed application in practice of the definition of nearly zero-energy buildings, reflecting its national, regional or local conditions.

  - Requirements are differently defined

Implementation of Nearly Zero Energy Buildings in Different European Countries

- Example of different requirements for U-values shows discrepancies across countries

U-VALUES [W/(M²K)]	AUSTRIA	GERMANY	FRANCE	ITALY	SWEDEN
Sources	OIB-RL 6	KfW	RT2012	D.M. 26/06/2015	BBR 25
Wall	0.35	0.20	-	0.26	0.18
Roof	0.2	0.14	-	0.22	0.13
Floor	0.4	0.25	-	0.26	0.15
Window	1.4	0.9	-	1.4	1.3

Table 14: U-values requirements comparison in the consortium countries.

- Further differences in requirements for primary energy demand, use of primary energy factors etc.

→ Different requirements lead to different levels of demand for highly efficient BIPV solutions.

Taken from CRAVEZero Report on the EU implementation of nZEBs[1]

[1]http://www.cravezero.eu/wp-content/uploads/2018/07/CRAVEzero_D21_Report-of-EU-implementation-of-nZEBs.pdf

Are Solar Cells with Higher Efficiencies Required for Zero Eenergy Buildings?
Two Qualitative Arguments

- Limited area of building skin:
  - Façade area very limited for buildings with large footprint
  - Roof area very limited for high buildings
  - Floor area (and thus consumption) grows with floor number and footprint
    - → For larger buildings, surface areas are limited and reaching NZEB requires very efficient harvesting of the solar energy incident to the building skin.

- Higher efficiencies of solar cells reduces system cost drastically, specifically if the BOS share are high, as it is the case for integration in buildings.

Conclusions

- PV integration into building values high efficiency solar cells

  The pricing for higher efficiency solar cells in PV-Facades can be a bit higher compared to the use in large power plant since the BOS share is higher
  → BIPV is a market for high-efficiency cells

- (Nearly) Zero Energy Buildings certainly values high efficiency solar cells even more

Thank You for Your Attention

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