

# Hydrogen, Ammonia and Methanol in Hydrogen Hubs in the Nordic Region

## NORDIC HYDROGEN VALLEYS

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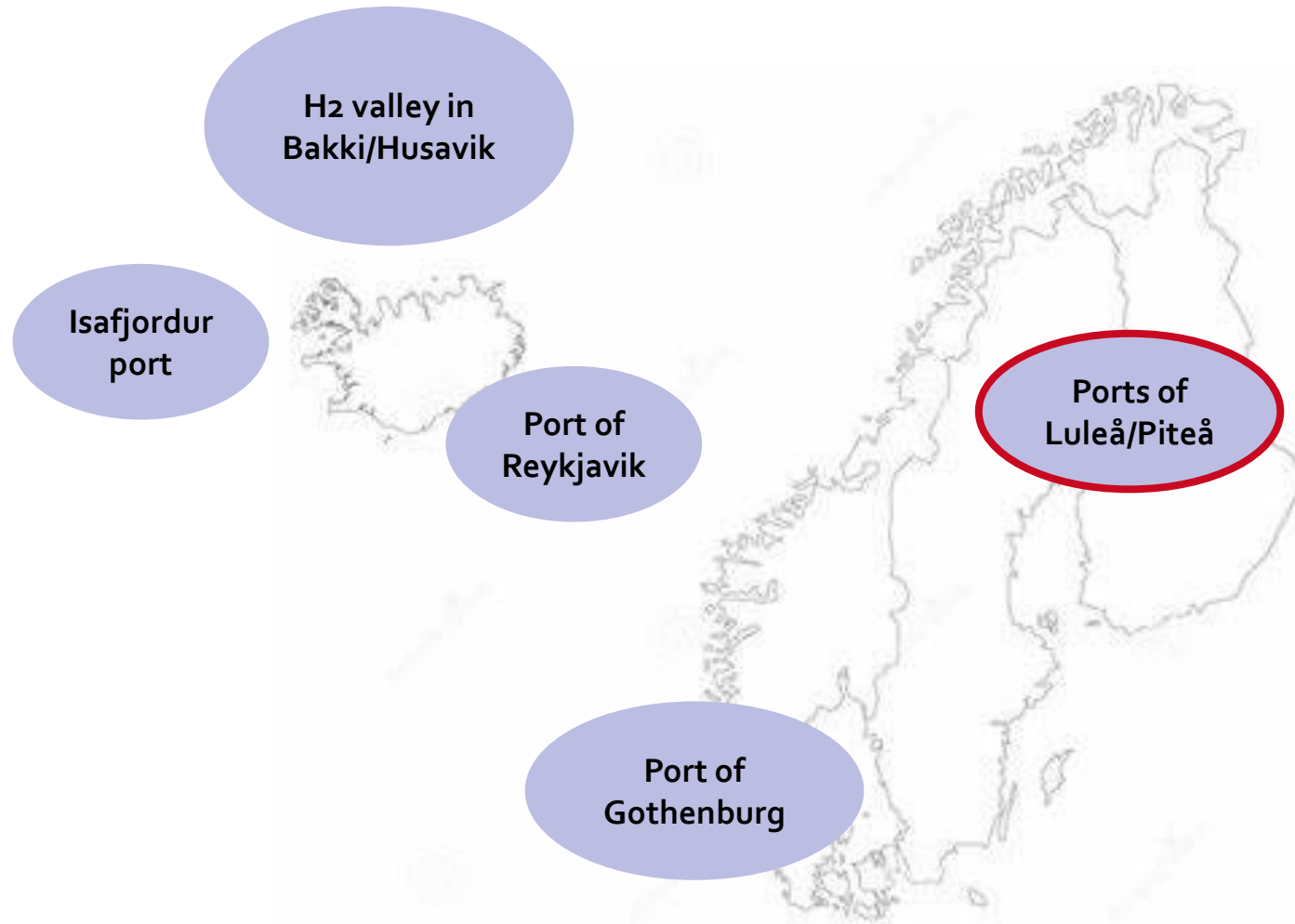
# Aim & Objectives of H<sub>2</sub>AMN



