

+ Business Model for Power to Gas/Liquids - Potentials, Challenges and Uncertainties



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staxera:

- 01. Company Facts and partners
- 02. Potential: Production methods for renewable CO₂-based fuels
- 03. Challenge: Road-to-Market
- 04. Uncertainty: Politics, Markets and Willingness-to-Pay
- 05. Control Power: Enhanced Business Model

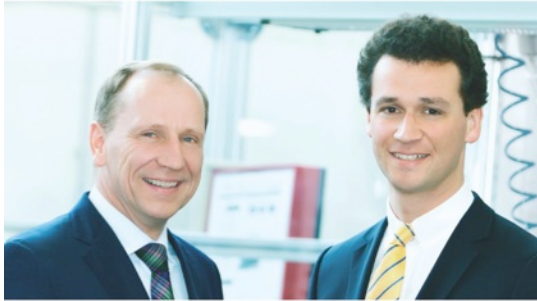




Who is sunfire?

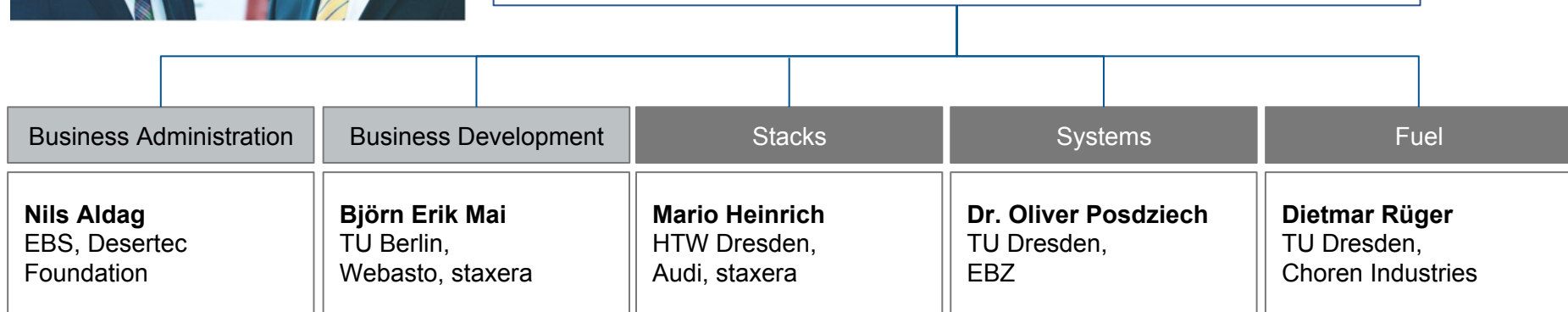
Company facts & partners

Management and company facts



Senior Management

Carl Berninghausen (CEO), EBS, Karibu, Thermea, e.a.
Christian v. Olshausen (CTO), TU Dresden, P&G, Daimler Fuel Cells



History

sunfire founded in 2010 (**staxera** 2005), staxera merged into sunfire in 2012, Bilfinger entry in 2012

Employees

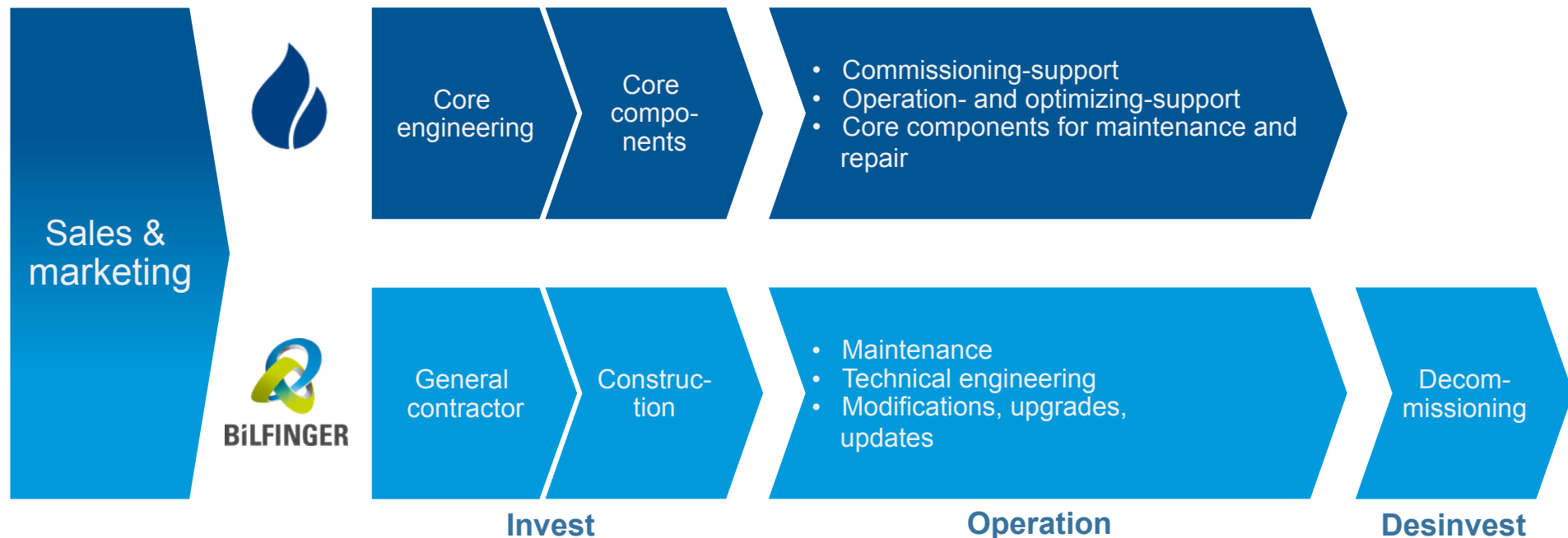
53 (47 engineers and technicians, 6 business graduates)

Infrastructure

Test environment for stacks, systems and PtL & PtG

The sunfire team has developed one of the most robust and cost competitive SOFC-stacks.

