MW – GW – TW: Building the value chain for electrolysis-based large-scale production of sustainable hydrogen

ECCM Conference

June 21 2019

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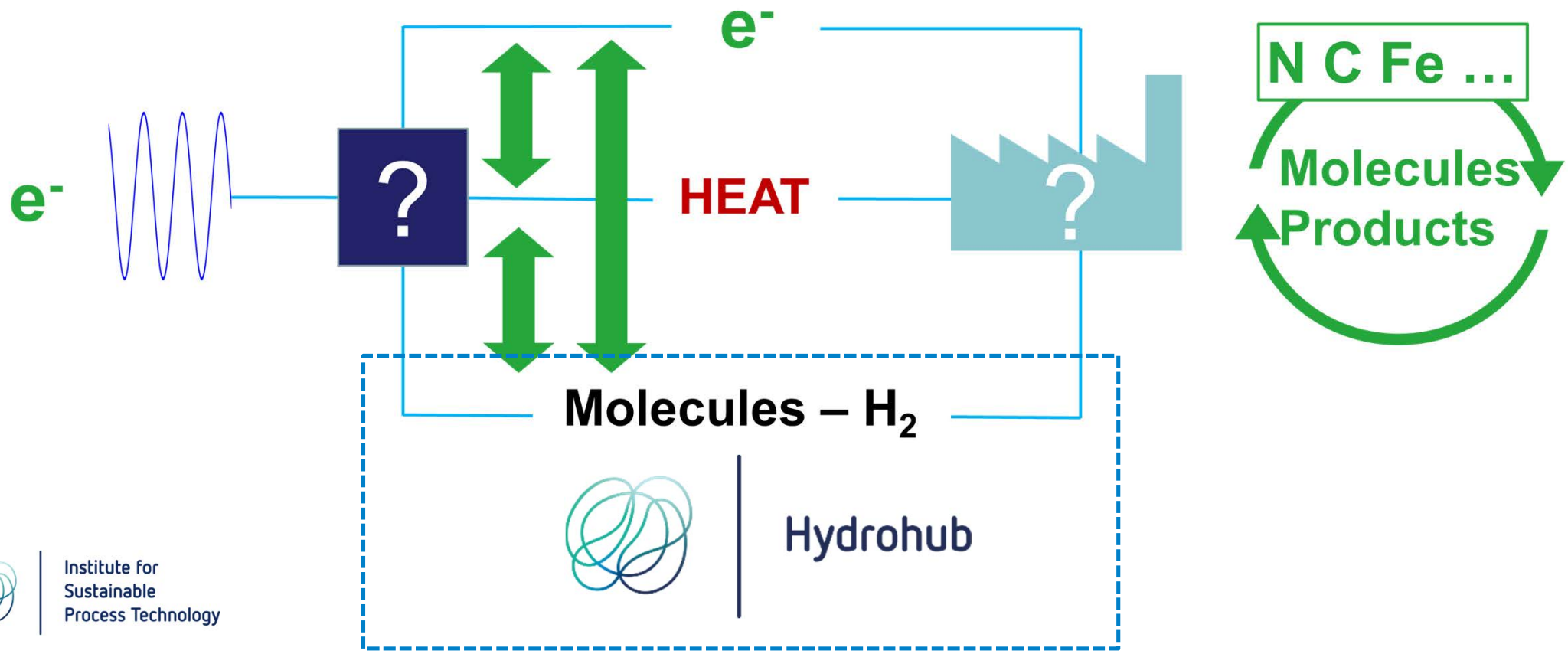
ISPT - Program Director System Integration