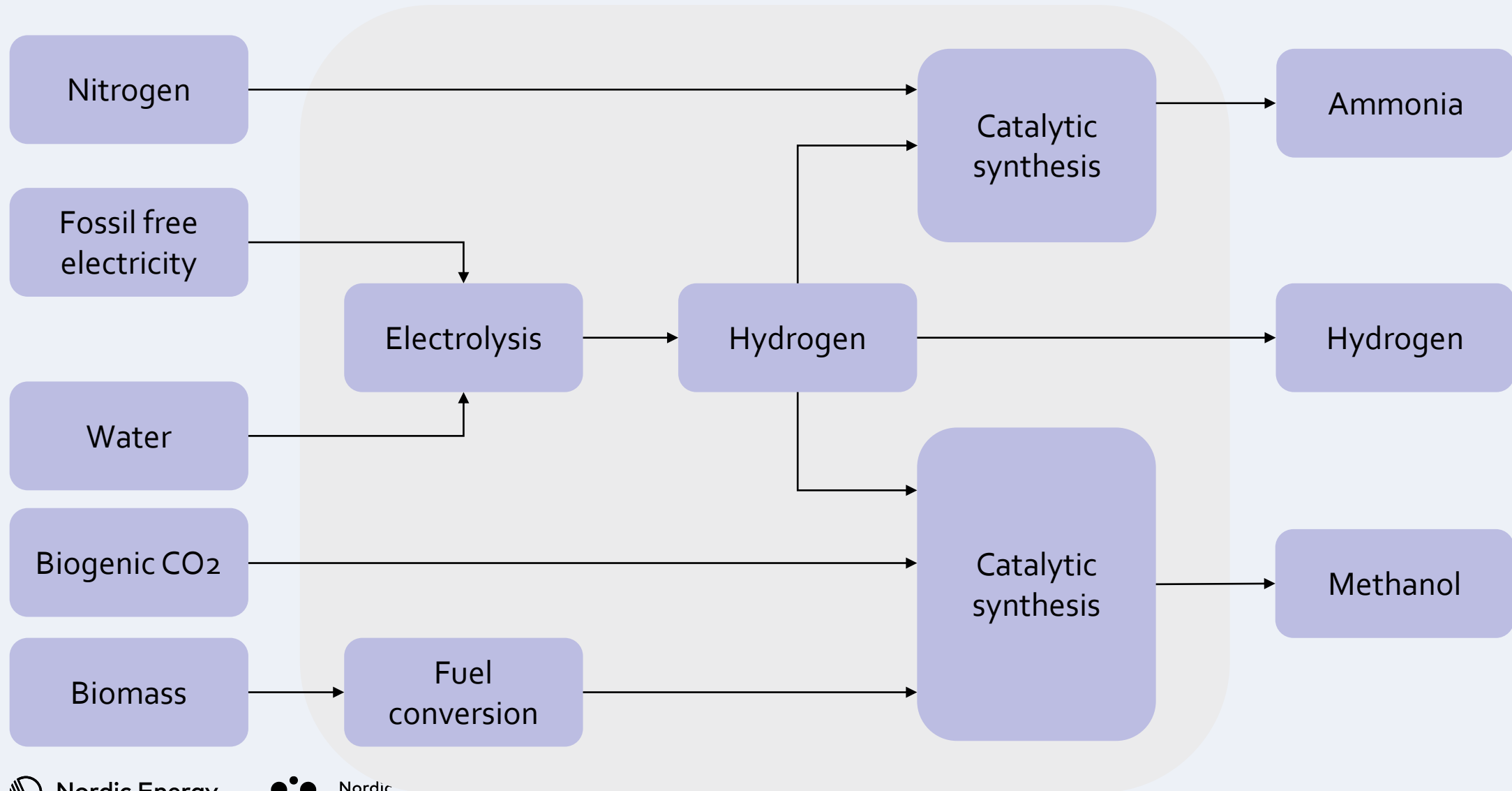
Increase knowledge on hydrogen-based fuel pathways (**hydrogen, ammonia, and methanol**) centered around ports in the Nordic region.

- Assess techno-economic conditions for implementation of H<sub>2</sub>-based fuel pathways
- Assess drivers and barriers for realizing these pathways incl. public acceptance, policy gap analysis etc.
- Assess opportunities for innovative sector couplings and energy systems integration
- Assess possibilities in of using existing underground rock caverns for hydrogen and ammonia storage
- Outline ambitious pathways and strategies/guidelines for the implementation of hydrogen-based value chains in ports in the Nordics by 2030/2040.

