Electric vehicles or use of hydrogen in the Danish transport sector in 2050?

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Electric vehicles or use of hydrogen in the Danish transport sector in 2050?

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TOP NEST workshop - WP2
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DTU Management Engineering
Department of Management Engineering

Agenda

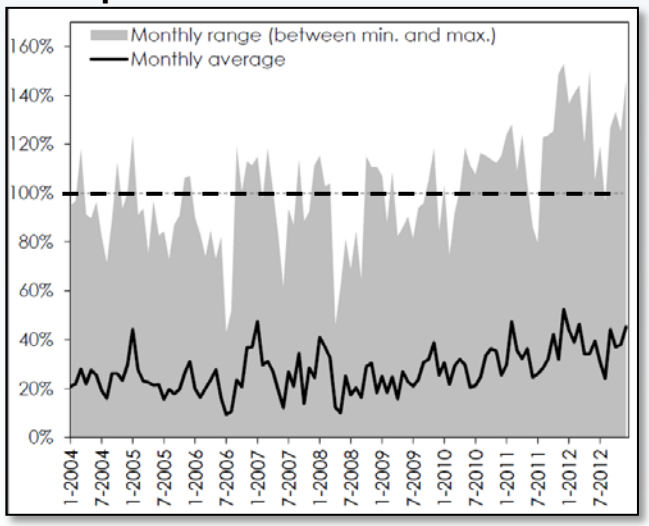
- Research motivation
- STREAM model
- 2050 scenarios
- Scenario results
- Technological path towards the 2050 target?

Research motivation

- Political targets in DK:
  - 2035: 100% RES based electricity generation
  - 2050: fossil free energy sector incl transport

- Large share of wind in the power supply
- Limited domestic biomass resources
- Need for a flexible demand

