

Green hydrogen for the decarbonisation of industry: A developer & owner's perspective

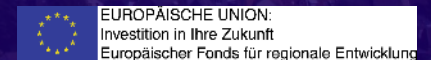
Anton Hoffmann | Hynamics Deutschland GmbH
12.05.2022



**Process⁴
Sustainability**

**Cluster for climate-neutral
process industries in Hesse**

Supported by:



Chances & Challenges for Green Hydrogen

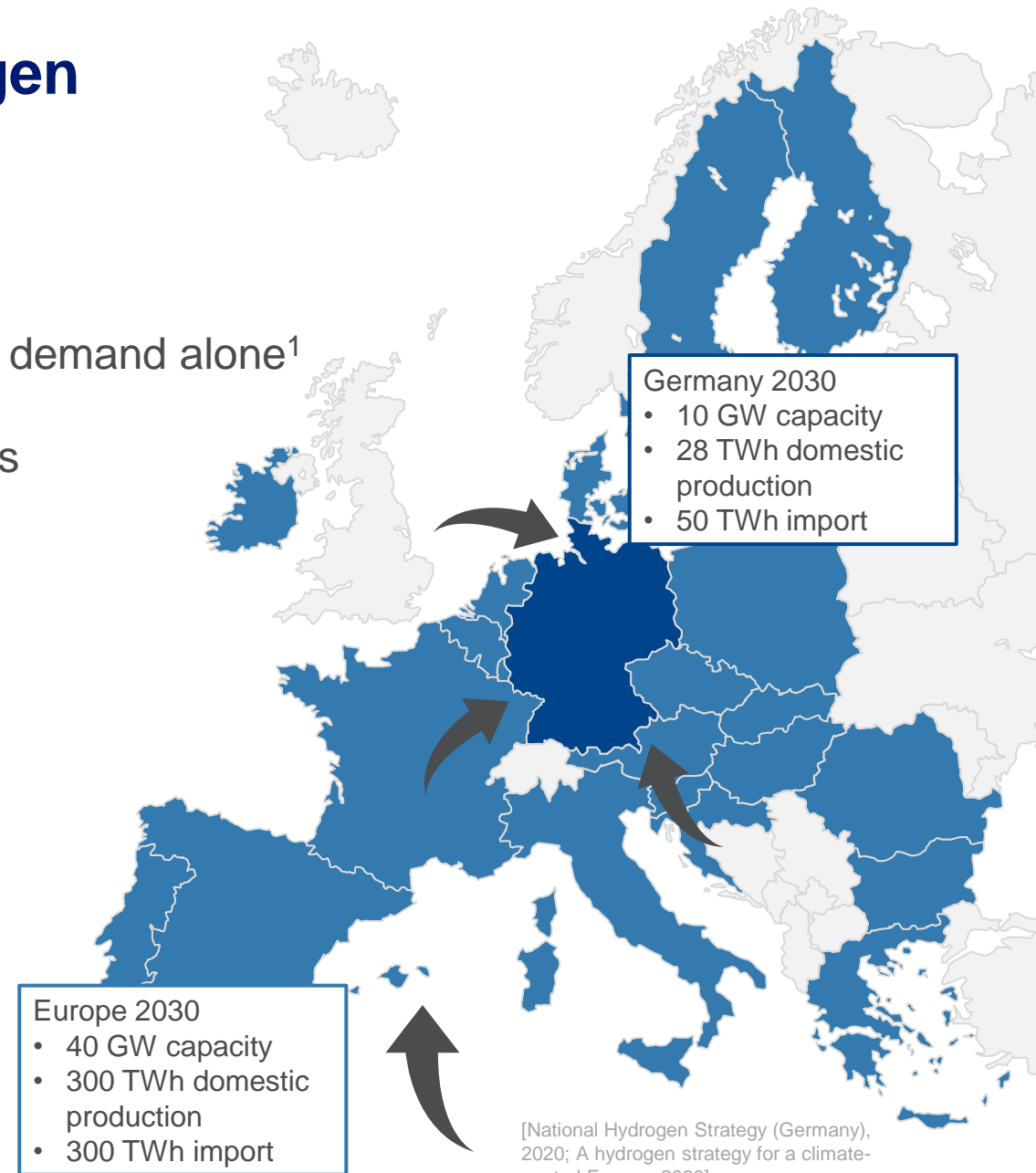
Chances for green hydrogen applications

- High future demand expected – 270 TWh of industrial H₂ demand alone¹
- First business cases in mobility and industrial applications