+ Cooperation Bilfinger/sunfire – a perfect fit for PtL & PtG



+ Corporate sales & marketing but individual focus on core competencies

sunfire: Engineering & core components

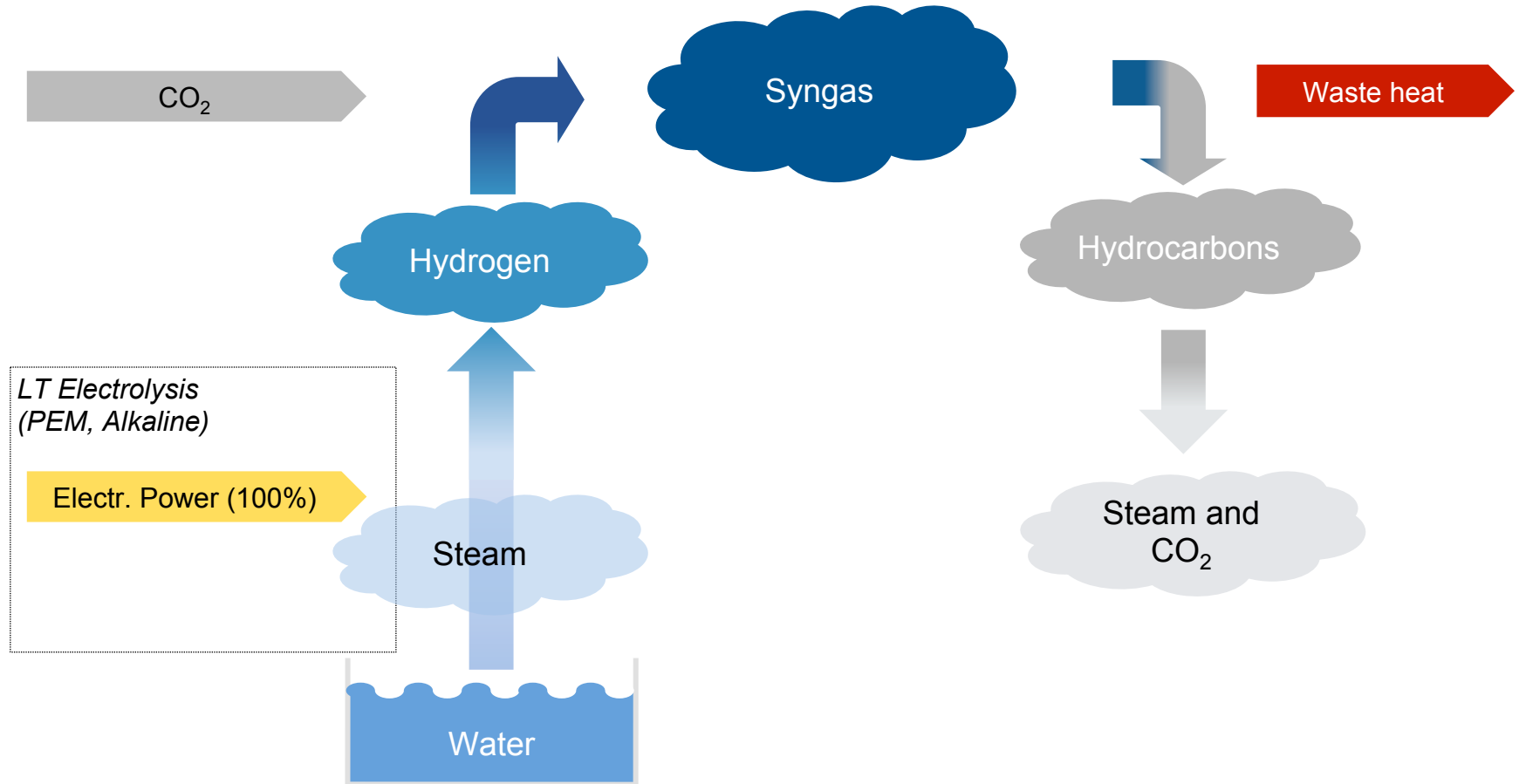
Bilfinger: General contractor & construction



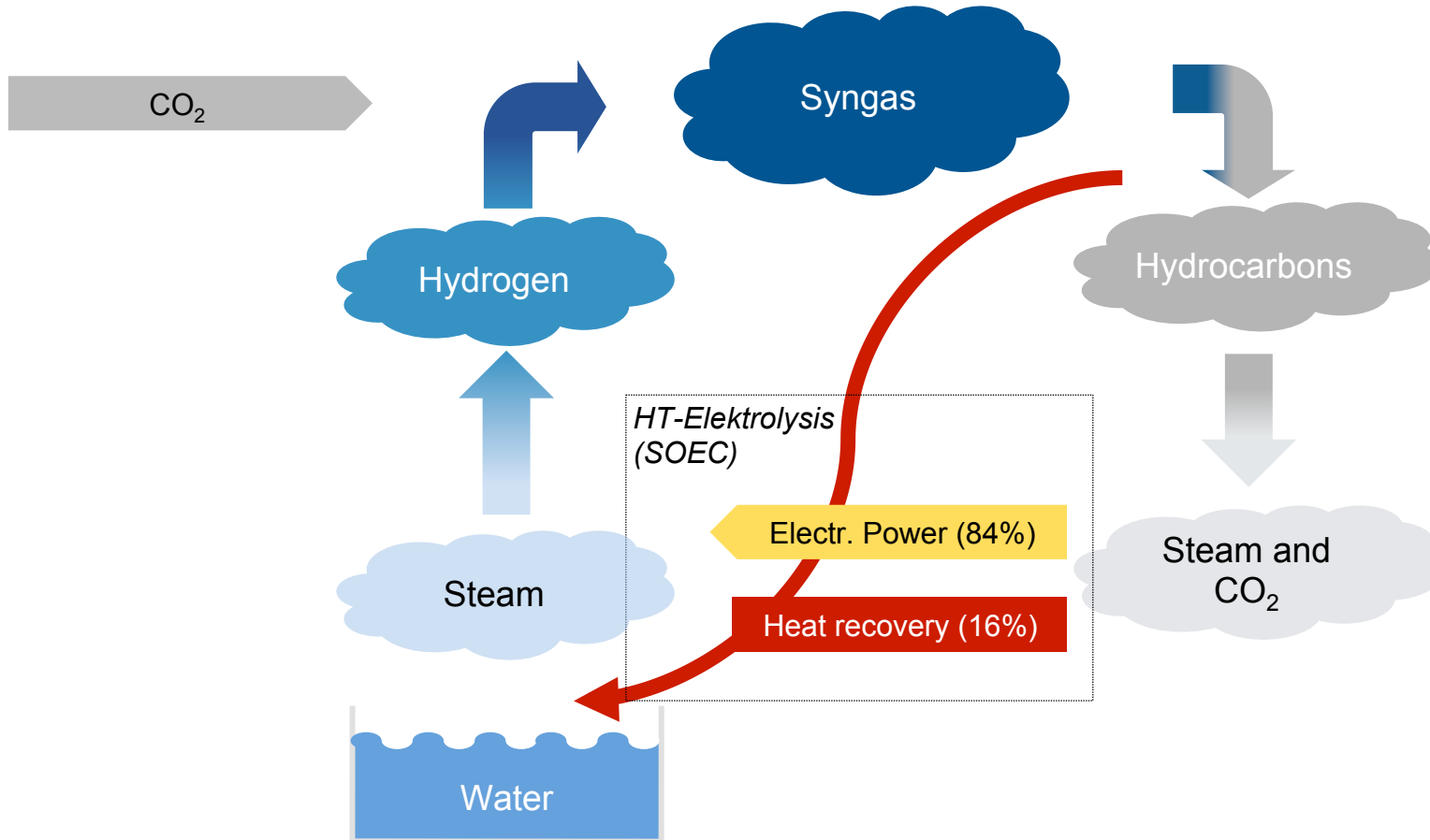
An enormous Potential: PtL & PtG based on High Temperature Steam Electrolysis



Patented efficiency advantage



High Temperature Steam Electrolysis increases the process efficiency significantly.
PtL: 50% → 70%, PtG: 55% → 80% (approximate values, based on LHV)