Institute for Sustainable Process Technology

System Integration ISPT – Program Scope



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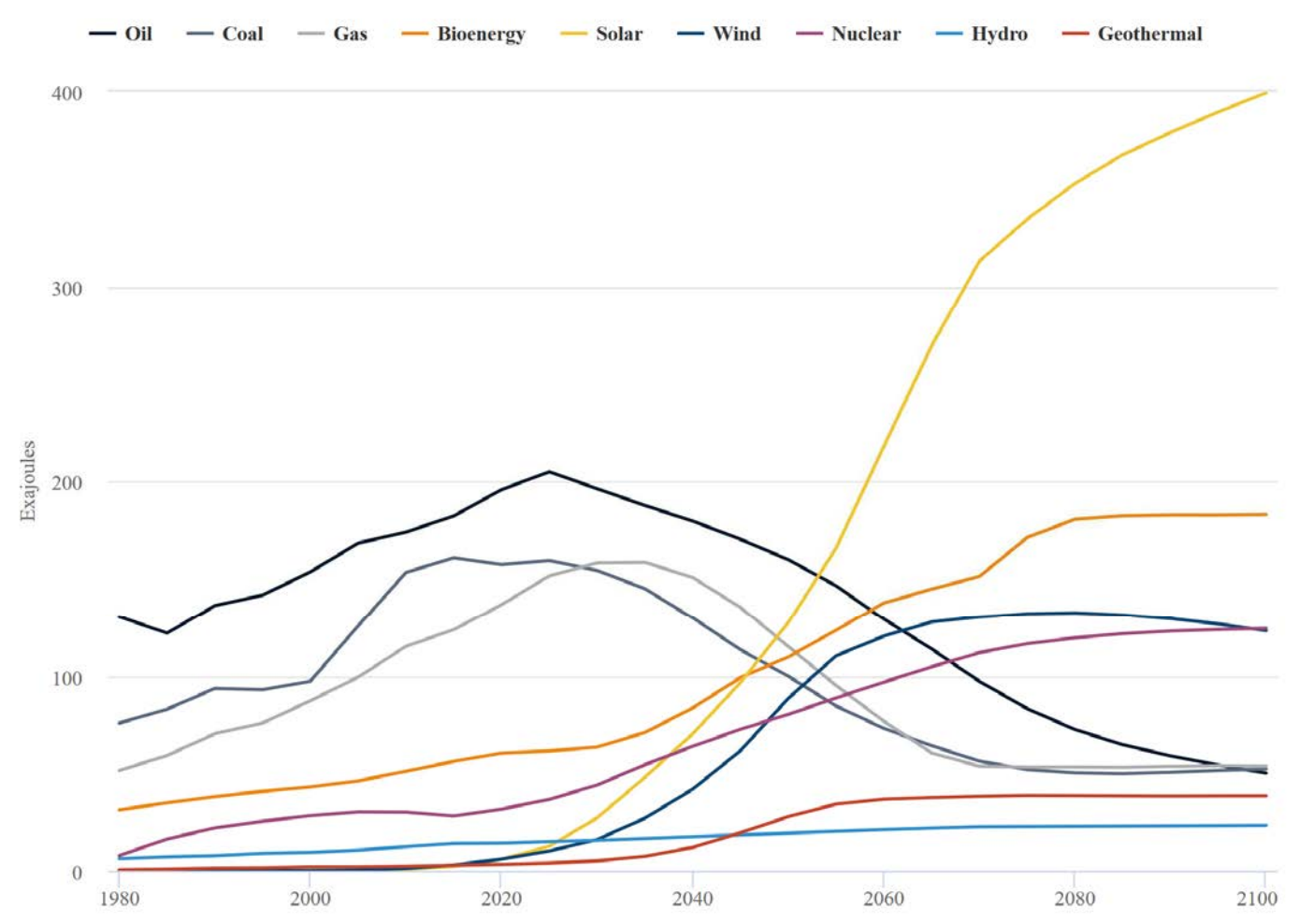


Carbon Brief - In-depth: Is Shell's new climate scenario as 'radical' as it says? (2018)