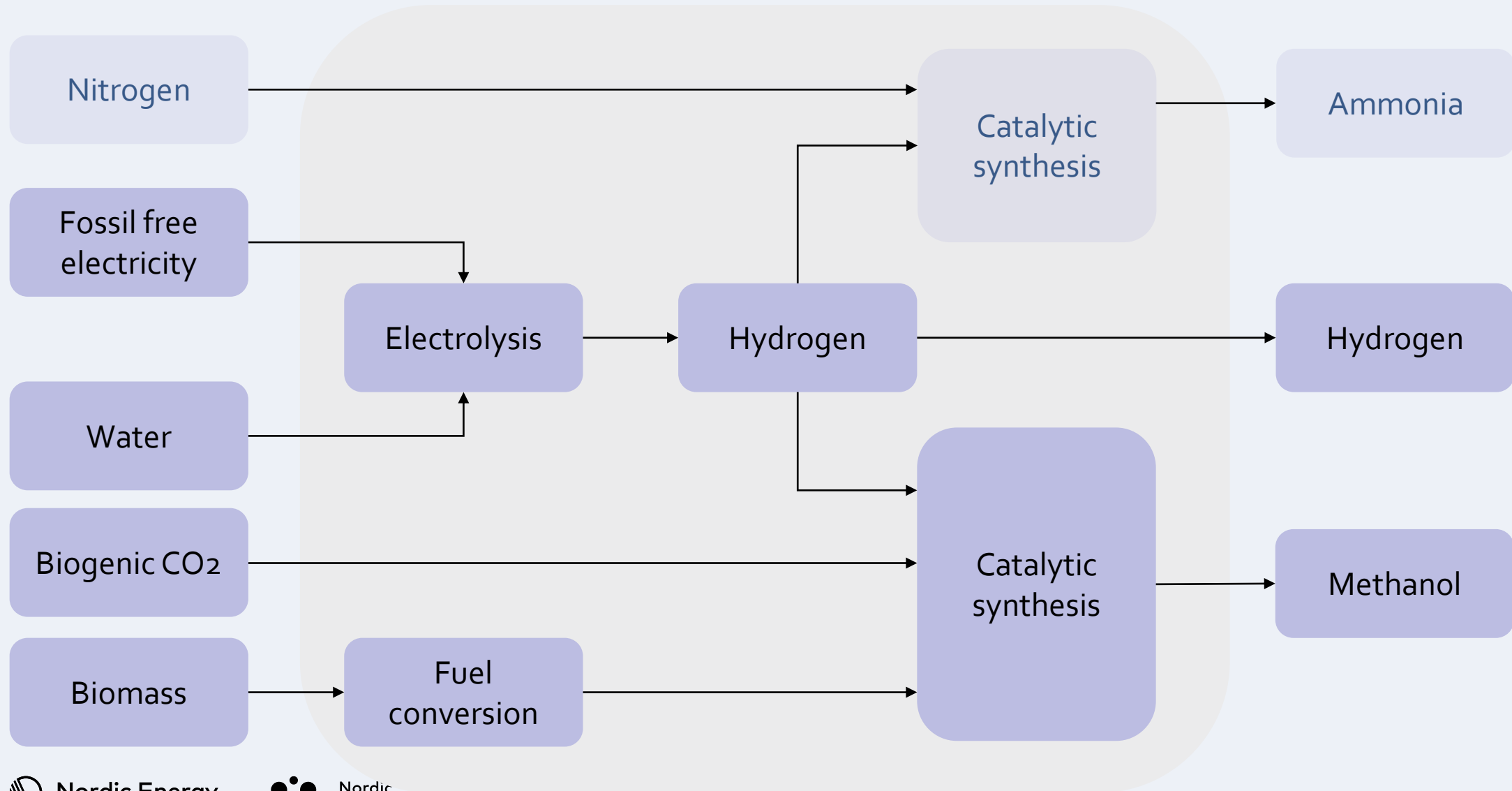
# Five case studies in two countries



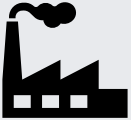

# Considered production pathways



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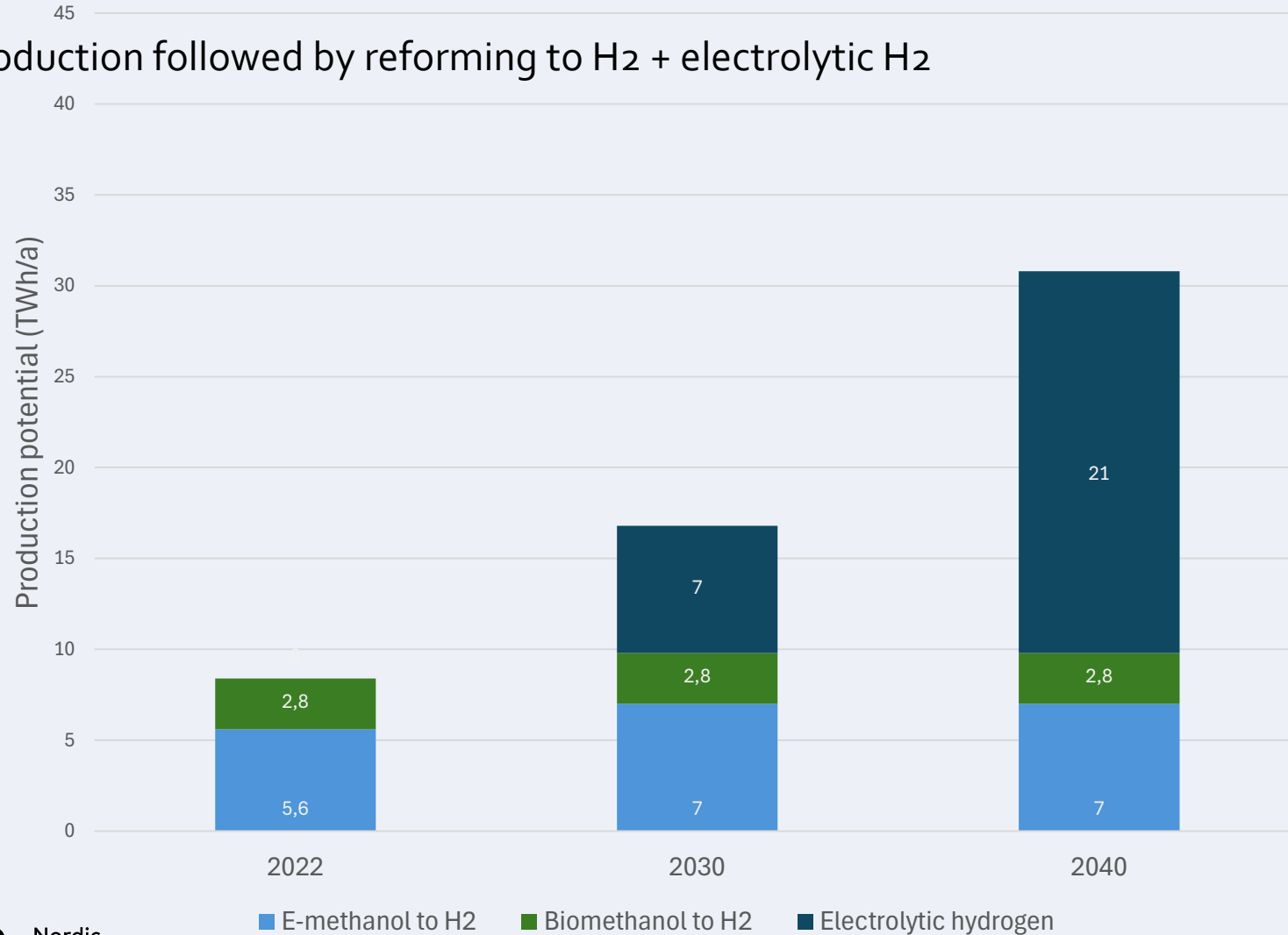
# Large renewable feedstock potentials in Norrbotten

|  | 2022                                    | 2030                                    | 2040                                    |
|--|---|---|---|
|   | 14 TWh<br>(exported<br>"surplus")       | 15-29 TWh<br>(est. "surplus")           | 18-48 TWh<br>(est. "surplus")           |
|   | 2,9 million tons<br>bio-CO <sub>2</sub> | 2,9 million tons<br>bio-CO <sub>2</sub> | 2,9 million tons<br>bio-CO <sub>2</sub> |
|  | 5-6 TWh                                 | 5-6 TWh                                 | 5-6 TWh                                 |

"Surplus" = Production – Demand (excl. H<sub>2</sub>)