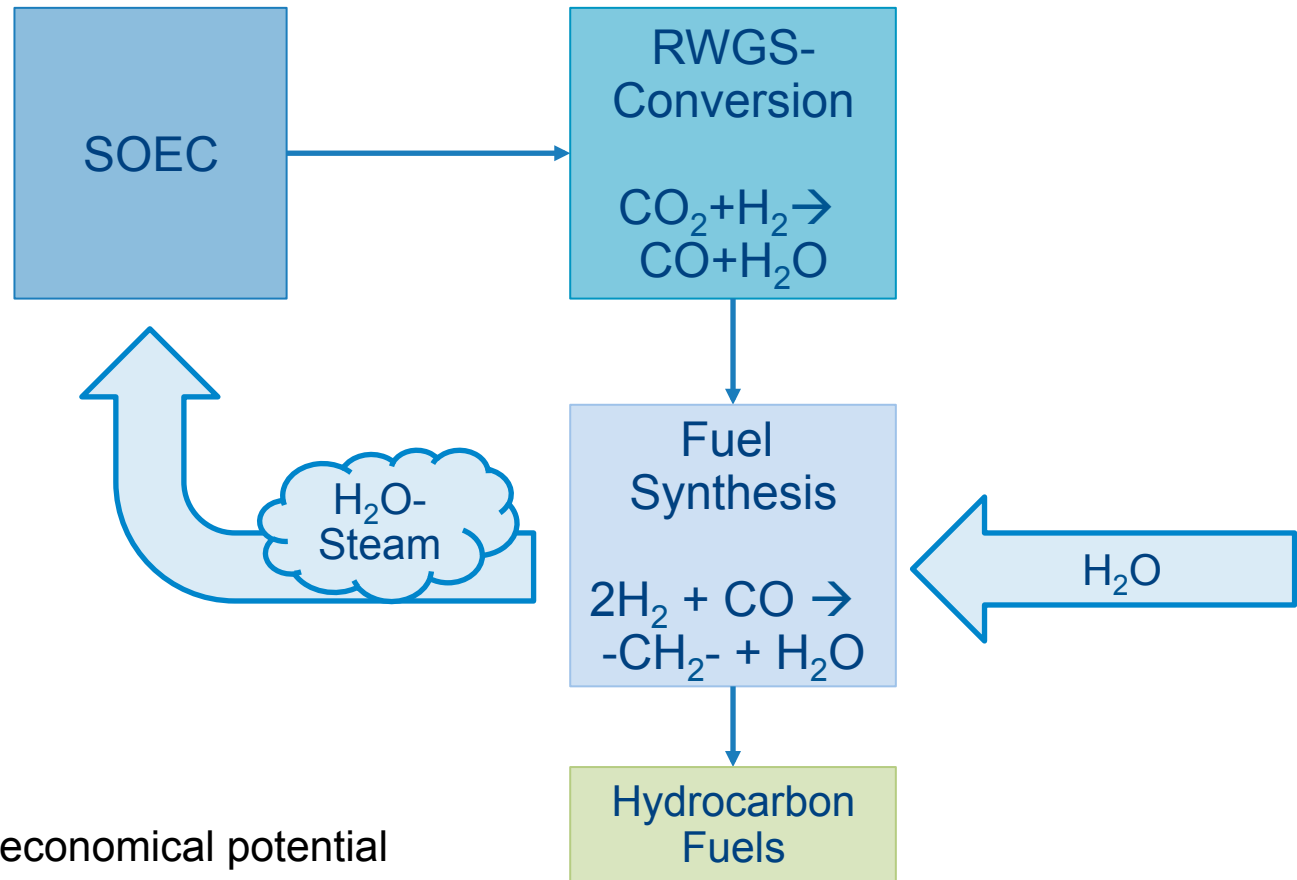


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+ Production method Power-to-Liquids



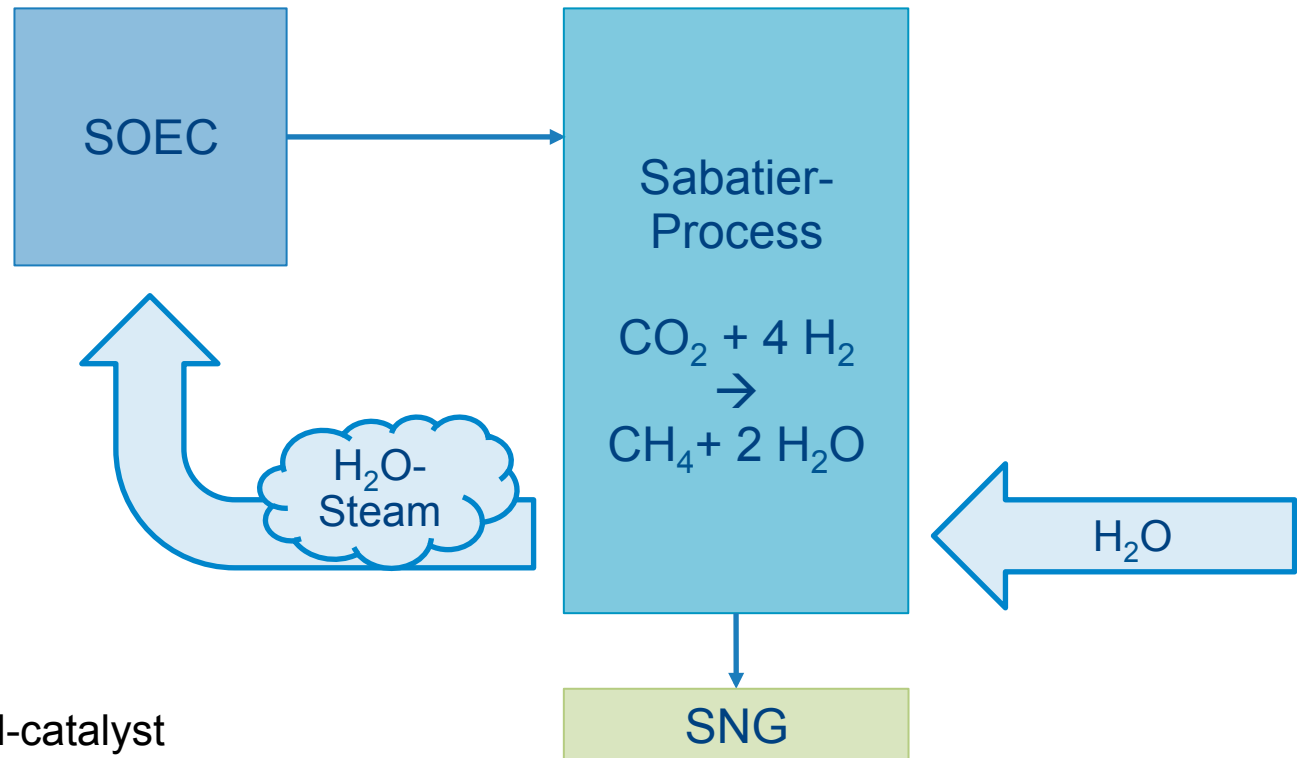
sunfire's Power-to-Liquids process consists of three components:
SOEC (Solid Oxide Electrolysis Cell), RWGS-conversion and fuel synthesis



+ High present economical potential

+ Production method Power-to-Gas

Methanation is a relatively simple process. The increased efficiency due to the SOEC is still applicable. However, the economical potential of SNG is lower than for synthetic liquid fuels due to the cheap and still long time available natural gas.

