



CRAVEzero-WS @ISEC

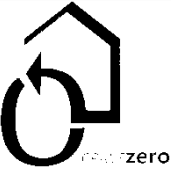
nZEB technologies and cost development

Benjamin Köhler (Fraunhofer ISE)



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Cost Reduction and market Acceleration for Viable nearly zero-Energy buildings



01

Data and Methodology

Required data, data sources, method

02

Relevant technologies

Active, passive, renewable

03

Cost reduction potentials

Top-down

04

Discussion/ Conclusion



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- Technical parameters:
 - Technical lifetime
 - Installed power (kW)
 - Efficiency
- Additional:
 - Past market development and market forecasts
- Economic parameters:
 - Absolut and specific investment cost (inflation-adjusted)
 - O&M cost
 - Learning rate
 - Stage in lifecycle

- Twelve case studies are foundation
 - Office, single- and multifamily buildings
 - Information about HVAC and on-site renewable energy technologies
- Additional detailed literature review
- Brought together in technology database (base year 2016)

- Two main approaches to determine cost reduction potentials:
 - Top-down
 - Bottom-up
- Mainly Top-down approach applied due to data availability
- For identified critical/ very important technologies
Bottom-up analysis

- Top-down
 - Costs decreases in relation to increased cumulative production (learning effects)
 - Learning rate describes the reduction in percent with each doubling of the cumulative volume
 - Needed data: investment costs, learning rate, market forecast (EU)
 - Result: cost curve for each technology
- Bottom-up
 - Determine all technological cost drivers:
 - Technological improvements
 - Shift of manufacturing processes
 - Potential pathways for future cost reductions
 - Materials, Utilities, Labor, Depreciation, Maintenance

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Relevant technologies

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- Active:
 - Heat pumps (HP; aerothermal, ground source)
 - Oil and gas boiler (reference; currently widespread in buildings)
 - Biomass boiler
 - Air conditioning
 - Ventilation (decentralized and central with heat recovery)
 - Thermal storage
 - Electricity storage

Relevant technologies

Active, passive, renewable

- Passive:
 - Insulation of building envelope
 - Free ventilation
 - Night cooling
 - Daylight
 - Shading
- Renewable:
 - PV
 - Solar thermal