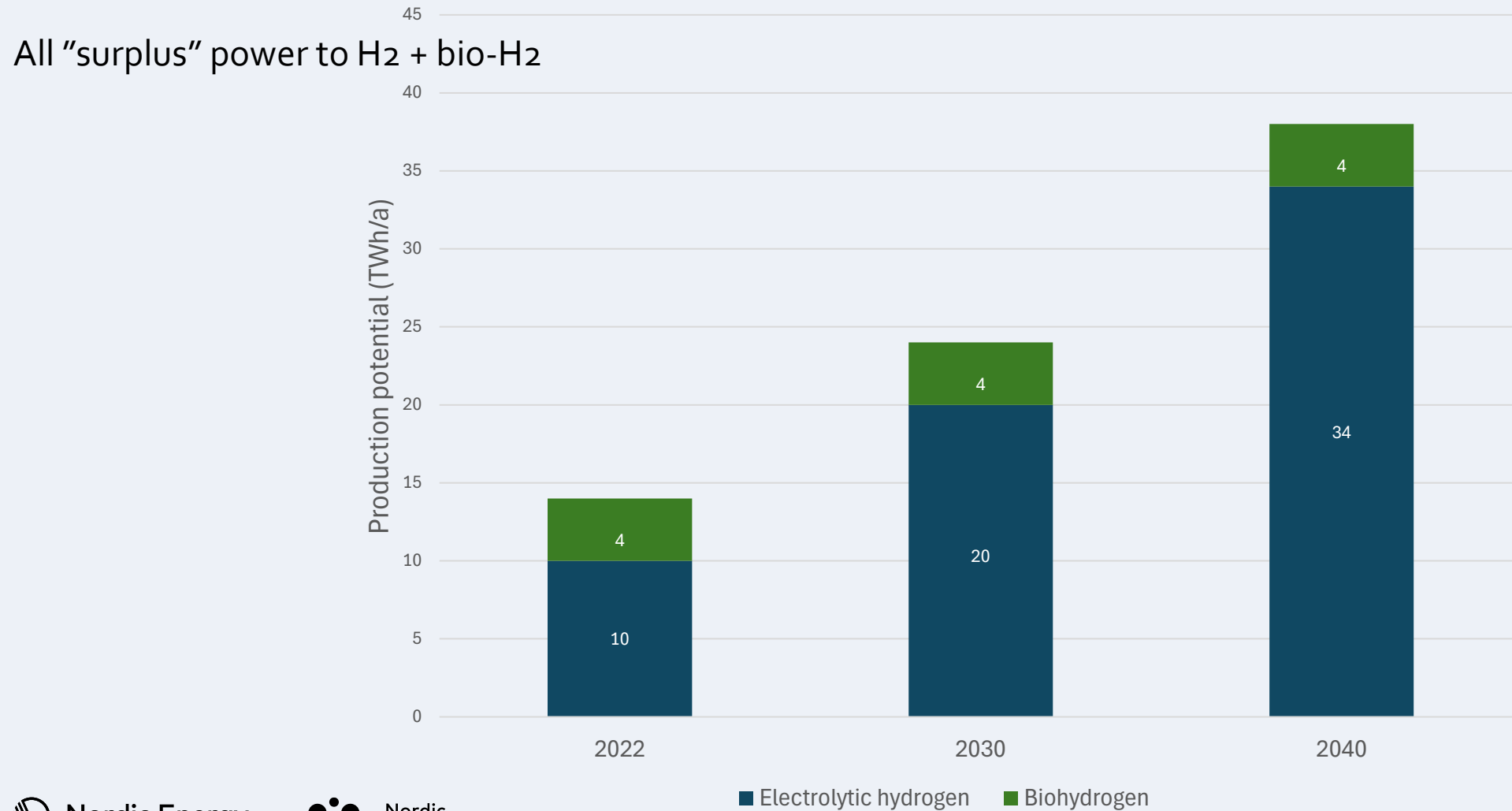
# Large H<sub>2</sub> production potentials

Maximal methanol production followed by reforming to H<sub>2</sub> + electrolytic H<sub>2</sub>