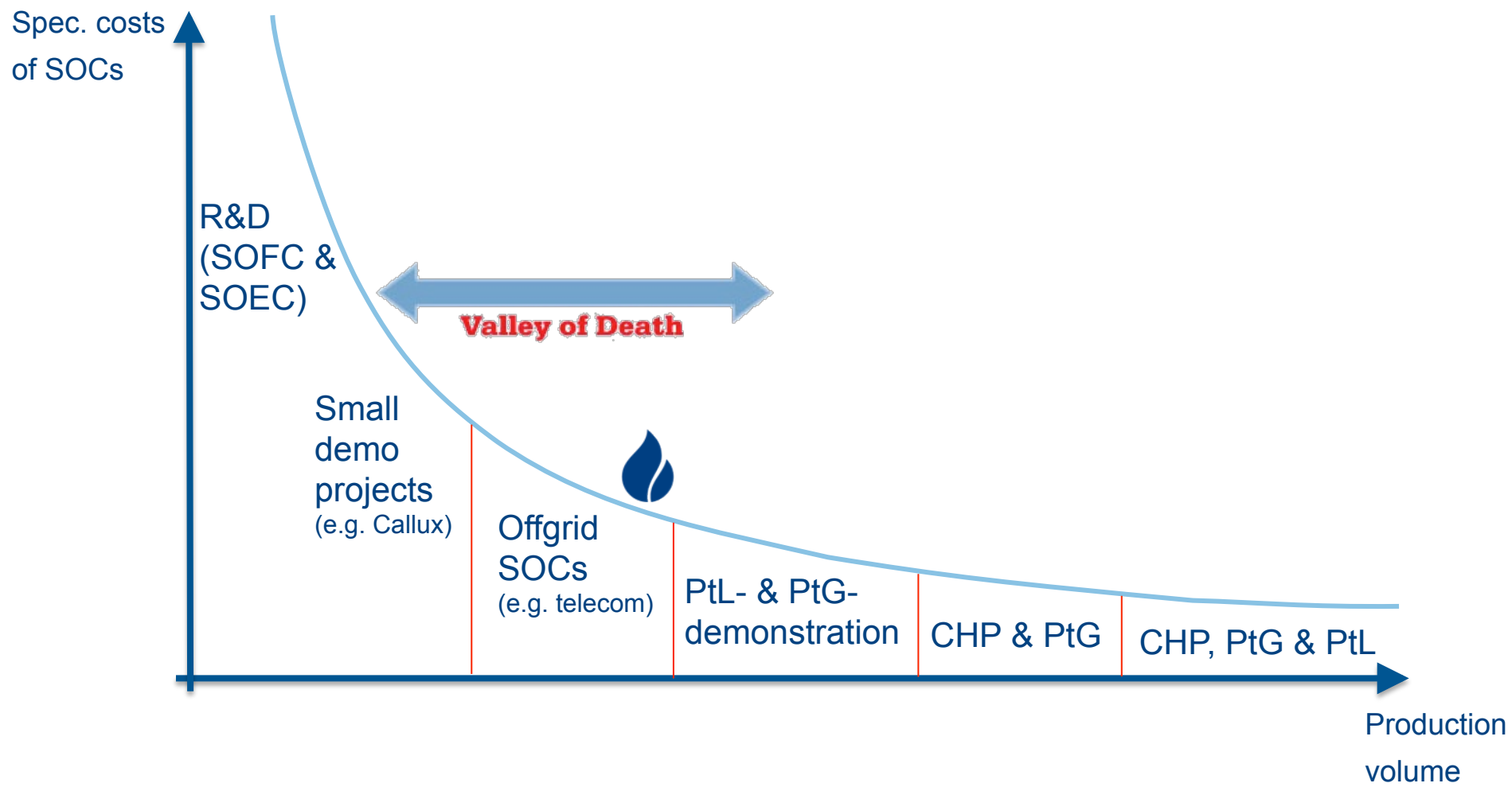


- + Simple Nickel-catalyst
- + No complex product separation



A challenging process: sunfire's Road-to-Market

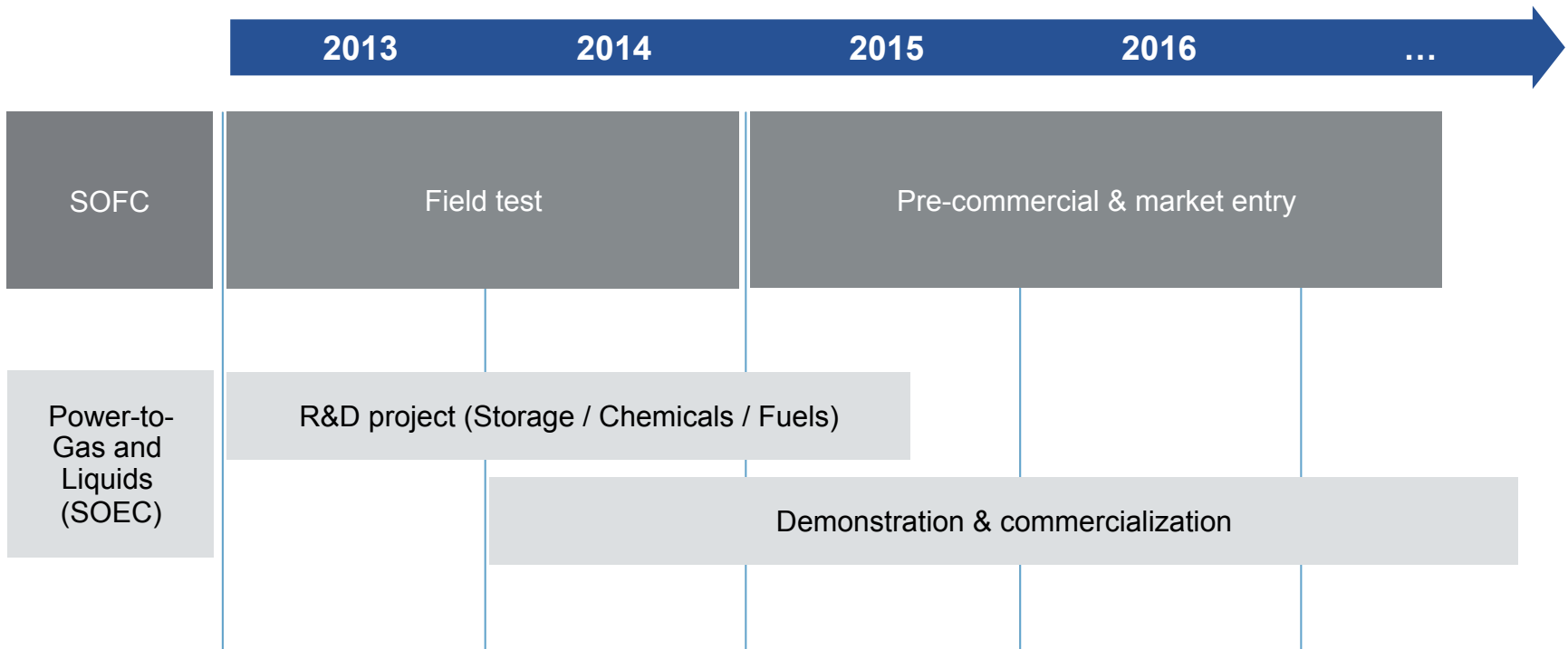
+ Road-to-Market or “How to overcome the Valley of Death”



