TKI ENERGIE EN INDUSTRIE
Topsector Energie

Outlook of Industrial Electrification in The Netherands

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MATCHMAKING TKI WOZ

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My background

Program Director System Integration ISPT

- 10 year at ISPT
- Renewable energy to the industry
- Hydrohub Innovation Program
- Circular Carbon

Institute for Sustainable Process Technology

Program Manager Industrial Electrification

- 4 years at TKI E&I – previously on industrial heat and energy efficiency
- Lead on MMIP8 – Industriële Elektrificatie en Radicale Proces Vernieuwing

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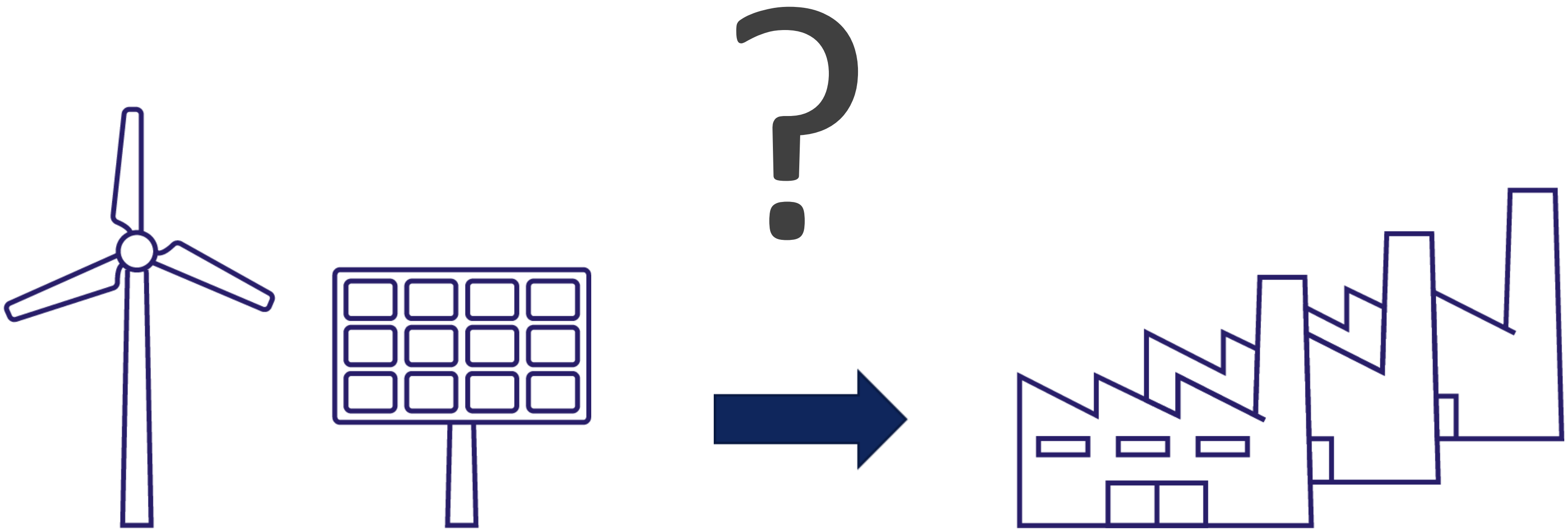
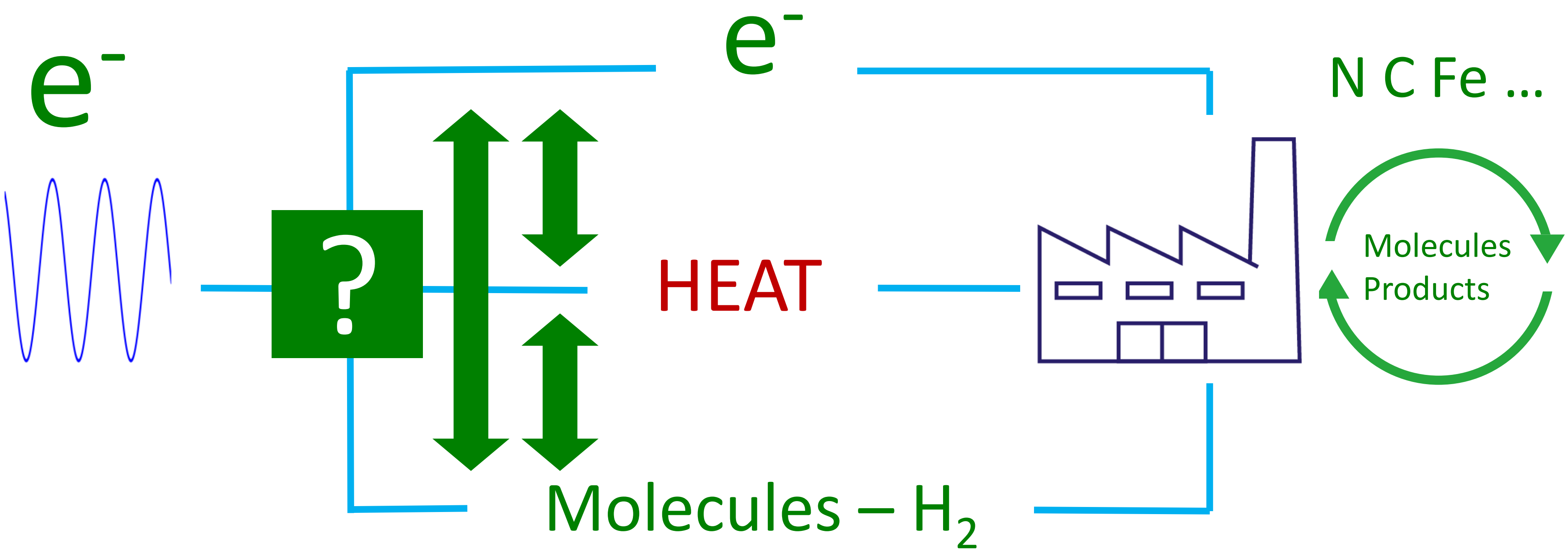
The Transition Challenge