Challenges

- Availability of renewable power
- Regulatory uncertainty
- Bottleneck of electrolyzer production capacity

¹ Agora Energiewende and AFRY Management Consulting (2021):
No-regret hydrogen: Charting early steps for H₂ infrastructure in Europe.



Hynamics at a glance

Financing



- (Co-) Investor in H2-projects, planning up to 3 GW until 2030
- 2 to 3 billion € of planned investments for hydrogen solutions until 2030
- Turnover 84 billion € in 2021

Electricity provider



12 GW of green electricity capacity in operation worldwide & leading global energy trader.

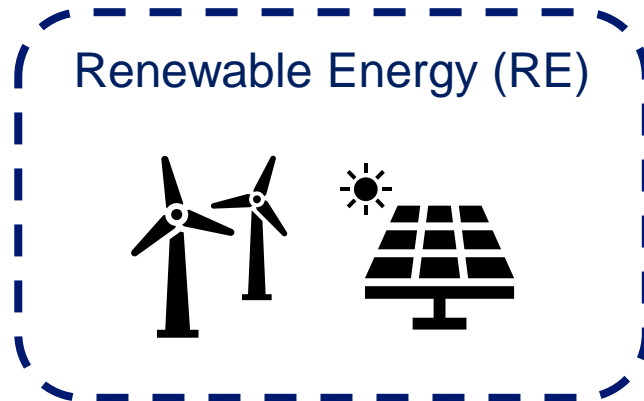


Engineering and R&D



Long-term experience with hydrogen projects and R&D with more than 4000 engineers & technical staff

Ecosystem of industrial green hydrogen projects

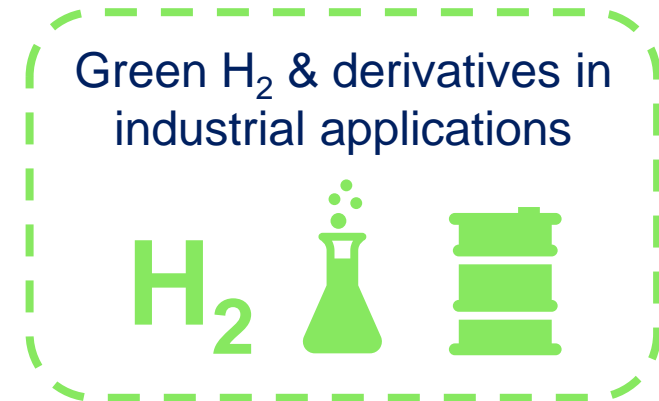


- Intermittent generation
- Multiple markets (Spot, forward, capacity, ancillary)
- Access to widespread transmission network
- Long-term contracts, no indexation

Sector coupling = solving conflicts



RE sourcing & flexibility ?
RE / H₂ shortage & surplus ?
Storage ?