Wind production share in DK-West

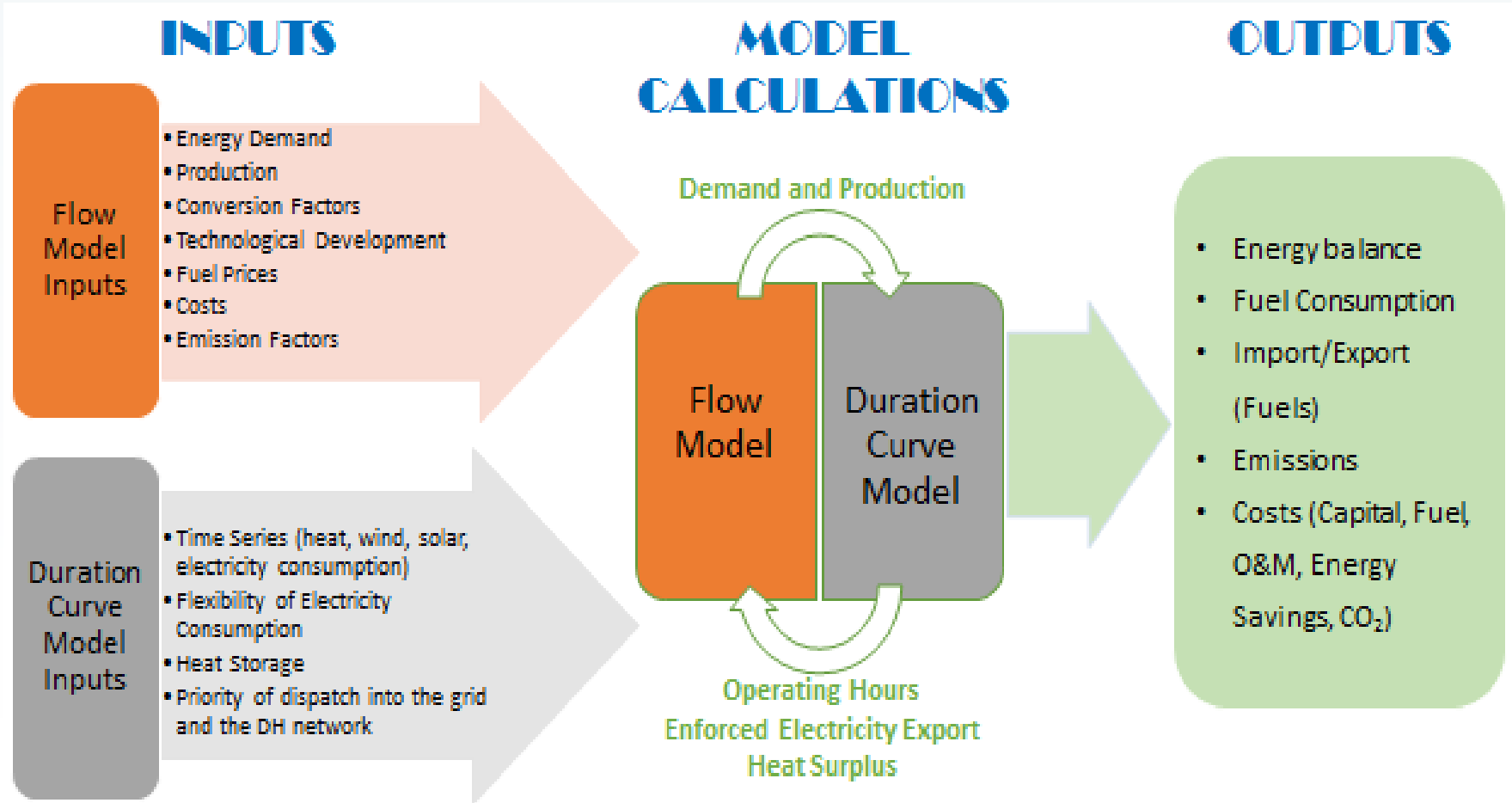


- Radical restructuring of fuel use and vehicle stock

- EV or H2?
  - Which costs?
  - Interaction with the energy sectors?

- Which technological path?
  - Low capital costs? Flexible demand? or high efficiency?