Deltalinqs

Pijlers Nieuws & agenda Leden Domeinen O

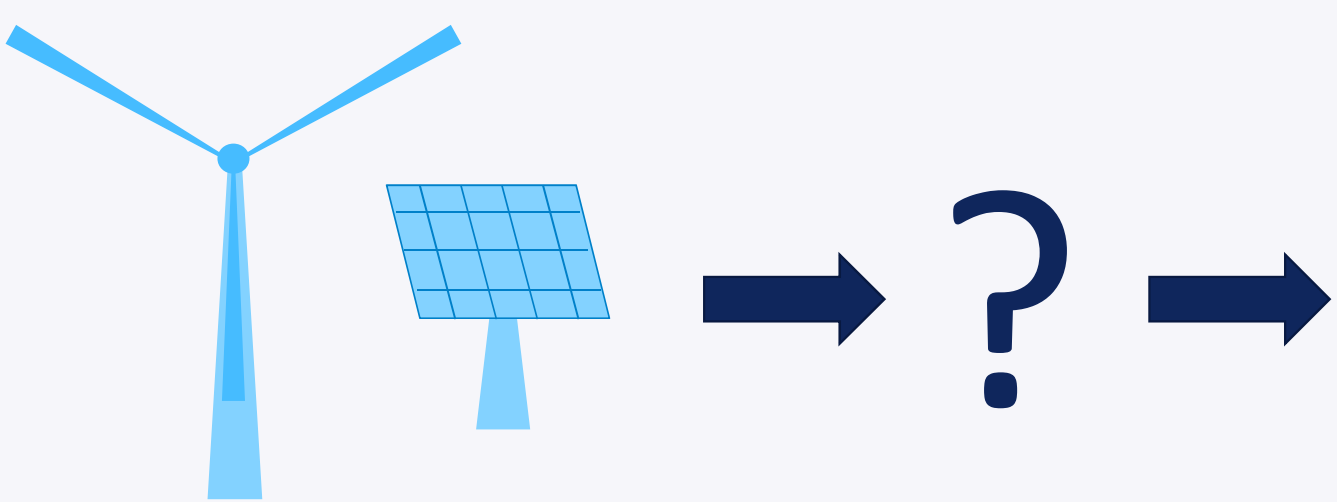
Nieuws

2019-06-17

"Groene waterstof heeft de toekomst, maar timing is cruciaal"

Het wordt een iconisch project. BP, Nouryon en Havenbedrijf Rotterdam onderzoeken de haalbaarheid van een waterelektrolyse-installatie van 250 megawatt voor de productie van maximaal 45.000 ton groene waterstof per jaar. Dat zou de grootste van Europa worden. Ruben Beens (BP) en Marcel Galjee (Nouryon) vertellen over de totstandkoming en mogelijkheden van de centrale.

Considering the scales…

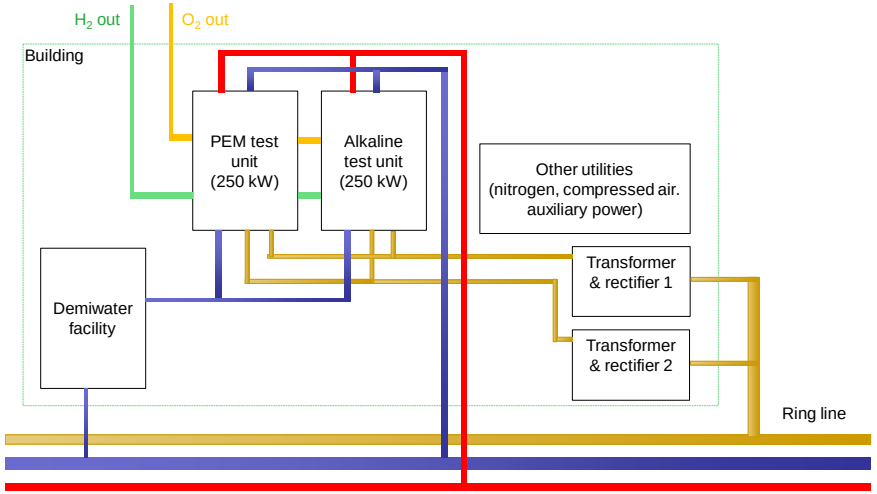


~10 GW offshore
NL in 2030

~800 kton / yr
current H2 use

Step 1 – MW Testcenter - understanding how to reduce electrolyser costs and increase productivity

- The MW test center - water electrolysis at higher TRL levels (4-7).
- Stack target cost prize of 50-100 €/kW at an efficiency of >80% (for first 5 years of operation) @ 30 bara by 2030.