+ Road-to-Market Strategy and timeline



Markets	Gas-to-Power			Power-to-Gas	Power-to-Liquids	
	microCHP 1-2.5 kW	Off-grid >2.5 kW	smallCHP >25 kW	Storage >2 MW	Chemicals >10 MW	Fuels >50 MW



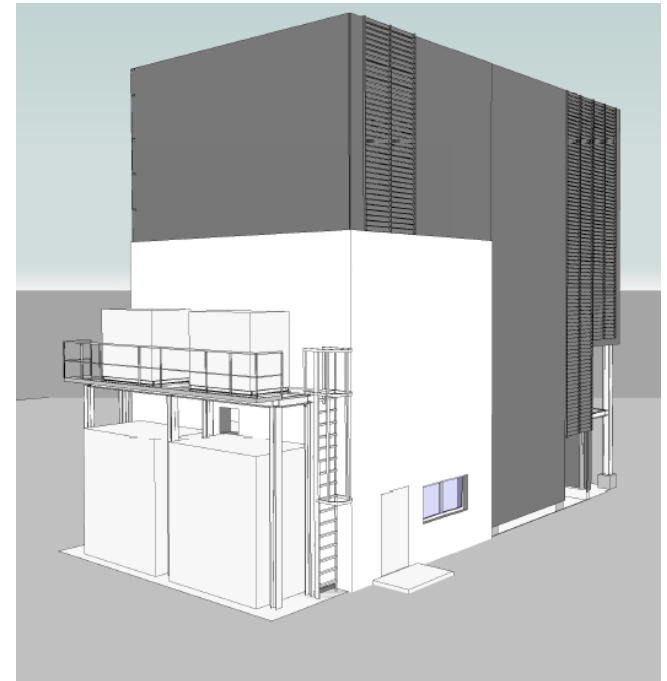
+ PtL Demo Plant Fuel1 Storage / Chemicals / Fuels



R&D project

- Construction of a Power-to-Liquids pilot plant targeting the verification of the chemical process & the development of a SOEC prototype
- Government-funded by Federal Ministry of Education and Research
- Project costs: € 12m (sf: € 8m)
- Project duration: May 2012 - June 2015 (start of operation in 2014)

Project consortium



Power-to-Liquids demo plant Fuel1 in Dresden

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+ PtL Demo Plant Fuel1 Storage / Chemicals / Fuels



Groundbreaking for demo plant
at 22nd of July 2013 &
construction progress after
three months.



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Federal Ministry
of Education
and Research