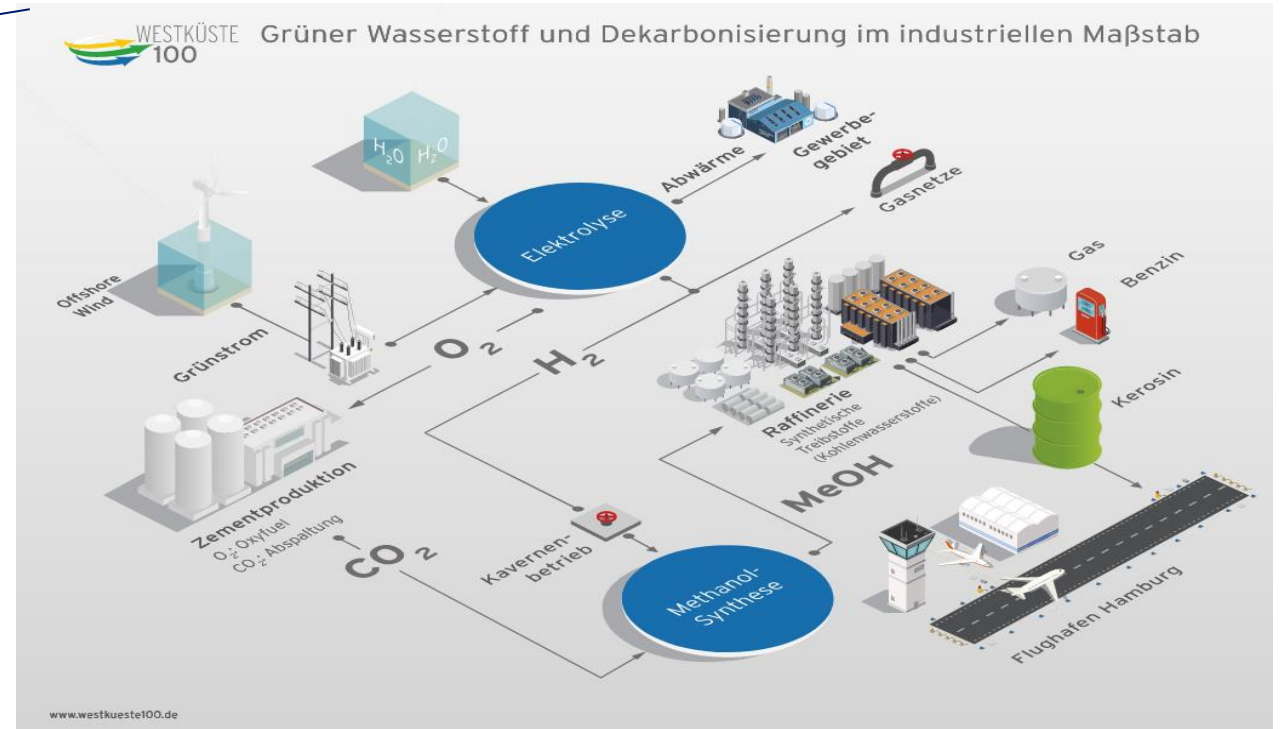


- Typically baseload demand with limited flexibility
- No H₂ transmission network yet
- Bilateral deals in & around regional demand clusters
- Short term contracts, with indexation

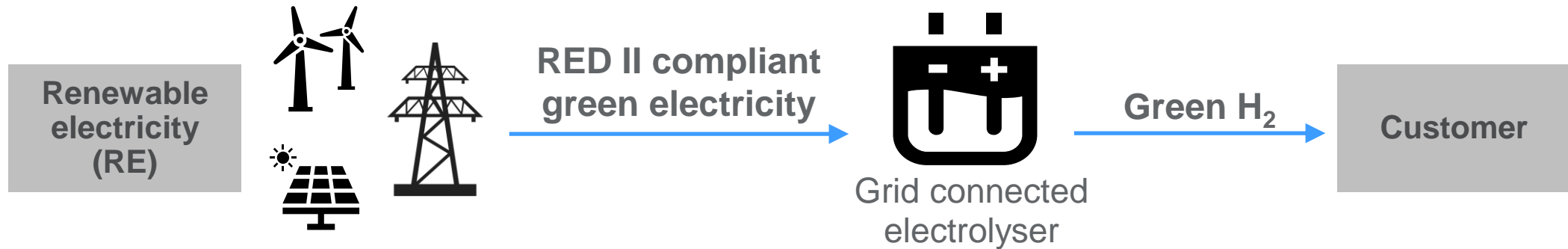
Project reference | Reallabor Westküste100