Operational in summer 2020

Step 1 – MW Testcenter - understanding how to reduce electrolyser costs and increase productivity

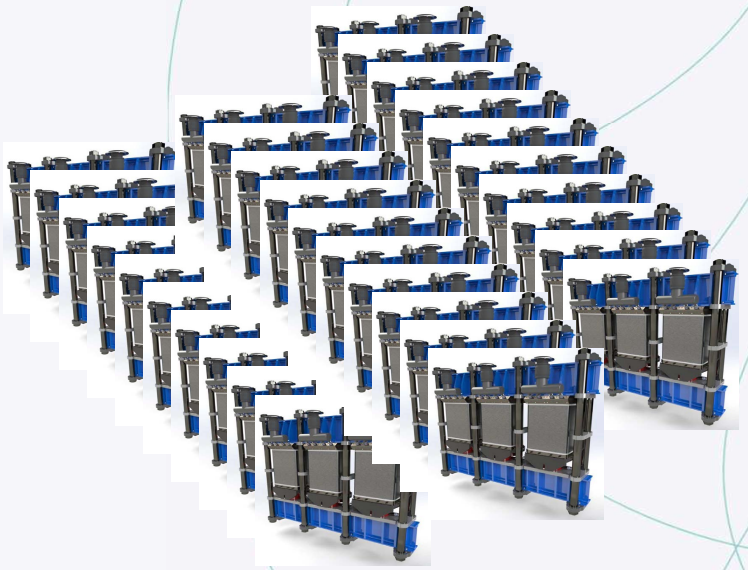
Experimentation on the larger scales

- Exploreand improve system heat transfer, mass transfer, fluid flow, electric fields
- Investigate internals, geometries, conditions, operations, to learn effects on semi-industrial scale
- Involve suppliers, system integrators, scientists, and many other relevant parties in open innovation on electrolysers to accelerate the development

Project status

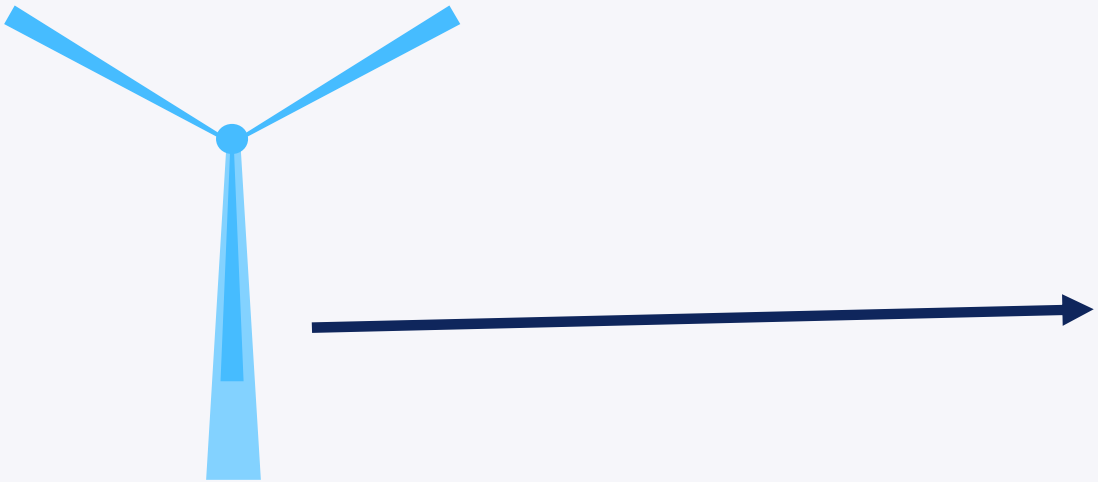
- Technical Kick-off early 2019 – facility opening summer 2020
- Project linked to several new applications 2019/2020 and engaging with new members and contributors

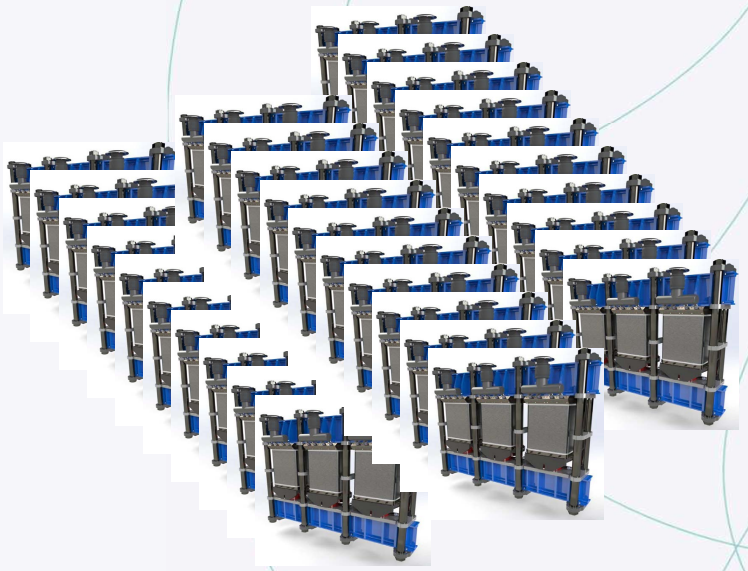
Step 2 – how to go up to GW scale?