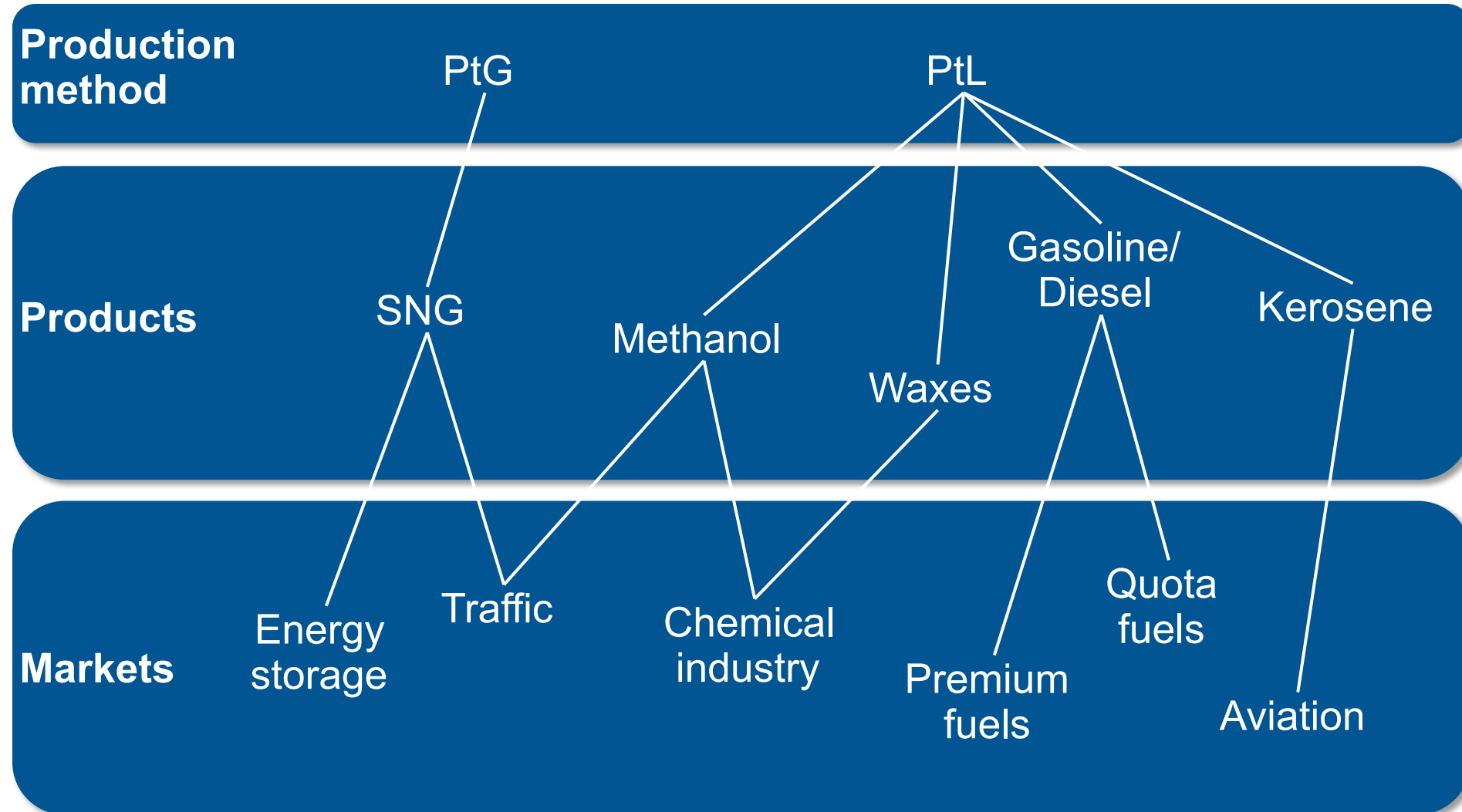
DLR Project Management Agency



Power-to-Liquids as a new Energy Option



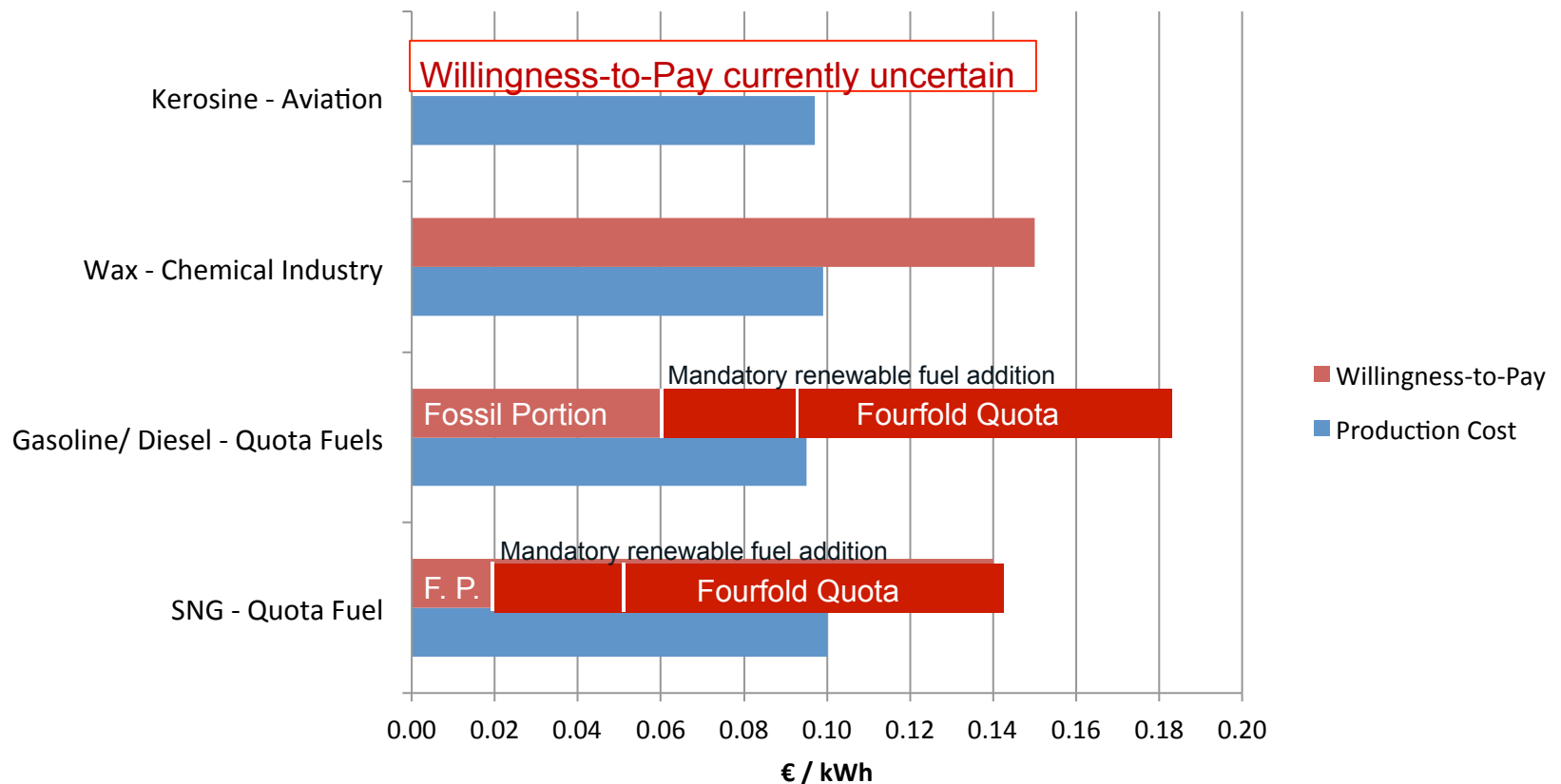
Still uncertain: Markets & Willingness-to-Pay



+ Power-to-Liquids Willingness-to-Pay vs. cost



The willingness to pay for sunfire-fuels is clearly higher than 0.10 €/kWh(LHV). The reason is the obligatory addition of renewable fuels to fossil ones with respect to 2009/28/EG – **as well as the intended fourfold crediting of PtX-fuels to this quota (see source at the bottom).**



Source of proposed amending: http://ec.europa.eu/clima/policies/transport/fuel/docs/com_2012_595_en.pdf

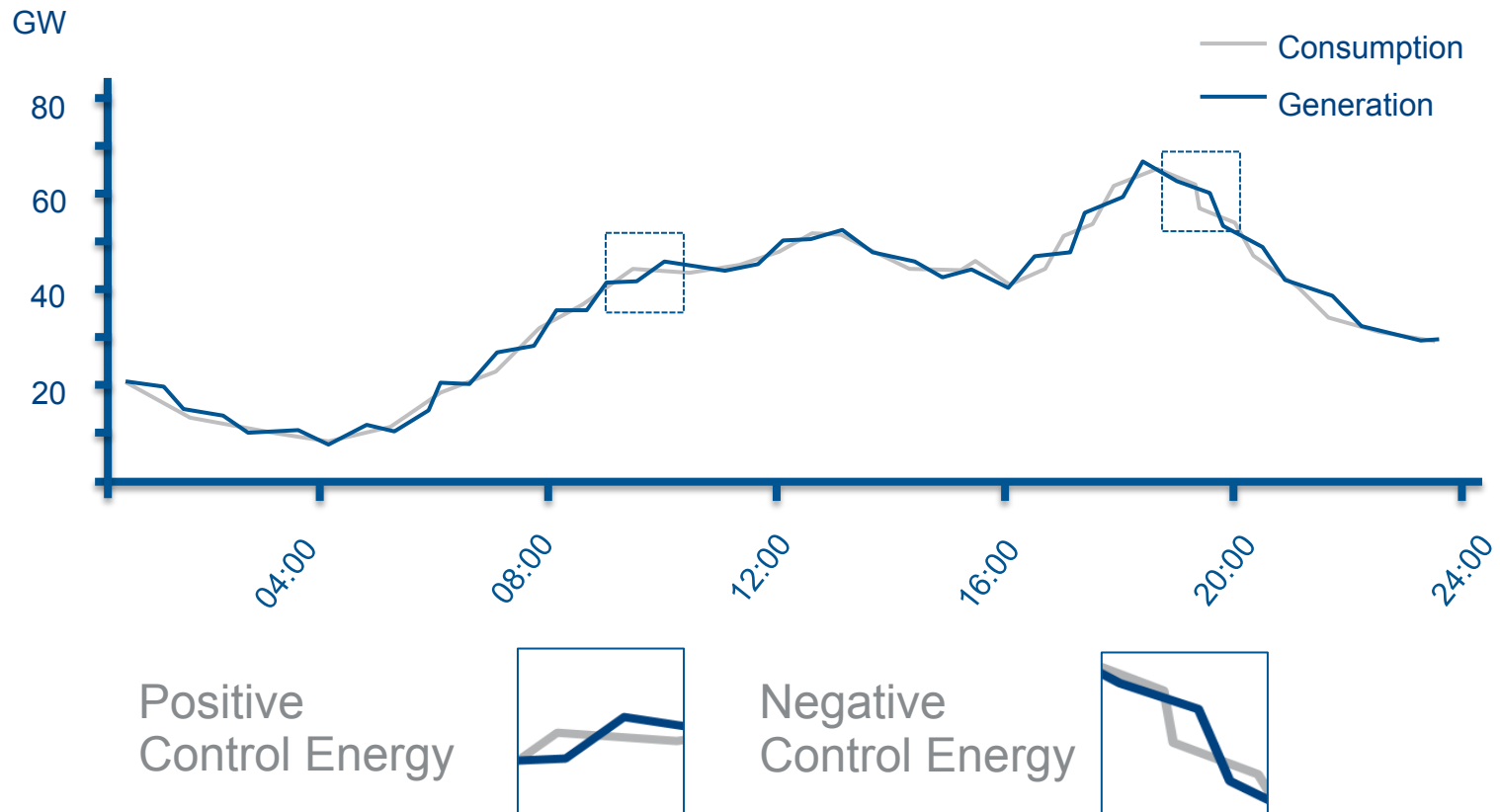


Control Energy Market: Enhanced Business Model for PtL and PtG



Control Energy

Control Energy is used to compensate temporary differences between consumption and generation of electricity.