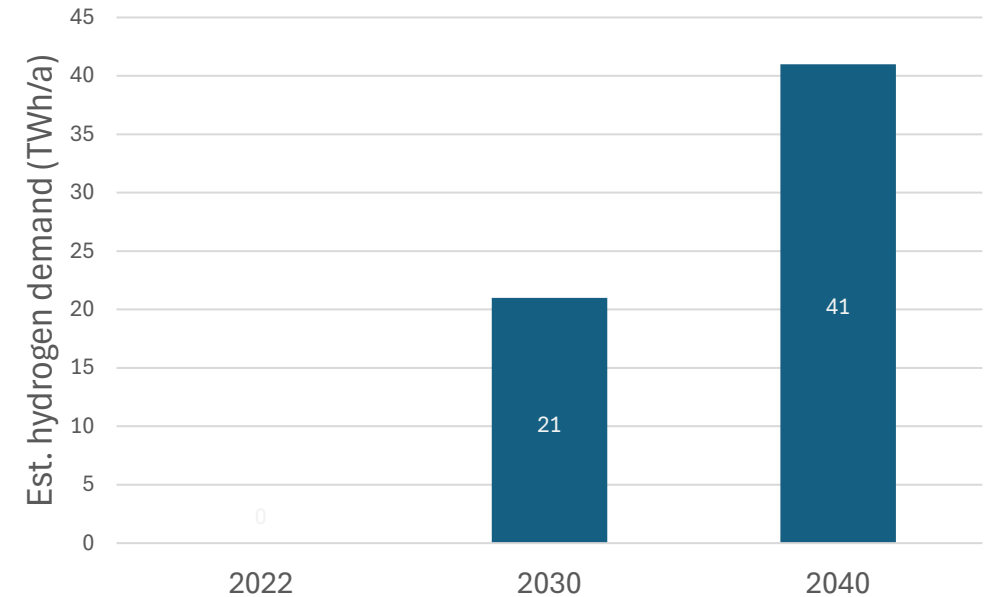
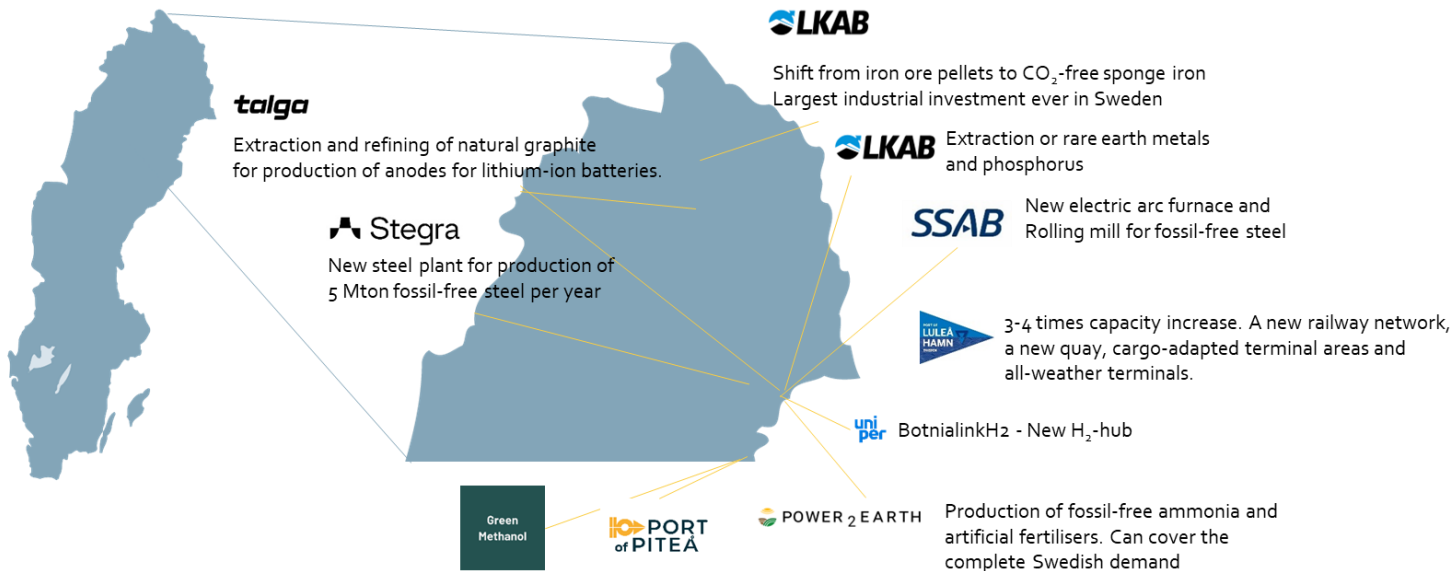