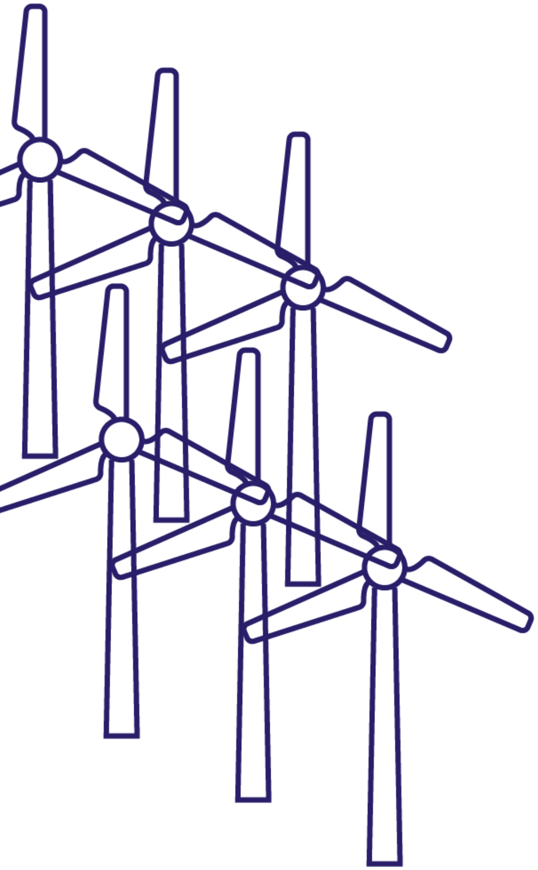
~10 GW offshore NL in 2030 – much more towards 2050

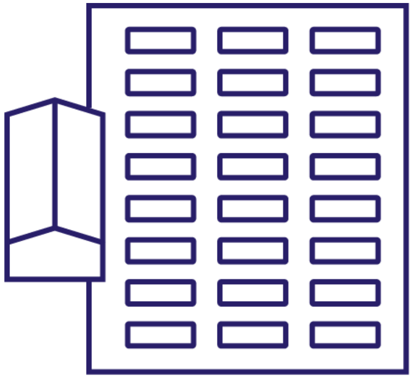
14,3 mton CO_2 reduction 2030 – net zero and circular in 2050

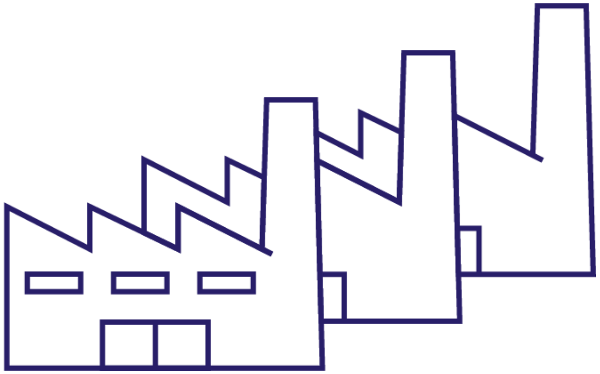
What are the options?