Source: ITM POWER www.itm-power.com

Step 2 – how to go up to GW scale?





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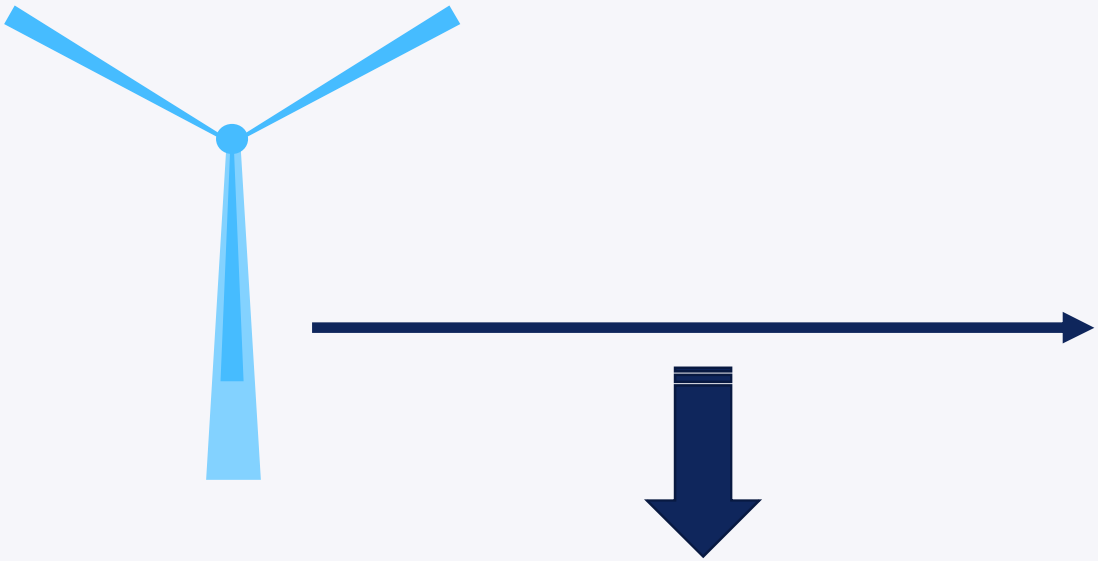