# Large H<sub>2</sub> production potentials

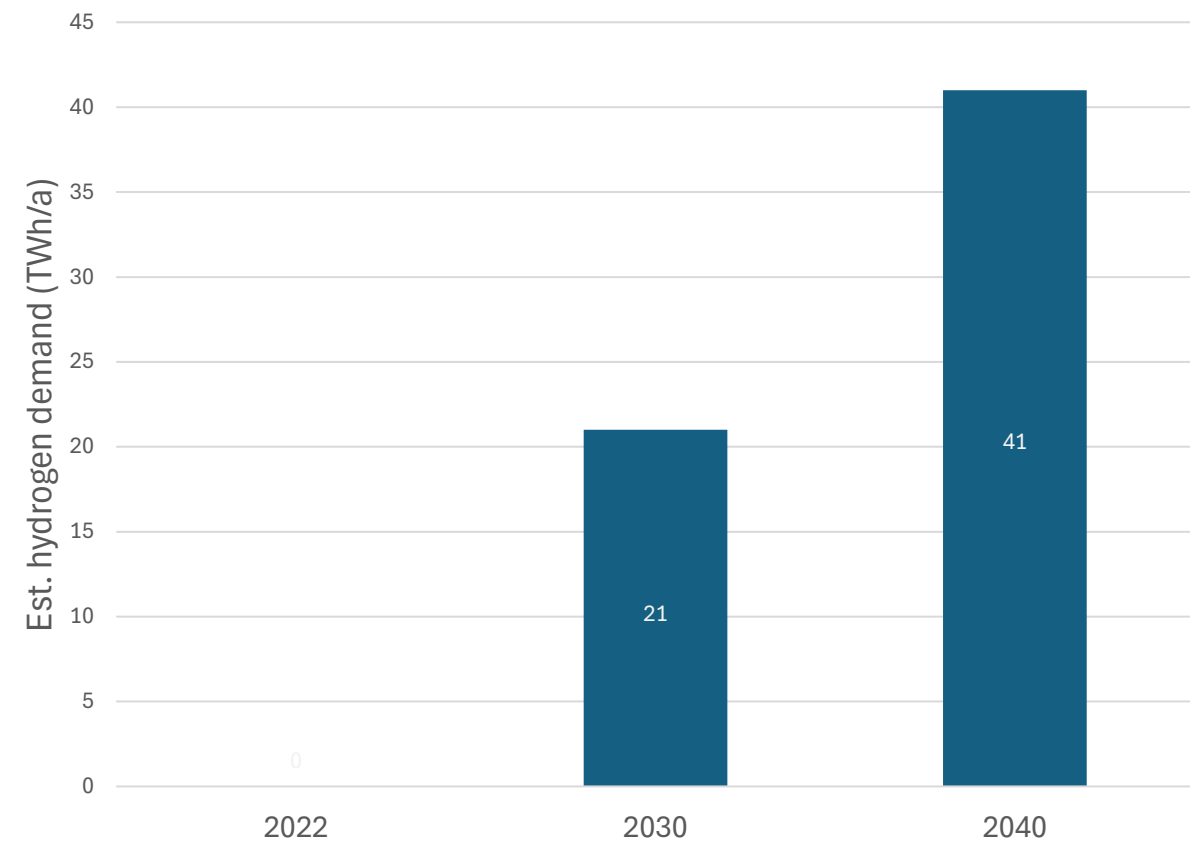
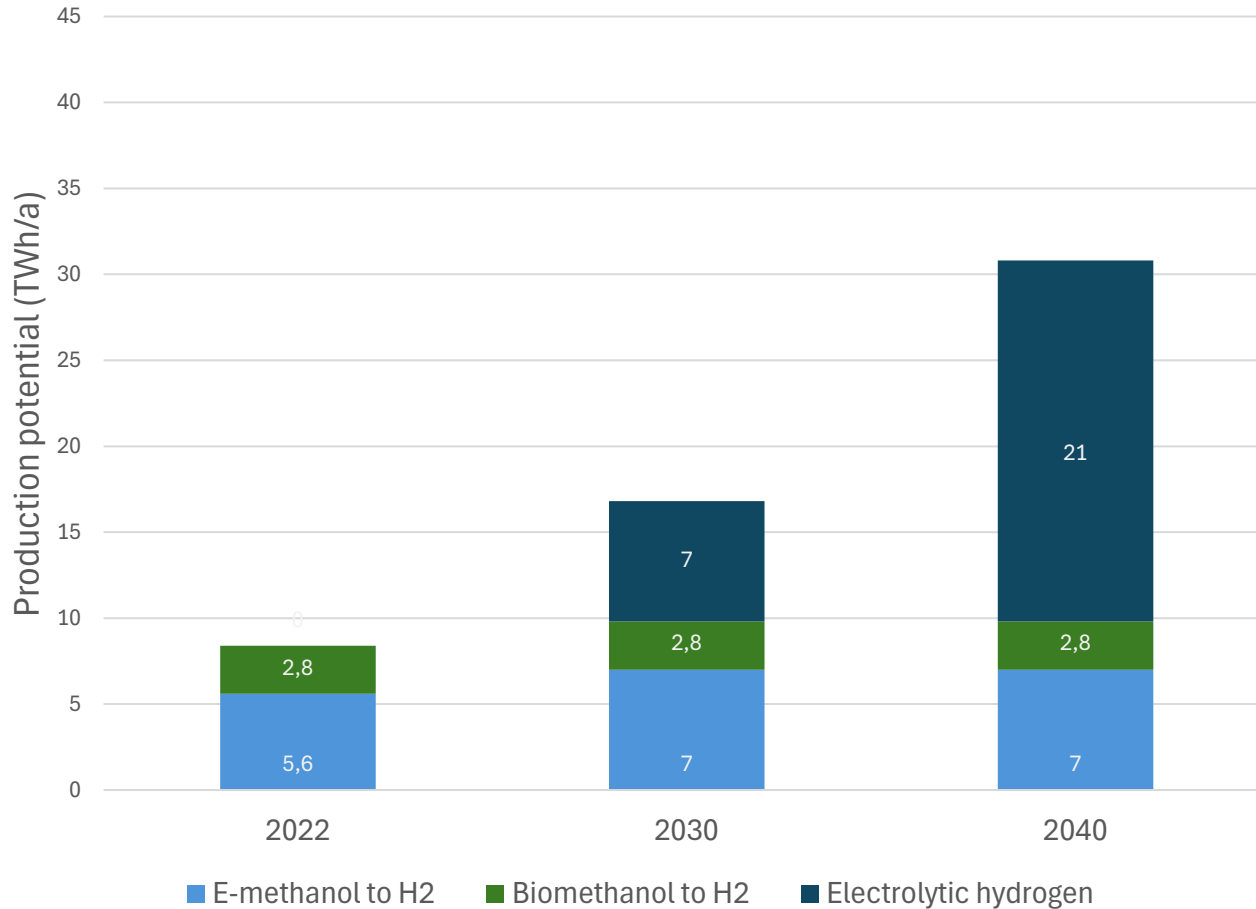