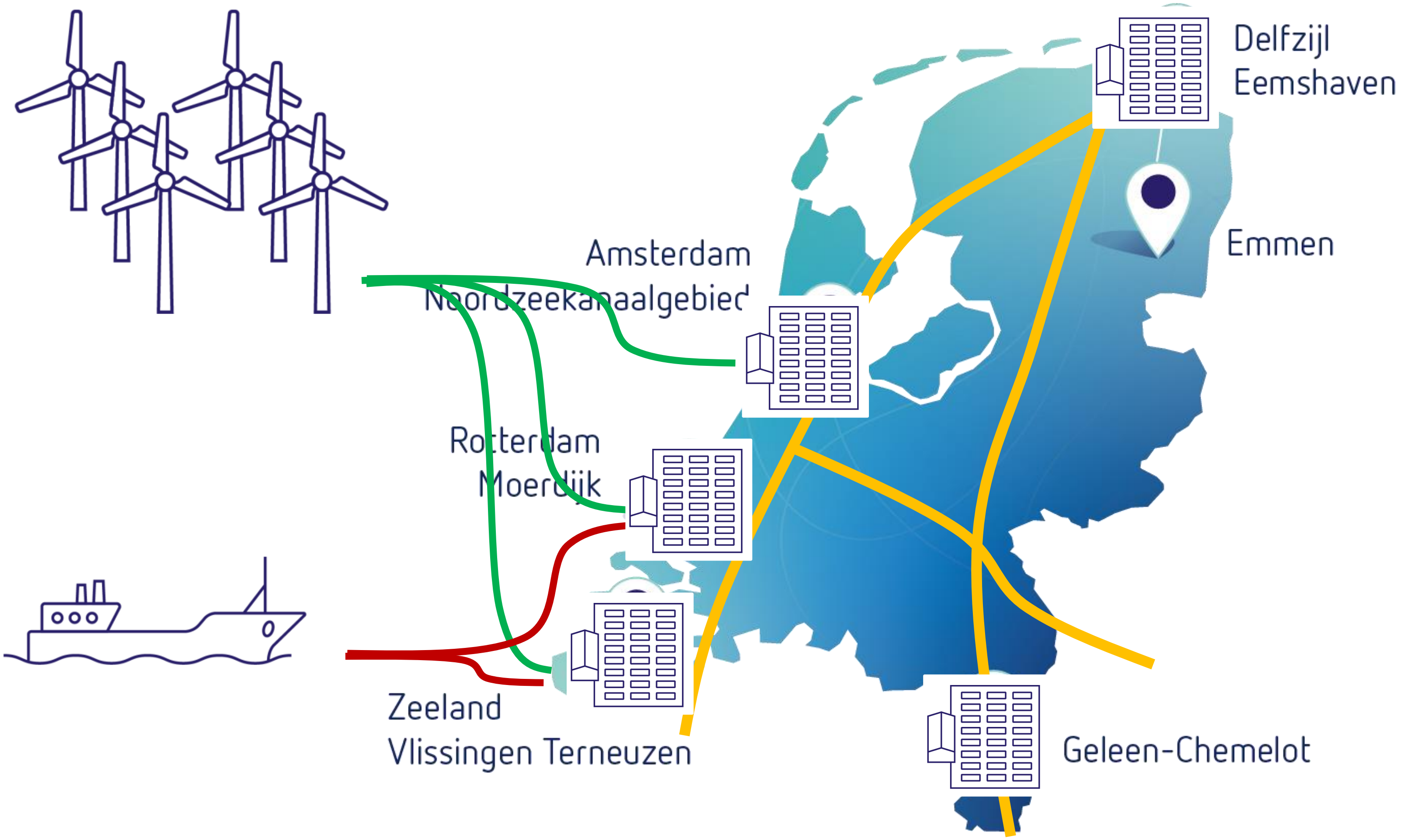
Hydrogen – innovation challenge 1 – matching the scales







Connect through GW scale water electrolysis


Delfzijl
Eemshaven
Emmen
Amsterdam
Noordzeekanaalgebied
Rotterdam
Moerdijk
Zeeland
Vlissingen Terneuzen
Geleen-Chemelot

Hydrogen – innovation challenge 2 – industry applications and market?

Energy source – fuel replacement towards zero-emission

- zero-emission drop-in solution for industrial heaters and furnaces?
  - Large-scale industries (petrochemical, refineries etc) – very large and concentrated heating need (e.g. cracker furnaces, ovens etc)
  - Smaller and distributed sectors - paper sector, food processing etc.
  - Back-up power supply (P2G2P)
- Alternatives?
  - CCS, but not always feasible
  - Electrification – see next slides

Feedstock

- Ammonia production – agro, chemicals, fuel (new application)
- Syngas - fuels and materials – requires renewable or low-emission C-souce
- Metal – Iron making – contribute to CO2 emission reduction – several routes exist or under development – CCS alternative

Market and transition outlook

- Upside – fast adoption at scale – large volumes
- Downside – costs/affordability – need for H2 price < 2 €/kg
- Green – Blue – competition or synergy?
- Need for distribution infrastructure to establish the market

Heat – electrification of heat supply Power-to-heat

Rotterdam Area estimate 500 – 1500 MW potential for Power-to-Heat applications
DOW high-temperature long-term outlook 2 GW potential