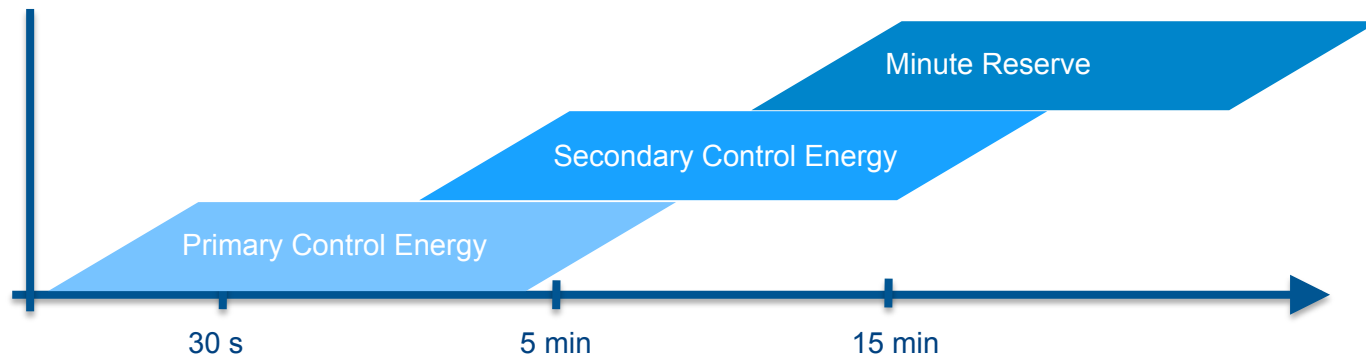
Control Energy



Types of control Energy

	Call for Bids	Minimum Offer	Activation Time
Primary Control Energy	weekly	1 MW	< 30 seconds automated
Secondary Control Energy	weekly	5 MW	< 5 minutes automated
Minute Reserve	daily	5 MW	< 15 minutes partly automated

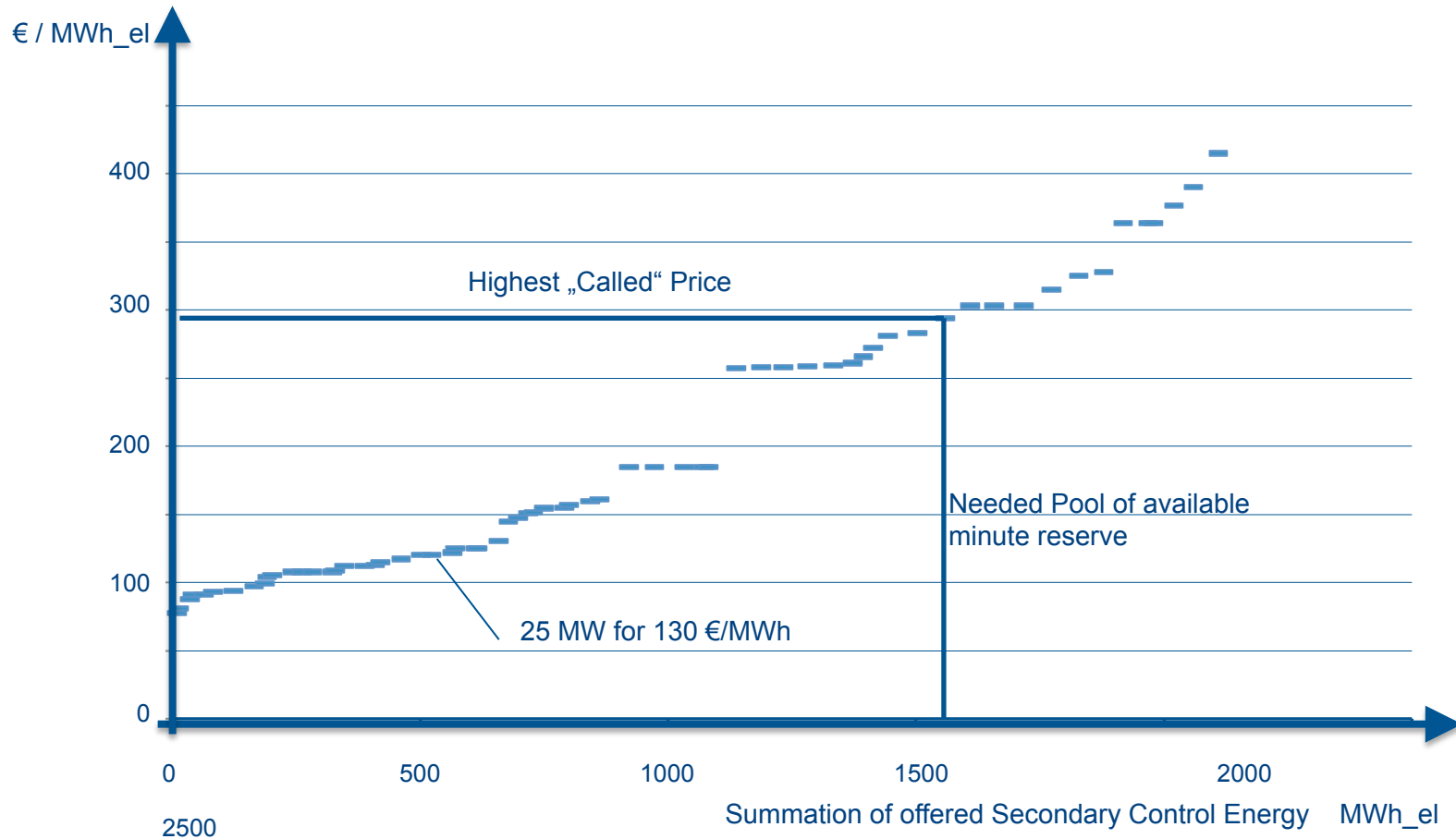
Order of Activation



Source of information www.regelleistung.net

Control Energy

Demand-Rate Auction for Secondary Control Energy



Source of Data: www.regelleistung.net

+ An enhanced Business Model for the “Energiewende”:
PtL and PtG as economical Control Reserve