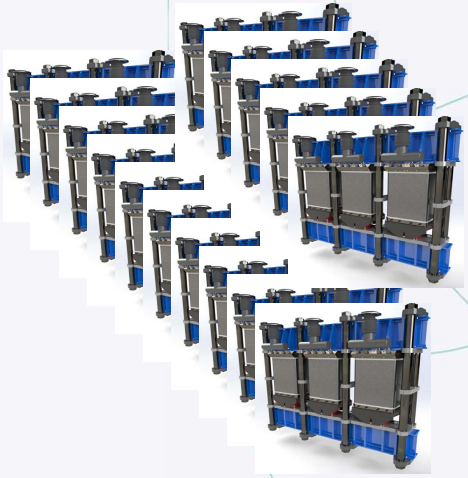

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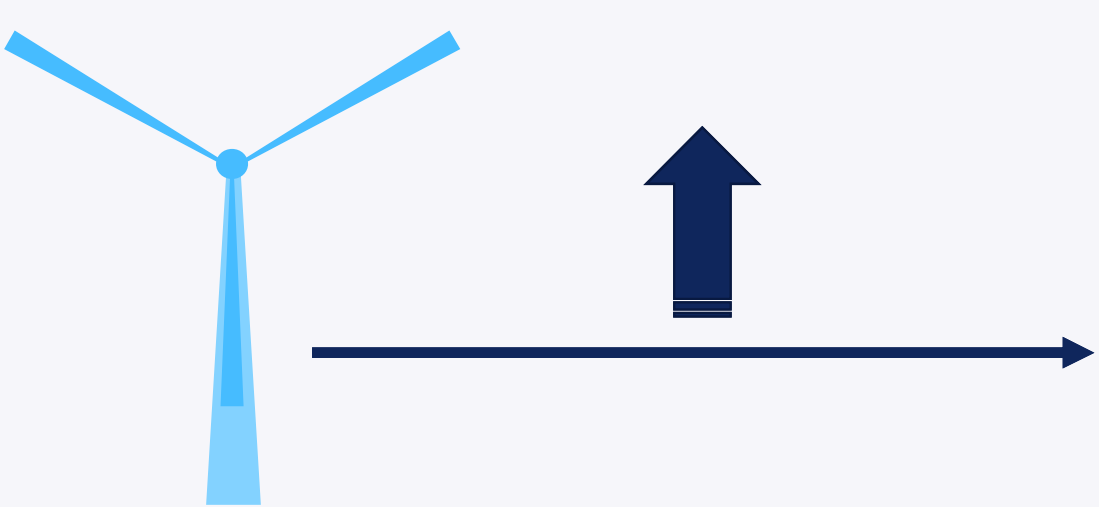

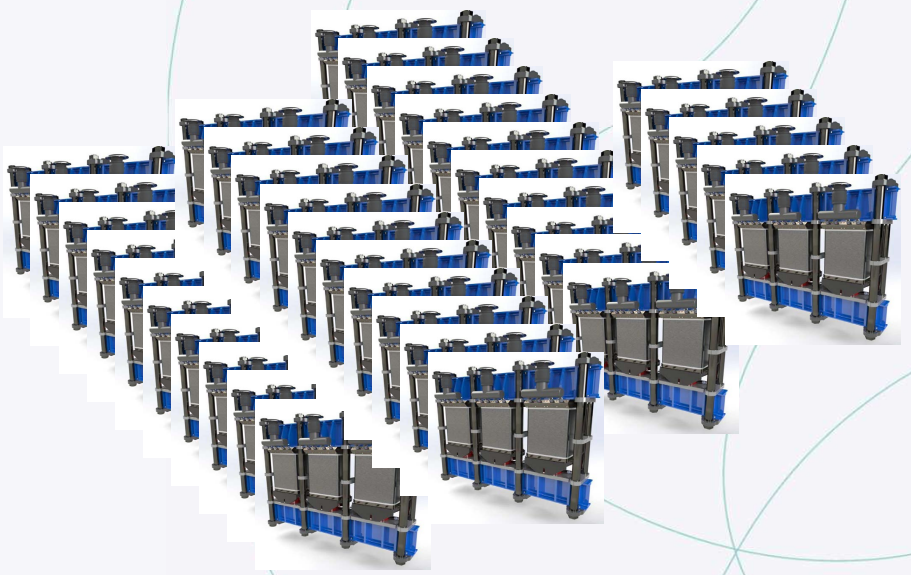

Step 2 – how to go to GW scale?

GW Conceptual design project – make design of GW scale system to learn how to drive down costs from 1000 to 350 €/kW or less

Part 1 – Founding basis – started end 2018

- Stack system breakdown – ECN/TNO
- Learning Curves of components – Utrecht University
- Optimal design for controllable system – Imperial College UK

Part 2 – System Integration – starting Q2 2019

- Understand how costs depend on local situation (infrastructure, users of H2, O2, heat, etc)

Part 3 – Conceptual design, engineering and costs – funding application done, Q3 2019

- Make designs to understand the design criteria and resulting cost structure, etc