# Investments of more than 100 billion €

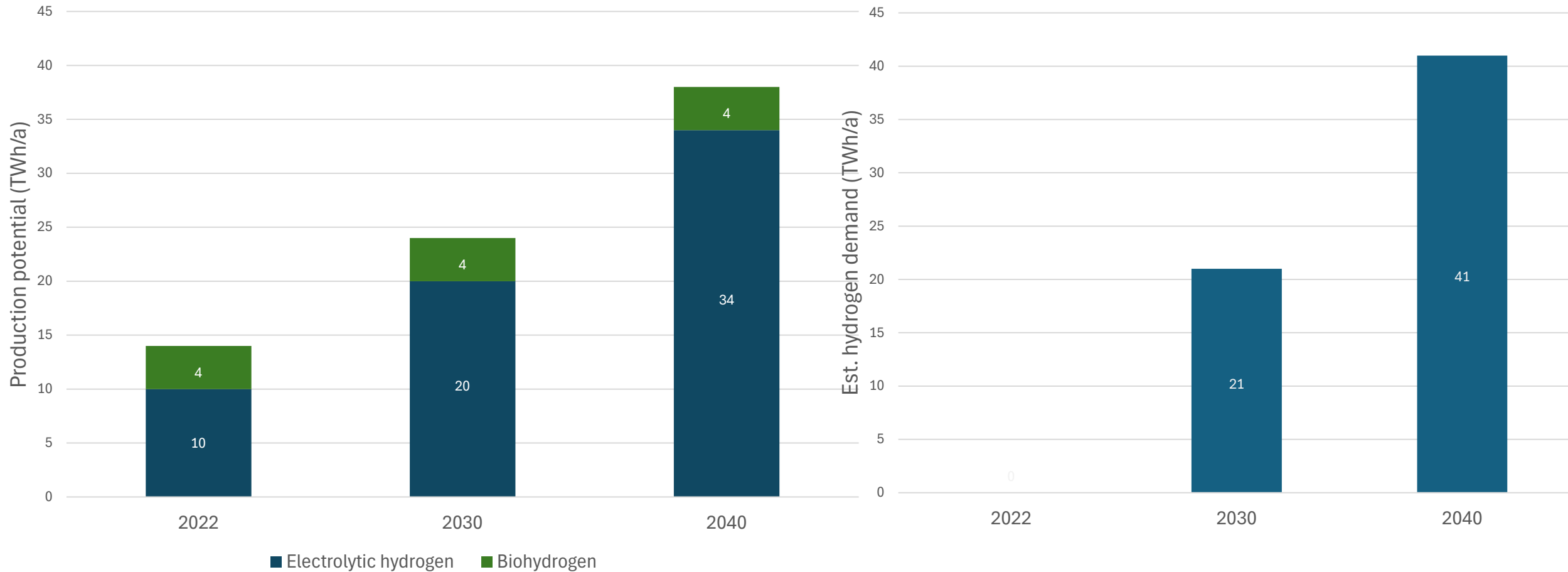


Ref: Wendt M., Wallmark C (Eds). (2022).  
Hydrogen, energy system and infrastructure in Northern Scandinavia and Finland.

# Enough to fulfil the demand?



# Enough to fulfil the demand?



# Major flows of hydrogen and derivatives 2050 (Mt of H<sub>2eq</sub>)



# Conclusions

- Large production potential of hydrogen and methanol in the region.
  - *Biomass based hydrogen is currently overlooked.*
- With the predicted hydrogen demand, energy export from the region is unlikely.
- Increased awareness of risks with foreign investments in green molecules production needed.
  - *Important to consider in policy making.*
  - *PTL in mid-Sweden is a recent example – Swedish majority ownership required.*
- In a just transition, energy colonialism must be avoided.



# Thanks.



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