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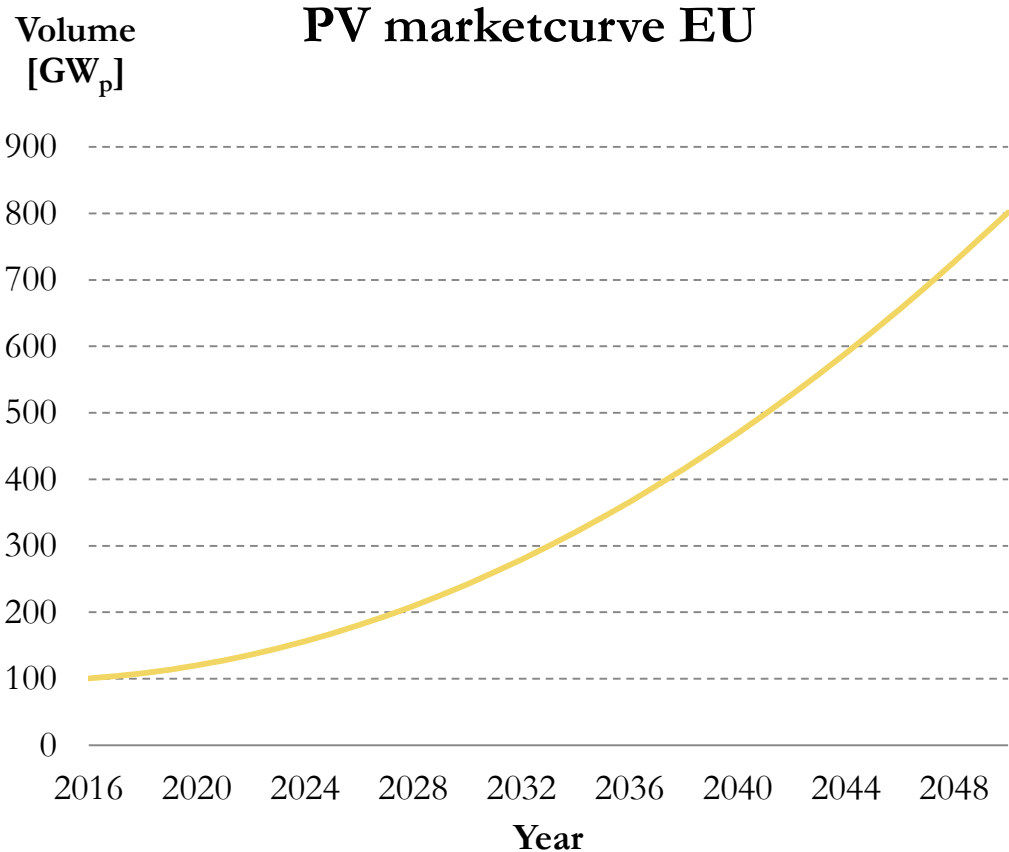
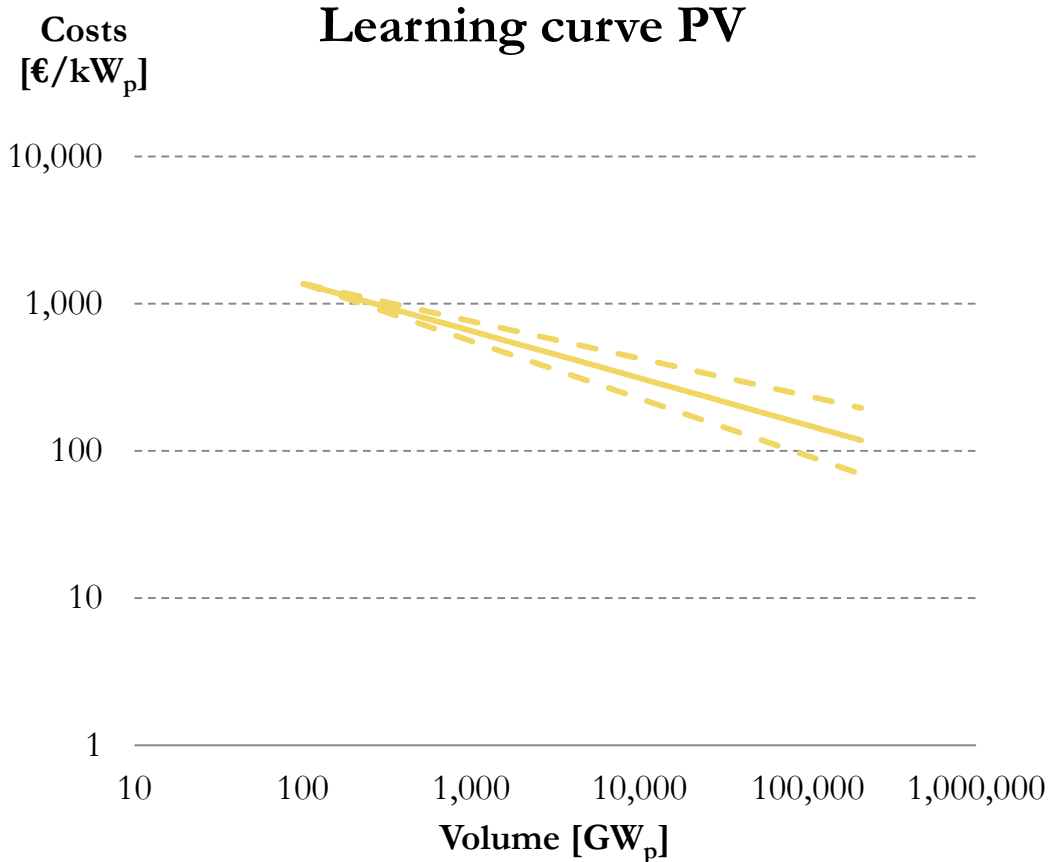
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Cost reduction potentials