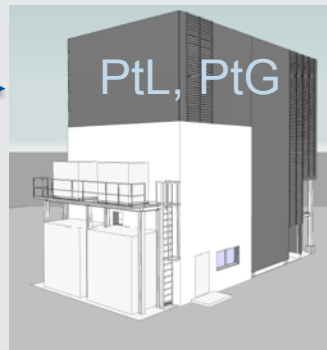


Production Costs



Electricity
Stock Market

100%
Plant Capacity



Earnings

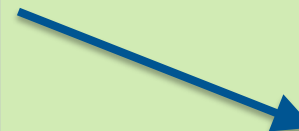
70 - 100%
Plant Capacity



Synthetic
Natural Gas



Synthetic
Liquid Fuels

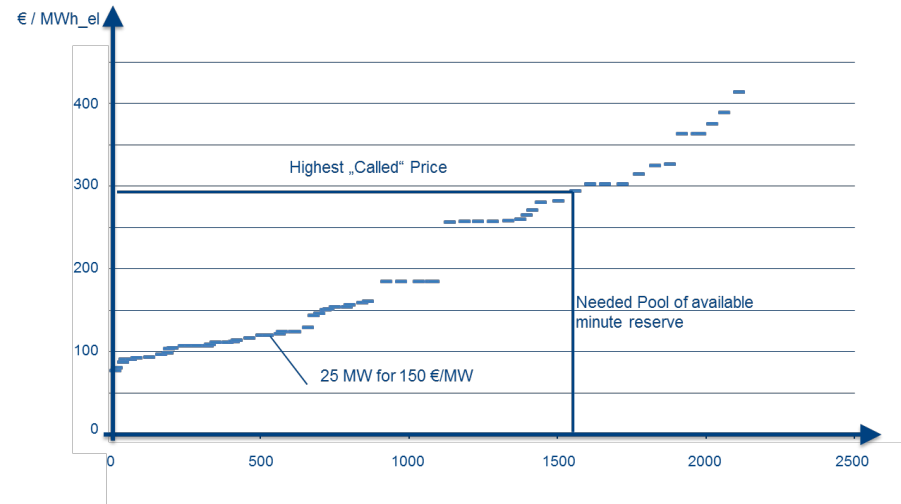
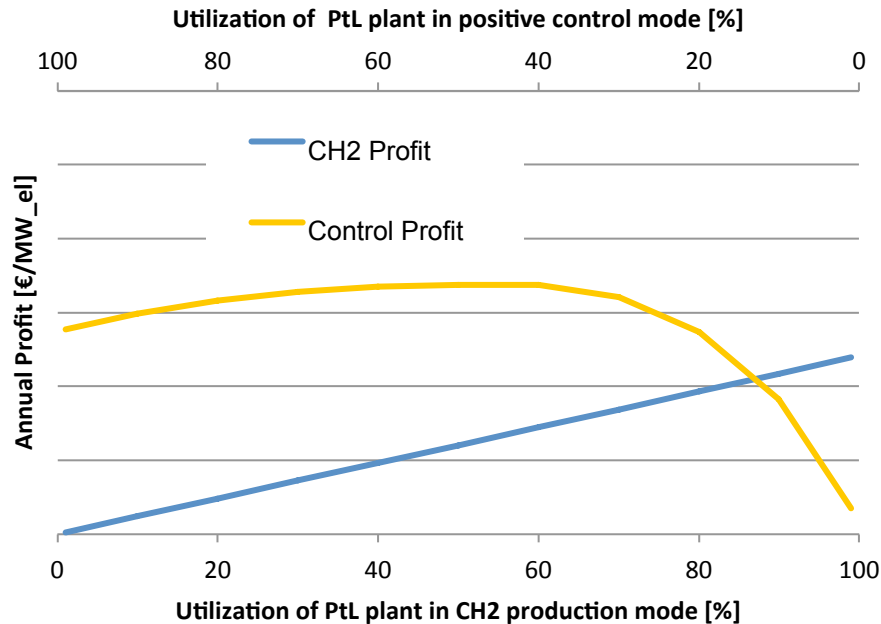


Up to 30%
Plant Capacity

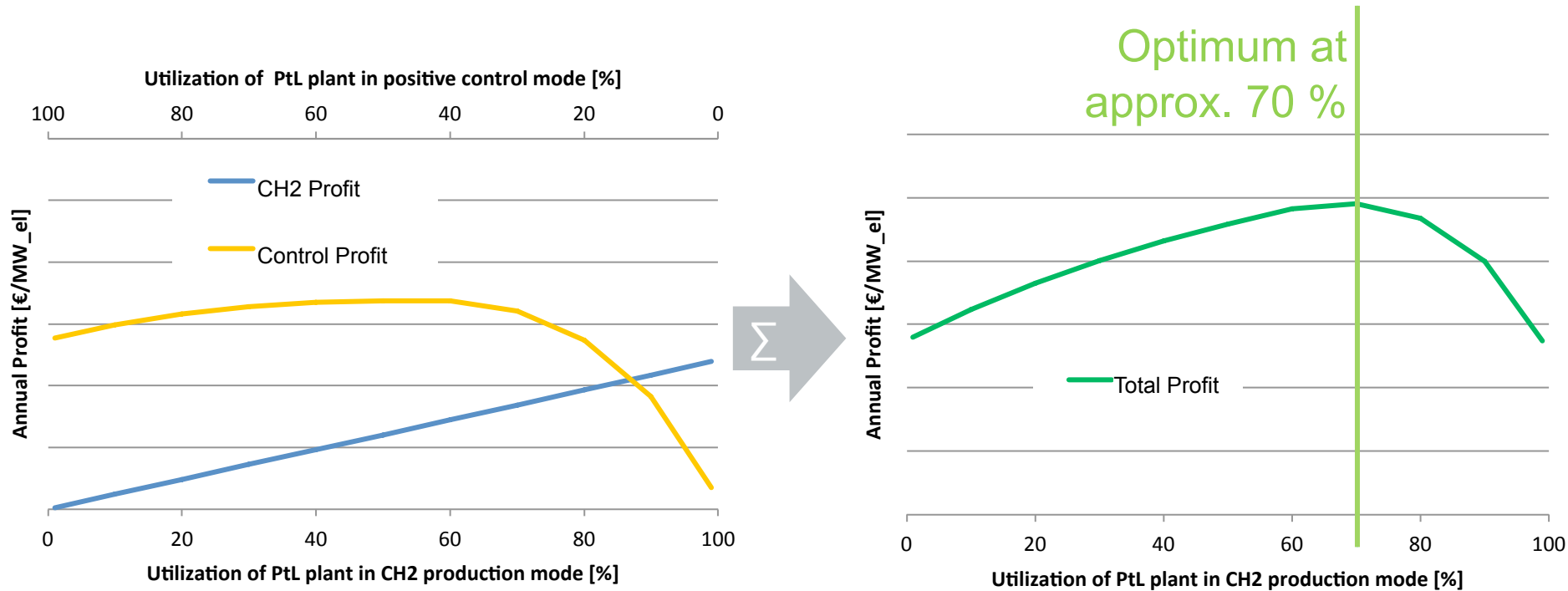


Negative
Control Energy

+ An enhanced Business Model for the “Energiewende”: PtL and PtG as economical Control Reserve



+ An enhanced Business Model for the “Energiewende”: PtL and PtG as economical Control Reserve



The generally positive effect of PtL and PtG for

1. A robust electricity grid and hence supply
2. 100% renewable primary energy supply in all other CH-based energy sectors

also enables the plant to increase its total economical profit.



Thank you for your attention



sunfire GmbH
Gasanstaltstraße 2
01237 Dresden
Germany

T +49 (0) 351 89 67 97 0
F +49 (0) 351 89 67 97 831
info@sunfire.de