STREAM model

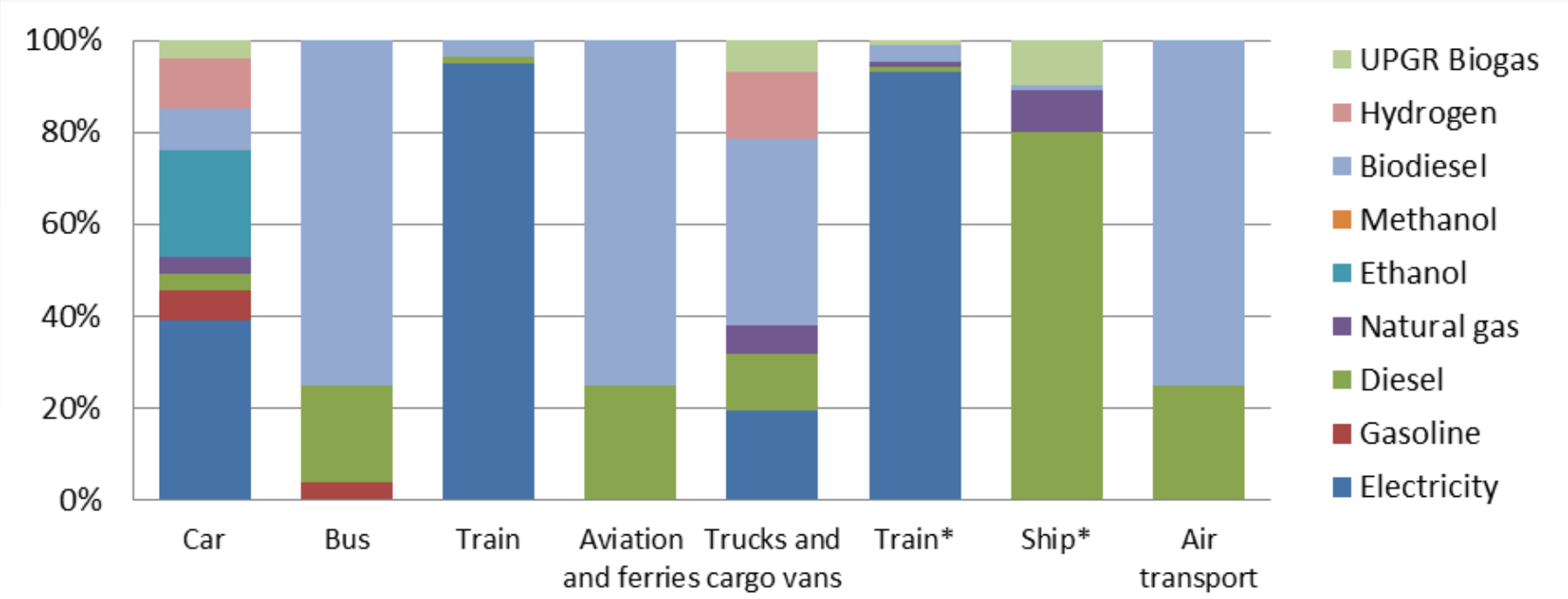


Reference - Carbon Neutral Scenario - CNS

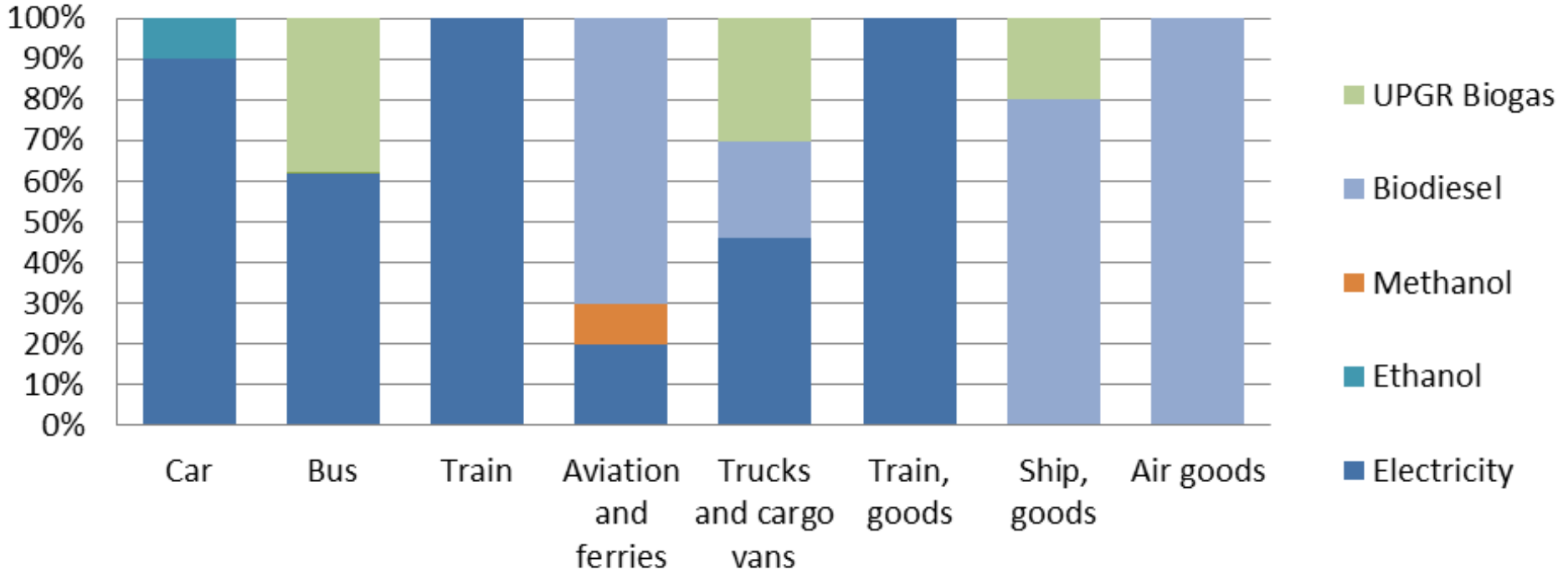
Eletricity production			District Heat boiler production		
	2012	CNS 2050		**2012**	CNS 2050
Coal Plant	57%	0%	Coal boiler	1%	0%
Gasturbine	23%	0%	Natural gas boiler	47%	0%
Wind, offshore	4.3%	56%	Geothermal	2%	0%
Wind, onshore	18%	27%	Heatpump	0%	21%
Biomass	9%	4%	Wood pellet boiler	31%	76%
