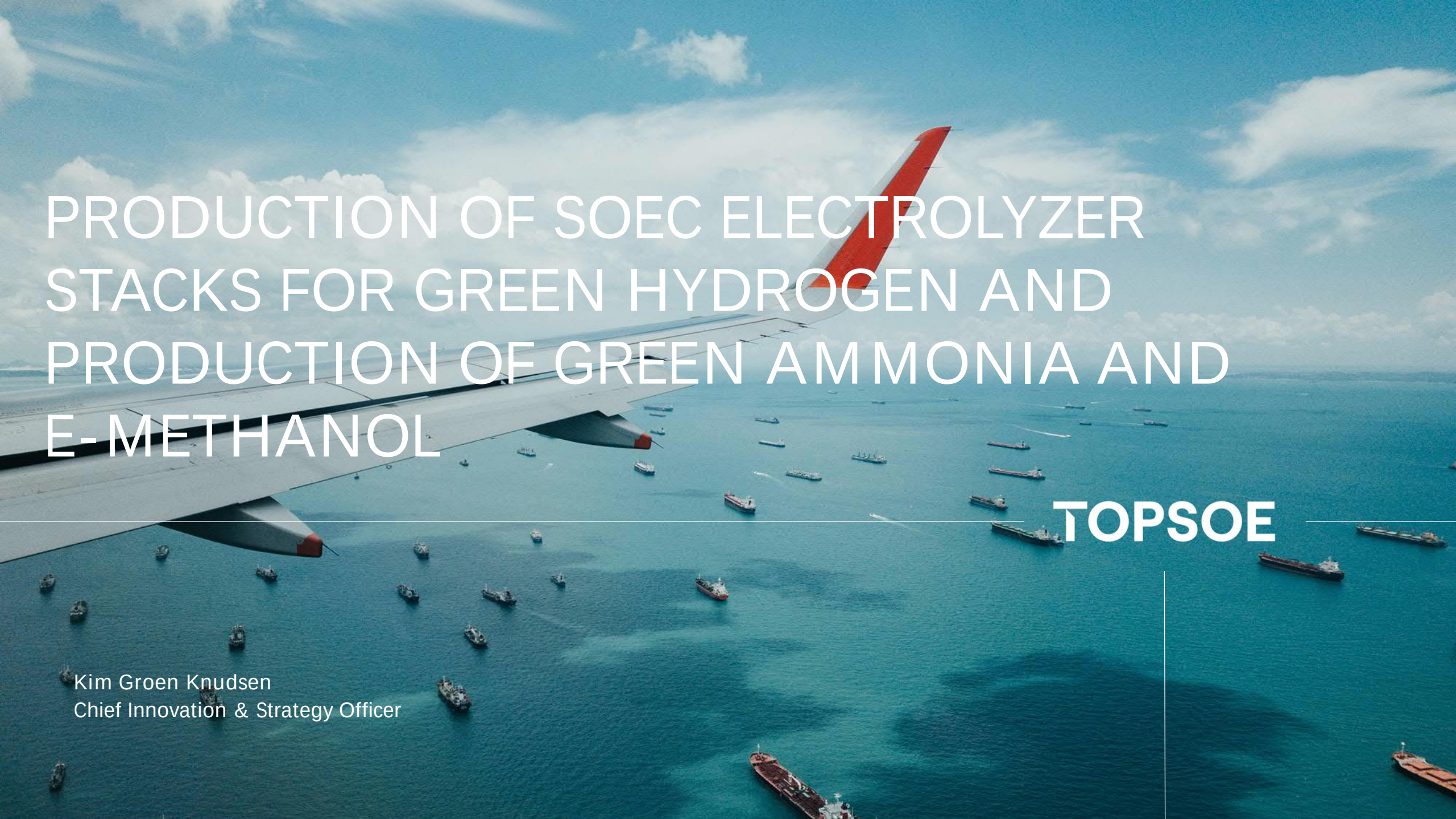
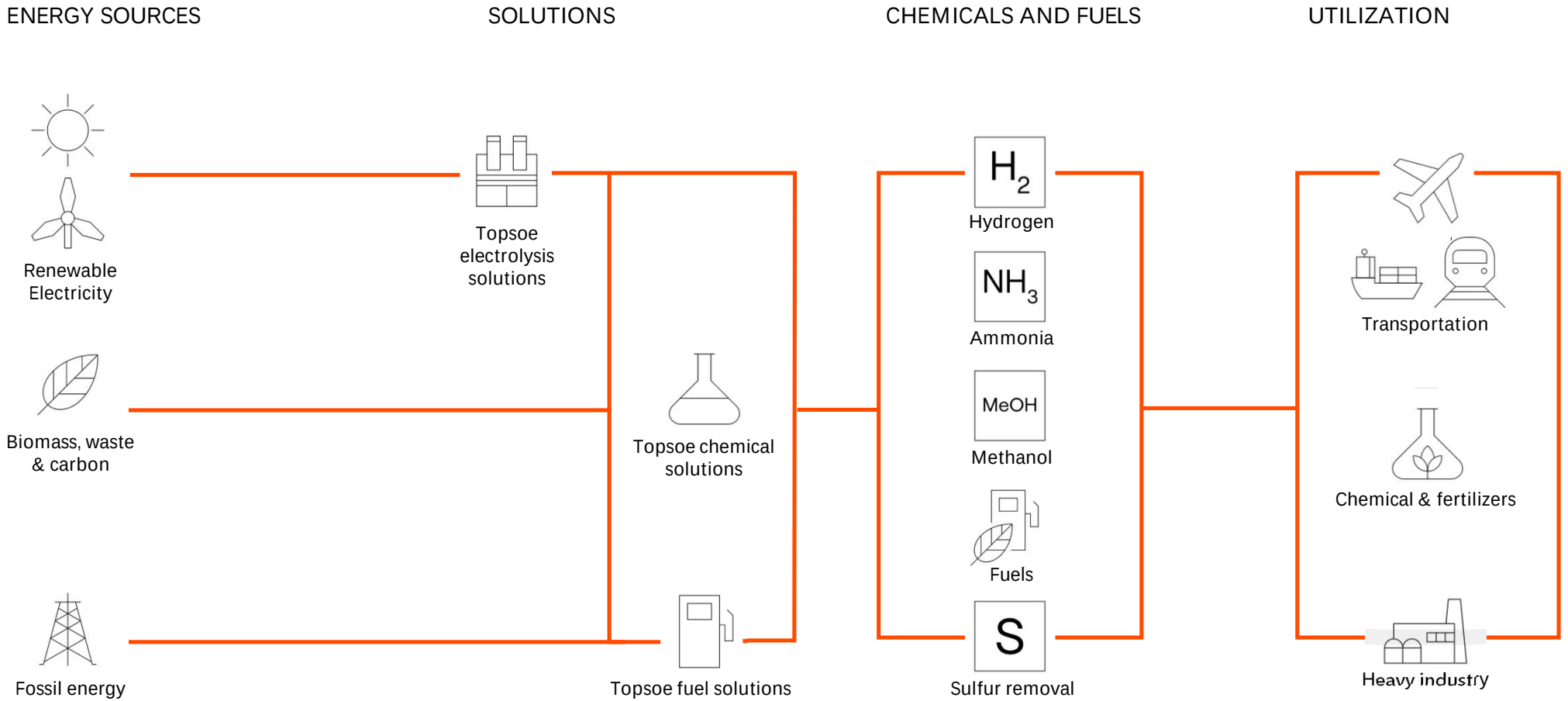