Direct heating

- High temperatures (> 800 C) - Cracker furnace electrification (DOW, Shell, Sabic) and steam reformers and other high-temperature applications:
  - First demonstrations by 2030 – 2035 – roll-out 2035-2050
  - Very large scale – e.g. DOW scale around 2 GW – base load need
- Electric Arc Furnace – typical for steel sector – potential to increase scrap recycling and reduce CO2 emission – Tata-specific solution
- E-boilers and other direct-heating solutions at lower temperatures – peak shaving or back-up potential

Heat pump technologies

- Mechanical Vapor Recompression – Coefficient-of-Performance >10 (1MW power → 10 MW heat) – large-scale demonstration at DOW going on – produces high-quality heat – replication can be expected
- Heat pumps – enables electrification and energy efficiency in many sectors, implementation difficult, may expect adoption when incentive increases (CO2 tax, subsidies)

Other electrification attention points

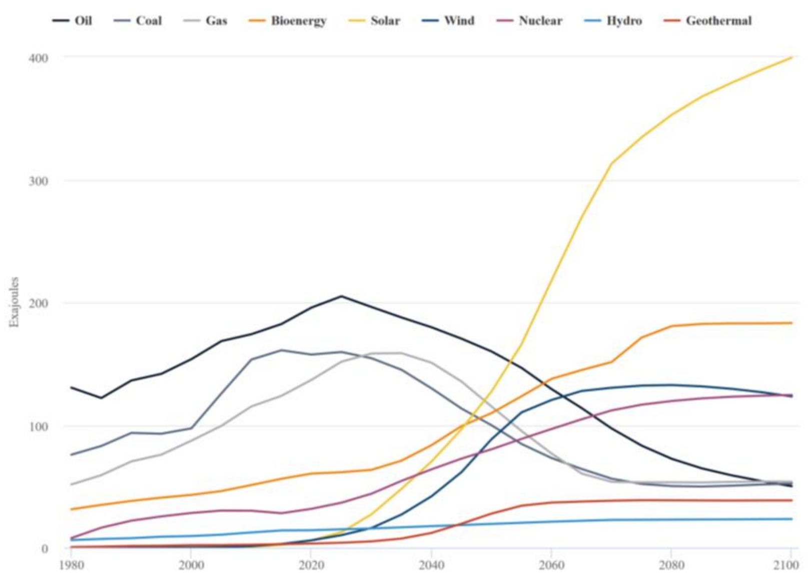
Direct large-scale use

- Classical routes – Chlorine, Aluminium and Silicon Carbide via electrolysis
- Future options – electro-chemical routes to synthetic fuels – CO_2 capture and conversion to Methanol or fuels
- Potential to be large scale, but long-term outlook (2050)

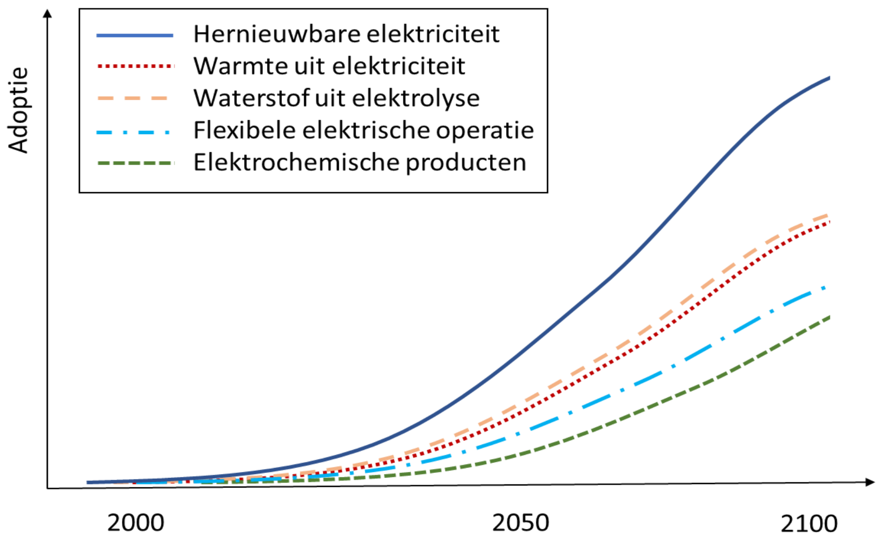
Power Grid – Capacity and Flexibility

- Electrification growth in industry expected from 2030 onwards, water electrolysis leads the way
- Growth in power production with renewables – 'green' back-up supply and flexibility in application will need to grow
- High-voltage infrastructure essential to secure supply for large-scale electrification and hydrogen production – long lead-times in planning

Outlook in summary



Prognosis of energy transition
Shell Sky scenario 2018



Industrial adoption of electrification
MMIP8 2019