Biogas	1%	4%	Oil boiler	15%	0%
Waste incineration	7%	5%	Biogas Boiler	1%	1%
Photo voltaic	0%	2%	Municipal waste	3%	3%
Wave power	0%	1%	Electric boiler	1%	0%
Biomass incl. CO2-storage	0%	2%	Solar heat	1%	0%
Demand coverage	118%	100%	**Demand coverage**	100%	100%
Electricity imports	-18%	0%	Heat import	0%	0%

Technology mix in the electricity and heating sectors

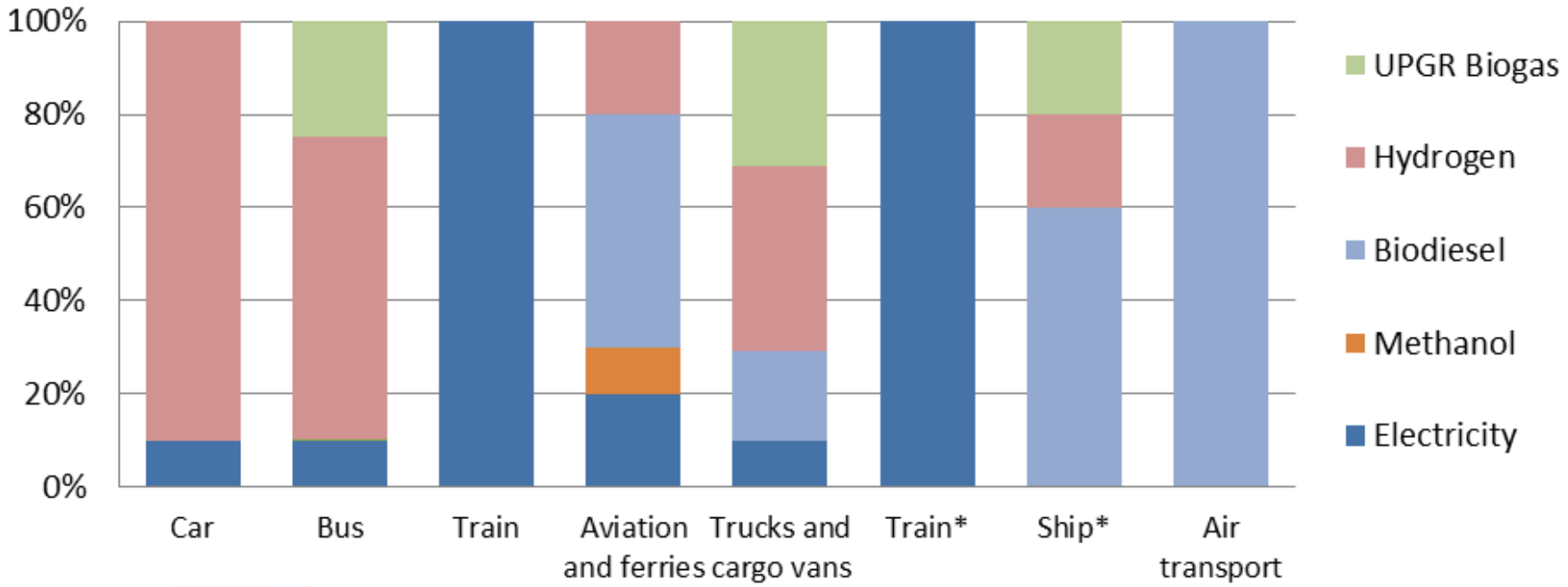
Reference - Carbon Neutral Scenario - CNS