System Integration in 5 industrial regions

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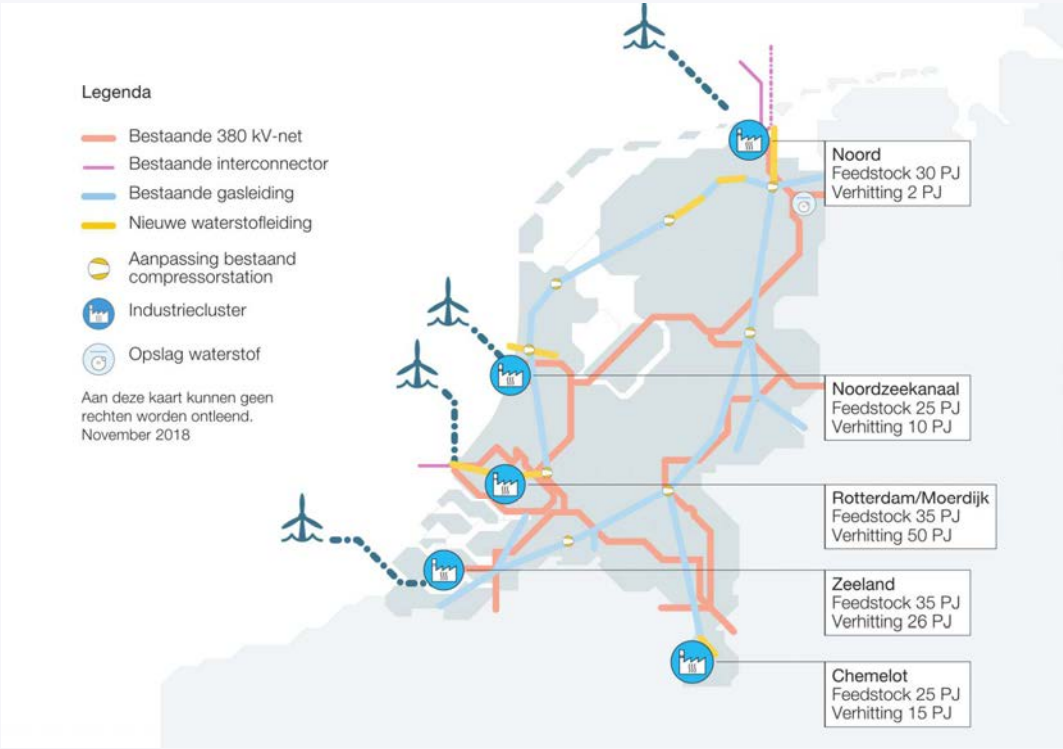
Step 3 – up to TW in 2050 – global supply chains?



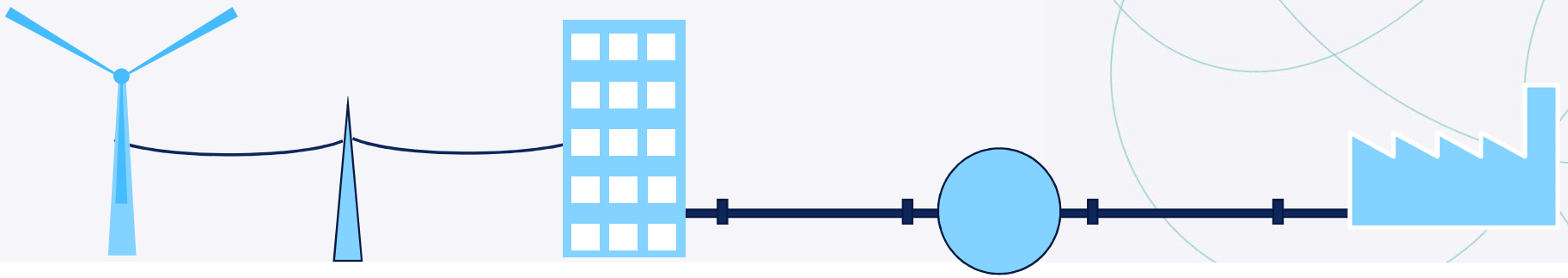
Step 3 – up to TW in 2050 – global supply chains?

HyChain Project – understand the emerging supply chains that shape the hydrogen economy driven by the energy transition

HyChain 1 – Understanding renewable Hydrogen use in industry under transition

HyChain 2 – What is the role of import from abroad ?

HyChain 3 – what options do we have to connect supply and demand? Technologies for



Step 3 – up to TW in 2050 – global supply chains?

- HyChain II – report published analysing the cost of importing green hydrogen
- Report and Full Model are available Kalavasta website

HyChain IV – Integral model and scenario analysis – project under development

HyChain V – societal and geopolitical implications – to be developed in 2020

Technology development

Hydrohub

Strategic Analysis

MW Test Center

GW scale concept

Source: ITM POWER www.itm-power.com

HyChain

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Royal HaskoningDHV
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