Key figures

- 30 MW electrolyzer capacity
- Replacing part of grey H₂ demand of refinery with green H₂
- FID scheduled in Q4/2022
COD scheduled in Q1/2025
- Storage of compressed H₂ in salt cavern
- Feasibility studies on methanol synthesis & oxyfuel for cement plant



Regulatory framework – EU definition of green hydrogen



Leaked draft delegated act on REDII article 27 specifies power sourcing criteria for production of green hydrogen / RFNBOs

Renewable origin	<ul style="list-style-type: none"> • Power purchase agreement with (new) renewable energy (RE) installations (wind & solar)
Additionality	<ul style="list-style-type: none"> • RE installation came into operation up to max. 36 months before COD of the electrolyser
Public aid	<ul style="list-style-type: none"> • RE installation did not receive any net investment or operating aid
Time correlation	<ul style="list-style-type: none"> • One hour time correlation between renewable electricity production and consumption in electrolyser
Geographical correlation	<ul style="list-style-type: none"> • RE installation and electrolyser are located within same bidding zone

Official draft to be published on May 18th

Power sourcing considerations – 100 MW electrolyzer

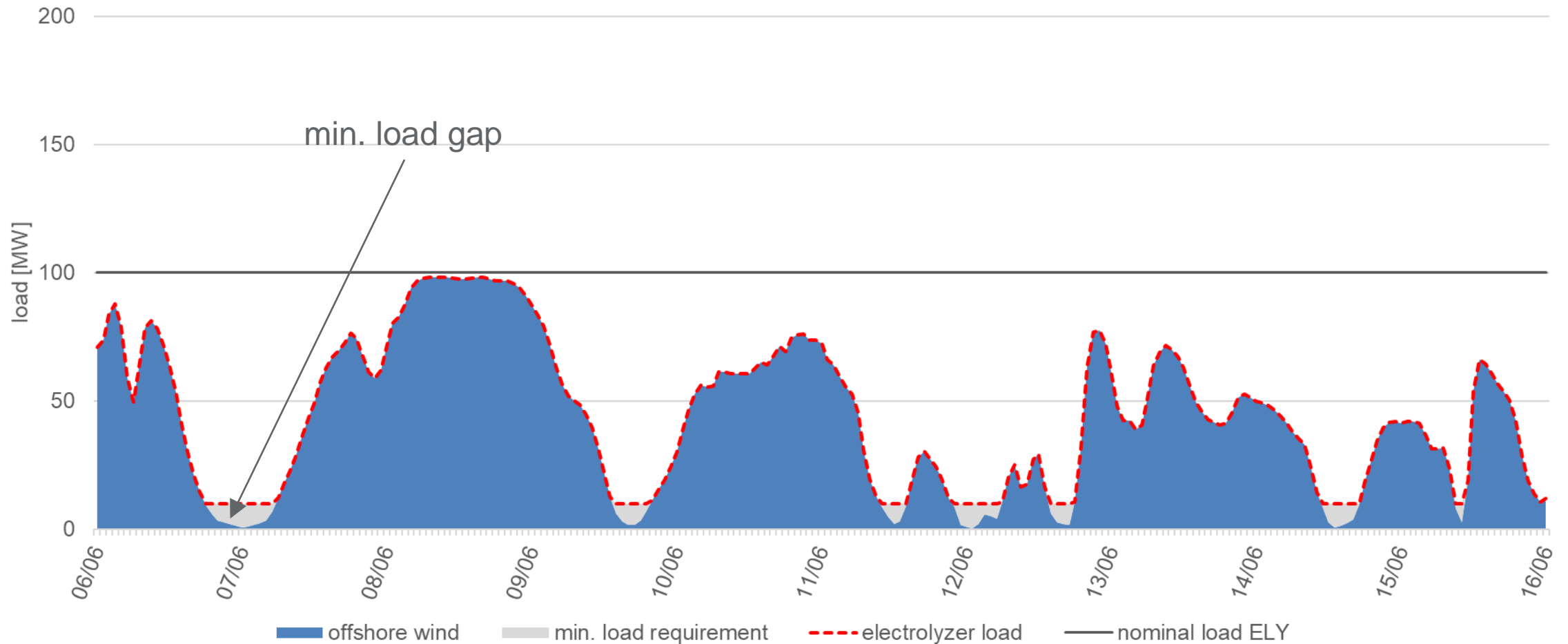


100 MW



100 MW

Annual capacity factor ~47%



Power sourcing considerations – 100 MW electrolyzer



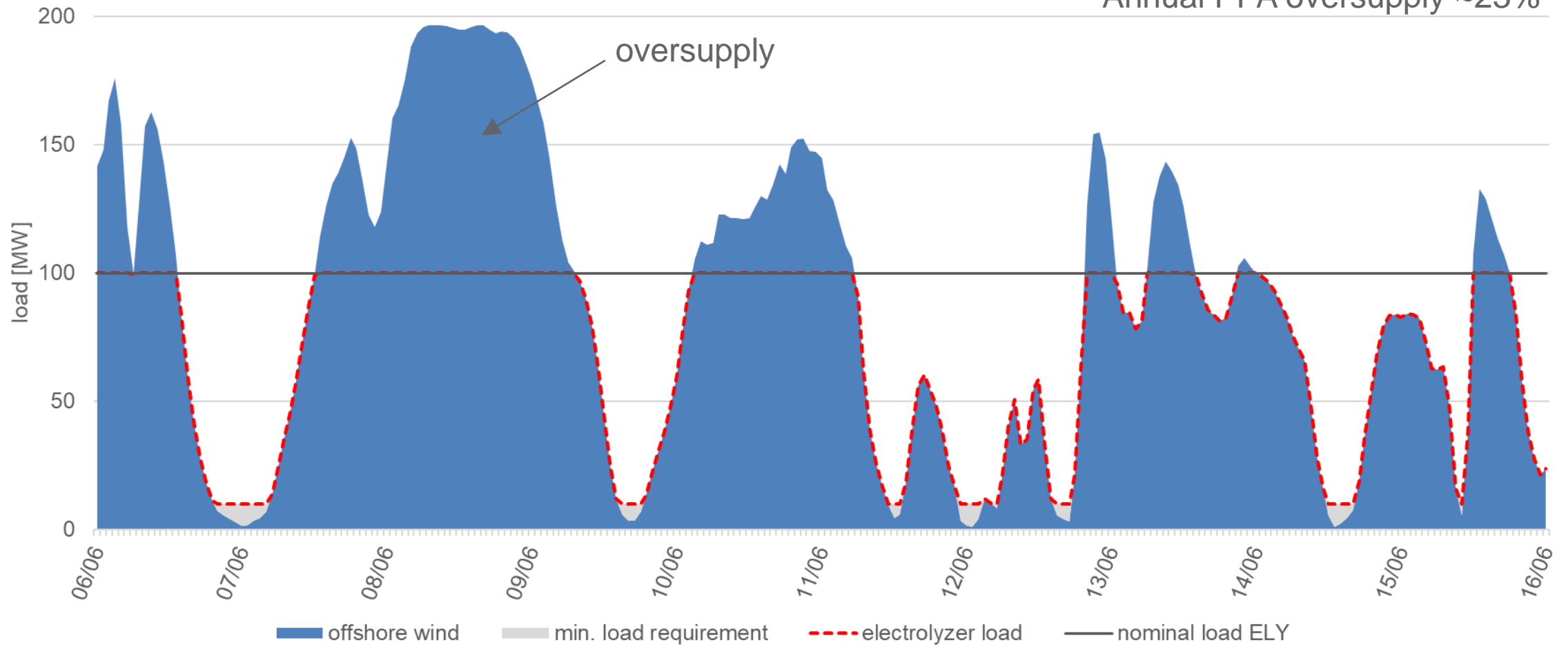
100 MW



200 MW

Annual capacity factor ~74%

Annual PPA oversupply ~23%



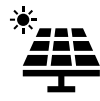
Power sourcing considerations – 100 MW electrolyzer