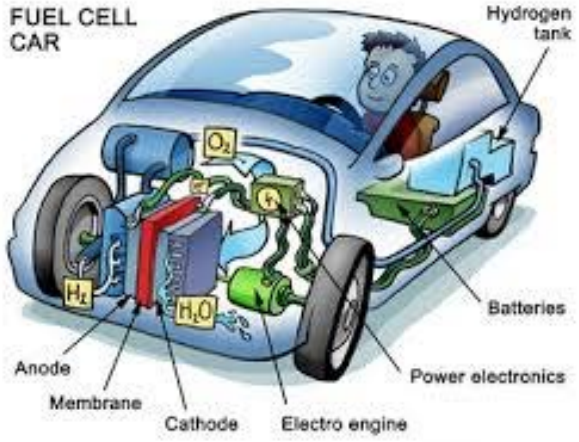


Electric Vehicles Scenario - EV

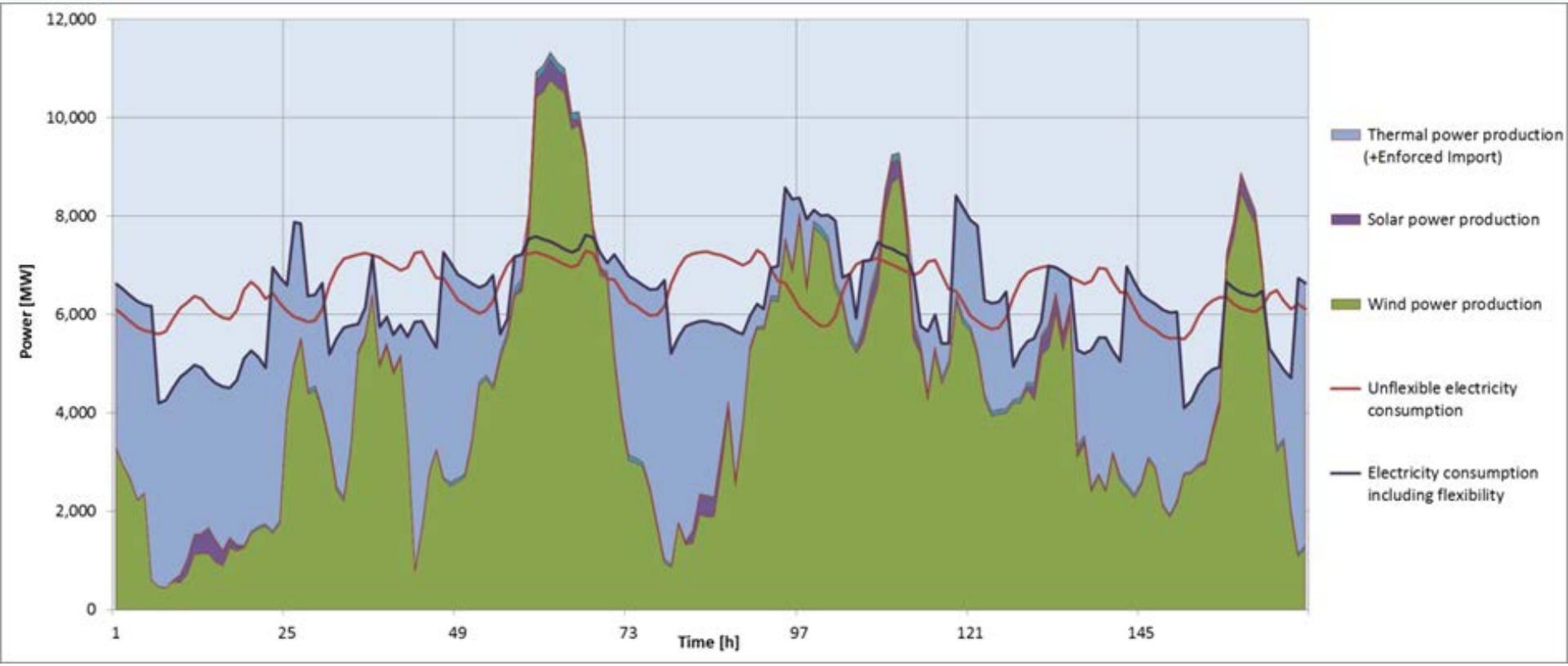


Hydrogen Scenario - H2



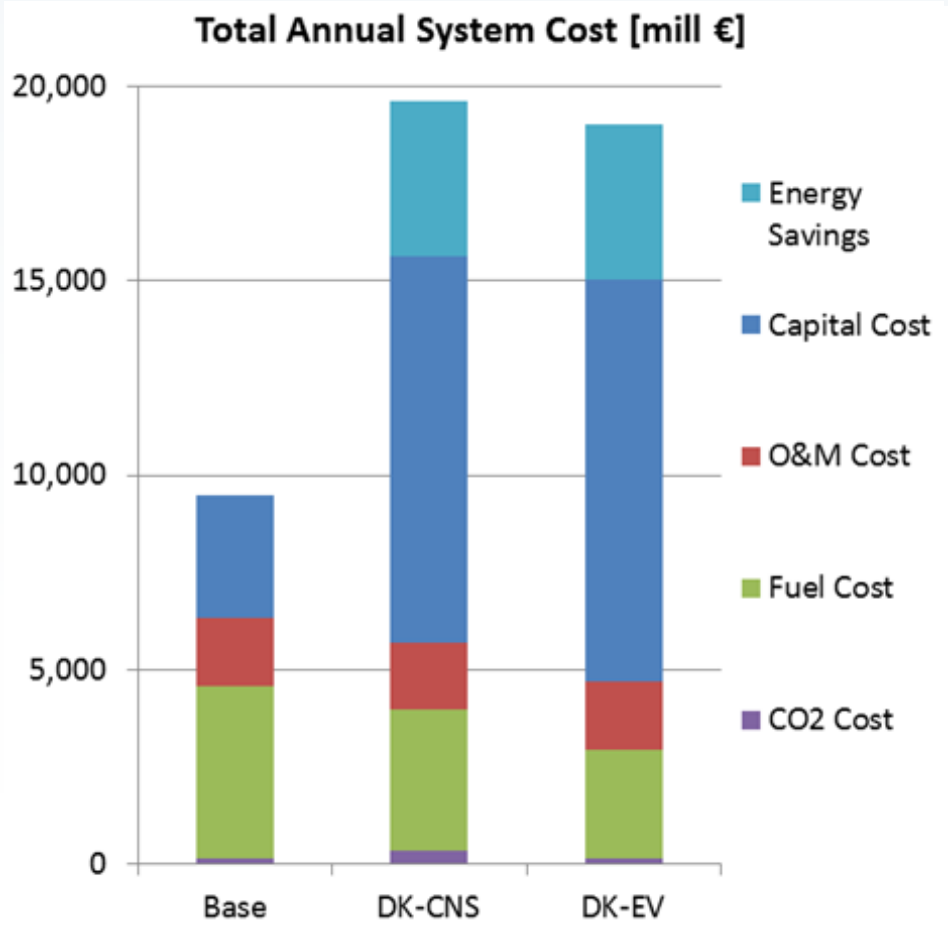


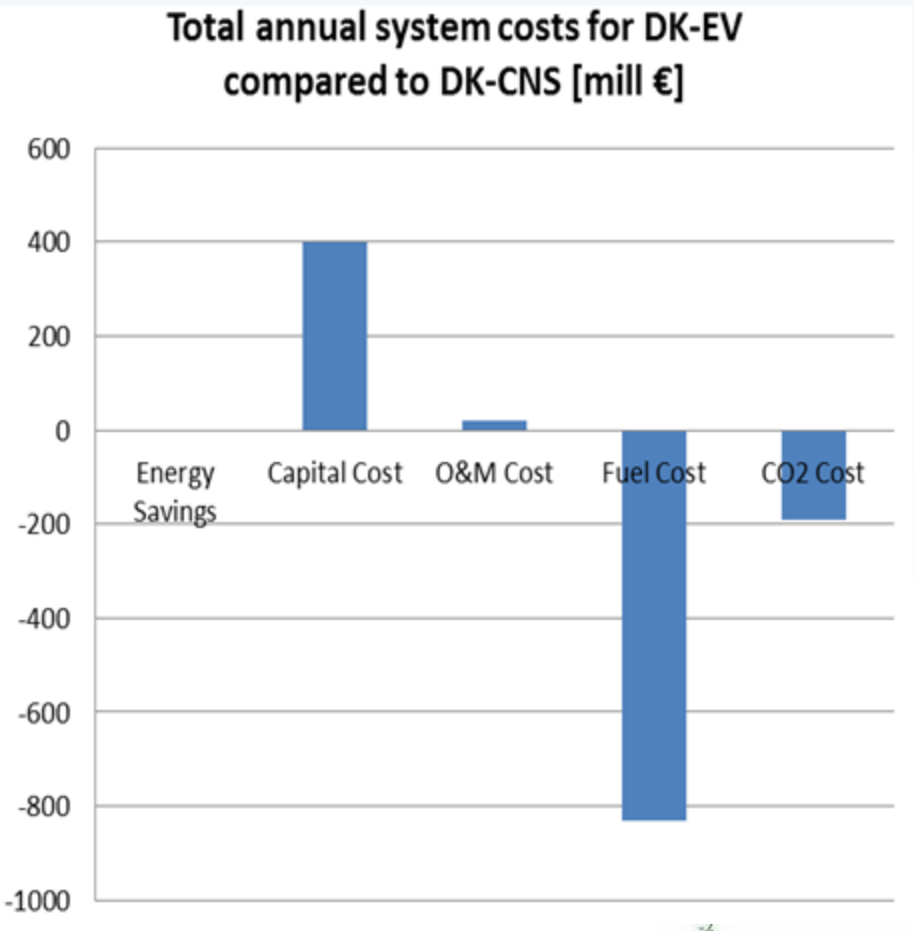