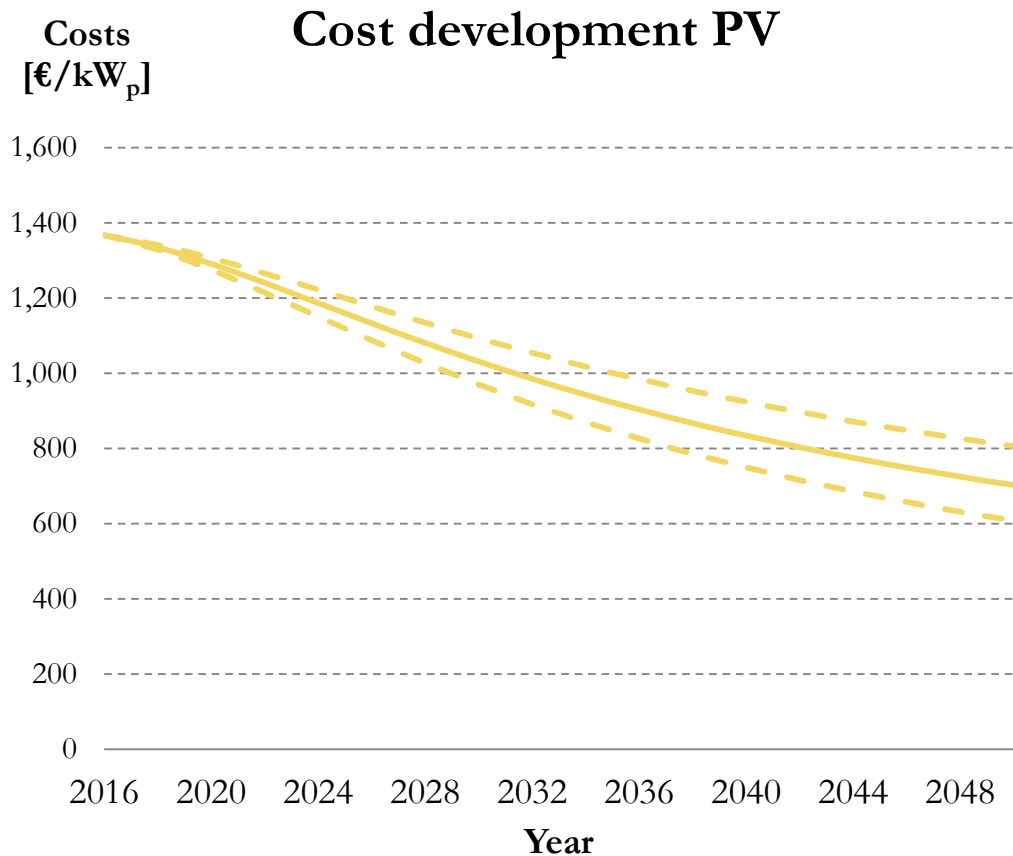
Top-down – exemplary procedure



03 Cost reduction potentials

Cost reduction potentials

Top-down – exemplary procedure

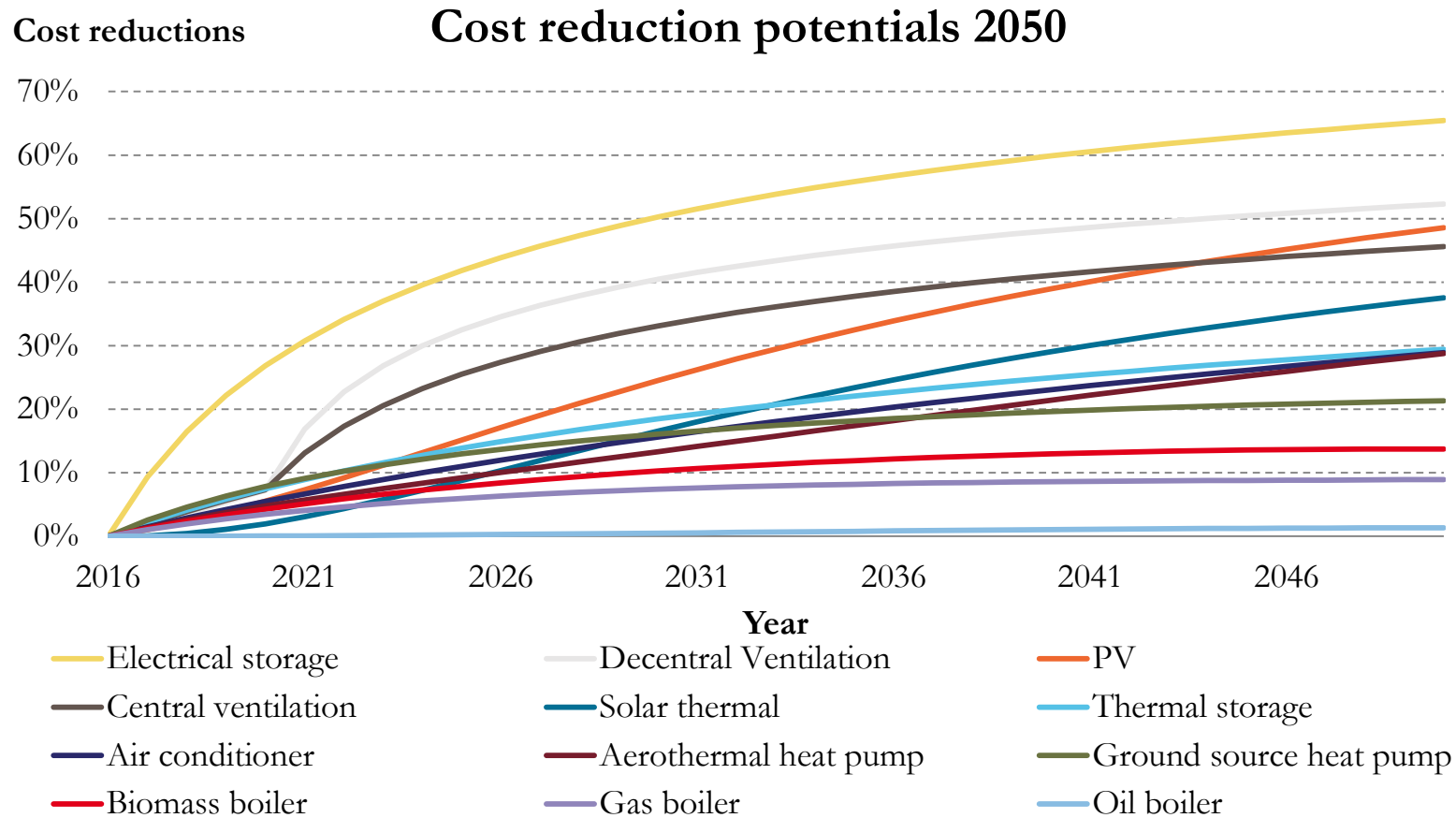


- Cost reduction potential of 49 %
- Costs will decrease from 1,370 €/kW_p to approx. 700 €/kW_p
- Range of 610 €/kW_p to 810 €/kW_p (-41 % to -56 %)

03

Cost reduction potentials

Top-down – exemplary procedure



- Cost reduction potentials between 1 % and 65 %
- Stationary batteries have highest reduction potential >65,4 %

Cost reduction potentials

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- Most technologies needed for nZEBs already available
- Latest and most efficient ones still have high cost reduction potential
- Probably **new technologies** will enter into market in coming years → which ones (e.g. Fuel-cell CHP) and how fast they develop cannot be foreseen → high uncertainties and therefore no cost curves developed!
- Challenge: Quantification of costs and effects of passive technologies/ strategies

- Top-down:
 - Cost reduction potentials until 2050 between 1% to 65%
 - Technologies with highest cost reduction potential: Storages, ventilation and on-site renewables
- Bottom-up:
 - PV: Efficiency optimizations and lower material input
 - Solar thermal systems: Less material use and switching to cheaper
 - Electrical storages: Economies of scale and technological improvements
- Highly insulated building envelope and low-tech, passive strategies are essential for nZEBs

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Thank you for your attention!
Questions?

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Co-funded by the Horizon 2020
Framework Programme of the European Union