100 MW



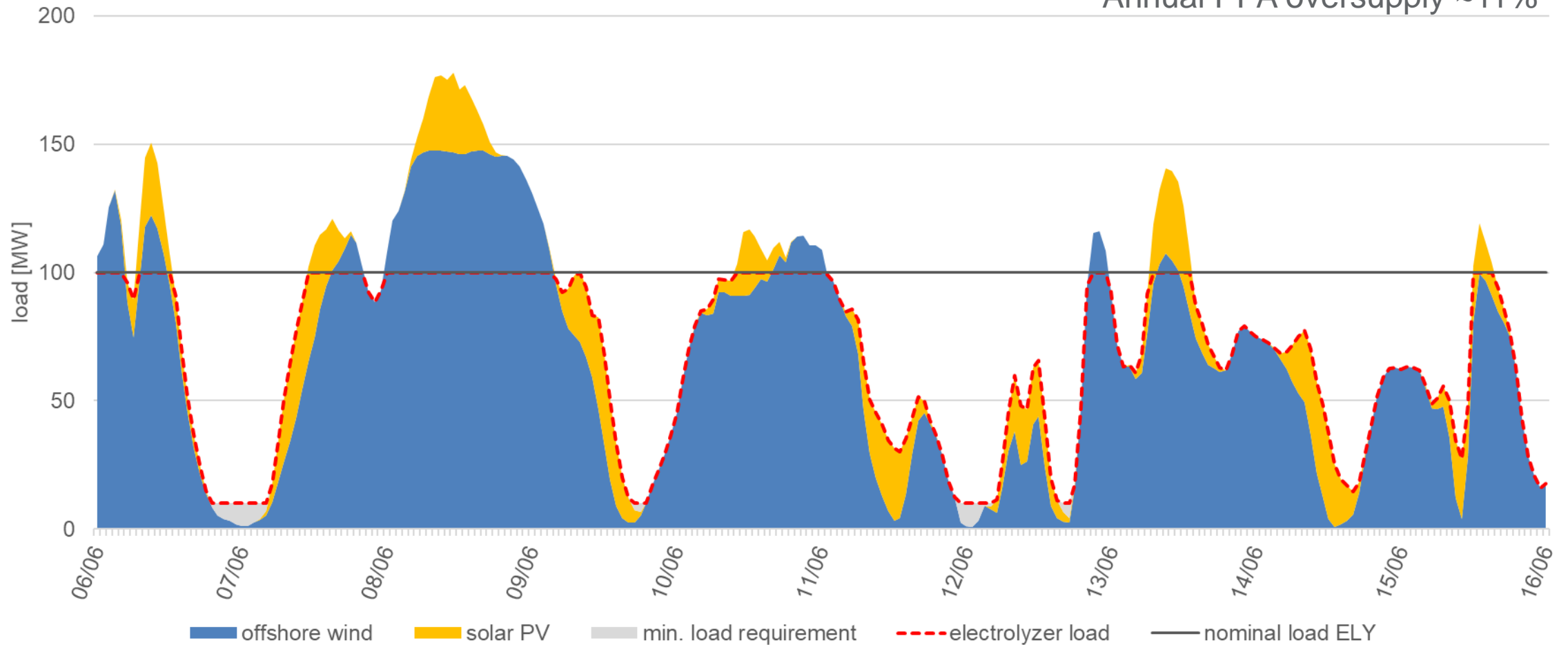
150 MW



50 MW

Annual capacity factor ~69%

Annual PPA oversupply ~11%



Key take aways

- Successful development of green H₂ projects requires a joint approach and collaboration of all stakeholders, especially a close collaboration of the (renewable) power sector with industrial/chemical sectors
- Regulatory certainty regarding the definition of green hydrogen is essential
- Economic electrolyzer operation requires a number of important considerations on power sourcing:
 - Selection and sizing of renewables assets & generation profiles, electrolyzer rated power and H₂ storage to meet industrial demand profiles
 - Strategies to intelligently use / market / hedge oversupply and reduce market exposure

Thank you ! – Questions ?

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