Scenario Results - EV



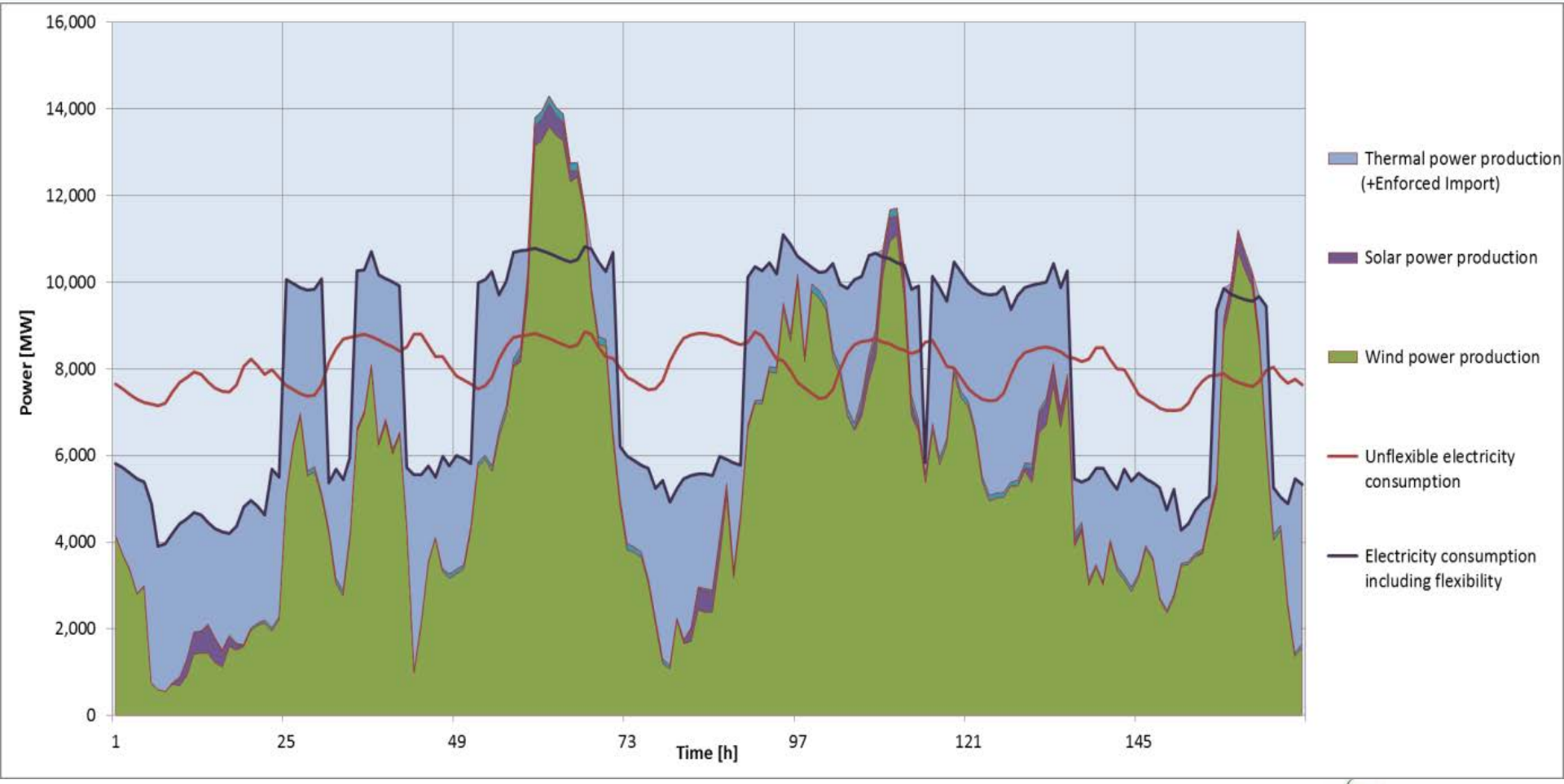
Power generation and consumption with and without flexible demand in week 10 in year 2050

Total annual system costs and the difference between the CNS and the EV scenario (mill €)

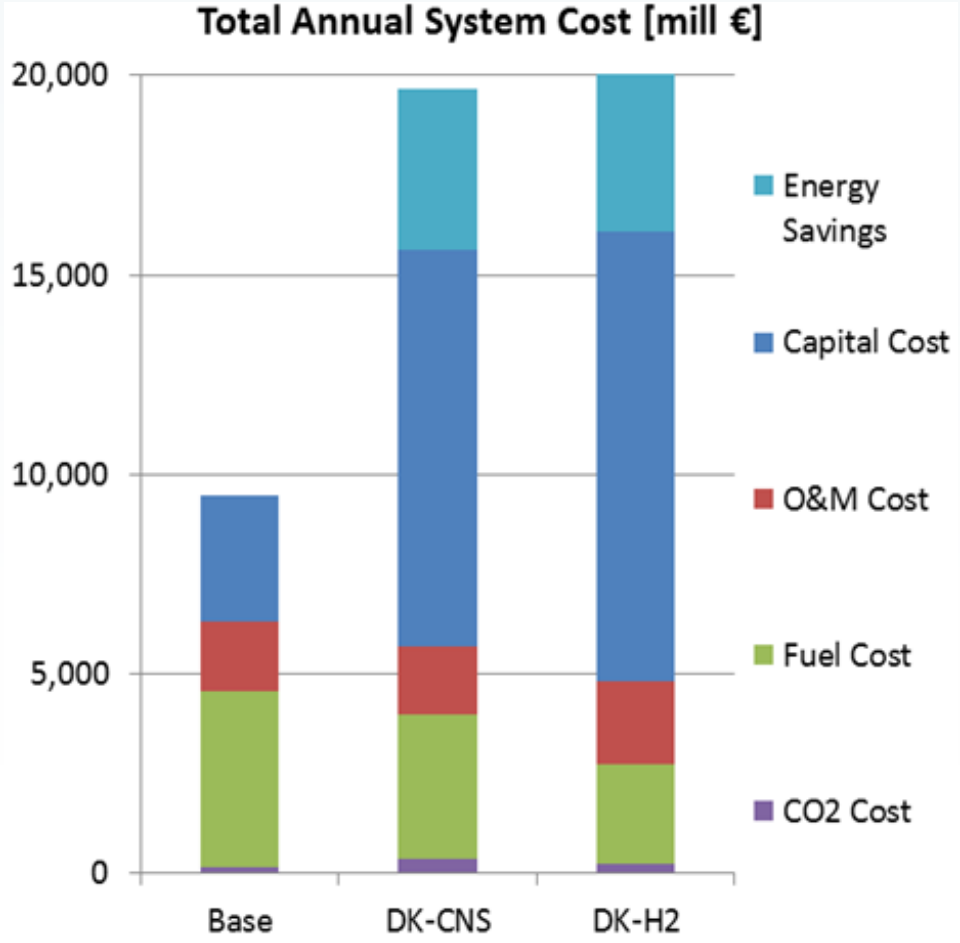


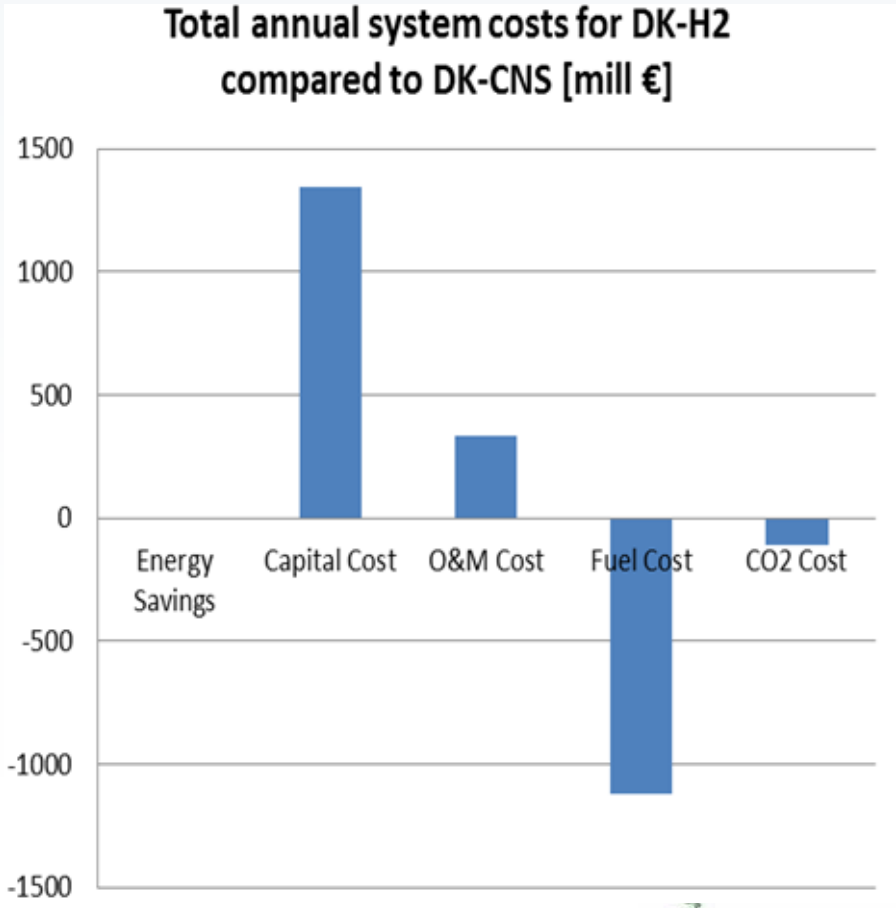


Scenario Results - H2

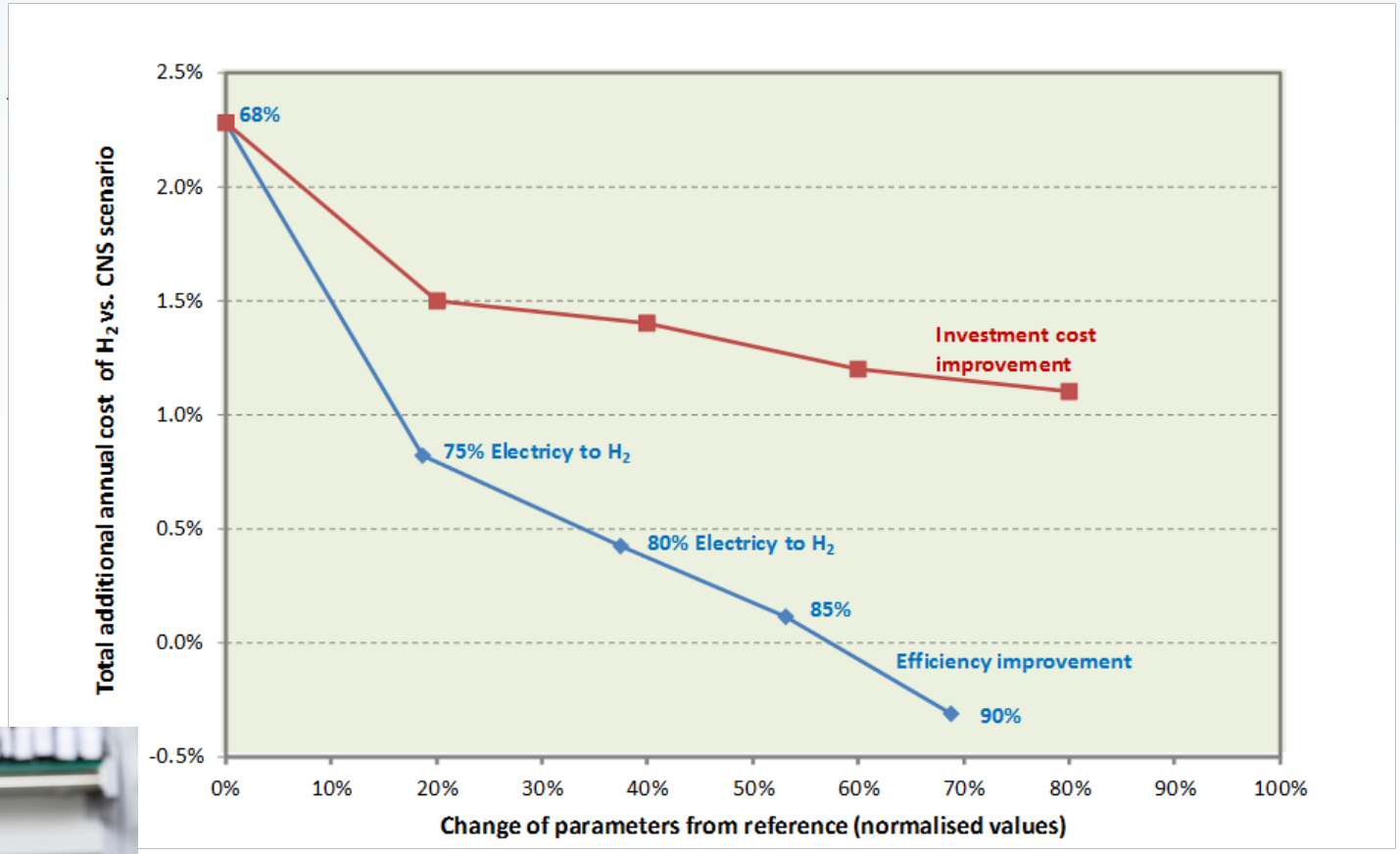


Annual system costs and the difference between the CNS and the H2 scenario (mill €)





Innovation and technological path - H2



Main findings

- EV could reduce the socio-economic cost of the system in 2050
- H_2 generation from electrolysis is more flexible
- H_2 production may generate heat
- A higher efficiency in the H_2 production is more important than a lower level of the capital cost
  - major driver of a successful H_2 scenario is a high efficient and flexible H_2 production in 2050
  - from a socio-economic view point: the technological path in innovation should have efficiency as its main driver towards 2050.

Thank you for your interest

Questions ?

APPENDIX