PRODUCTION OF SOEC ELECTROLYZER STACKS FOR GREEN HYDROGEN AND PRODUCTION OF GREEN AMMONIA AND E-METHANOL

TOPSOE

Kim Groen Knudsen
Chief Innovation & Strategy Officer

TOPSOE SOLUTIONS ACCELERATE THE ENERGY TRANSITION

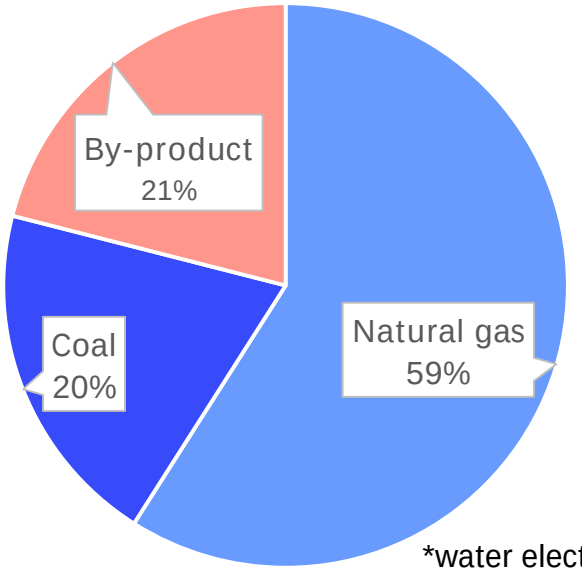


HYDROGEN MARKET IN 2020

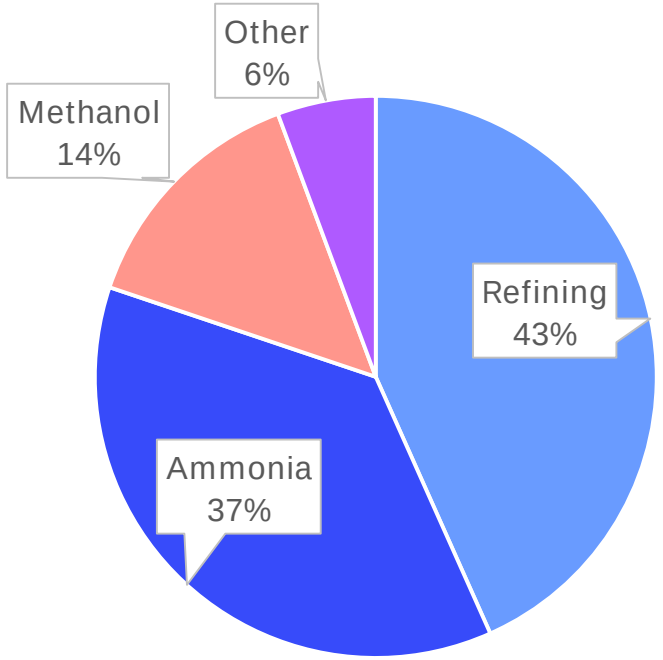
Selling price: 1-2 USD/kg H_2

135 billion USD (90 Mill tons @ 1.5 USD/kg)

H2 Production



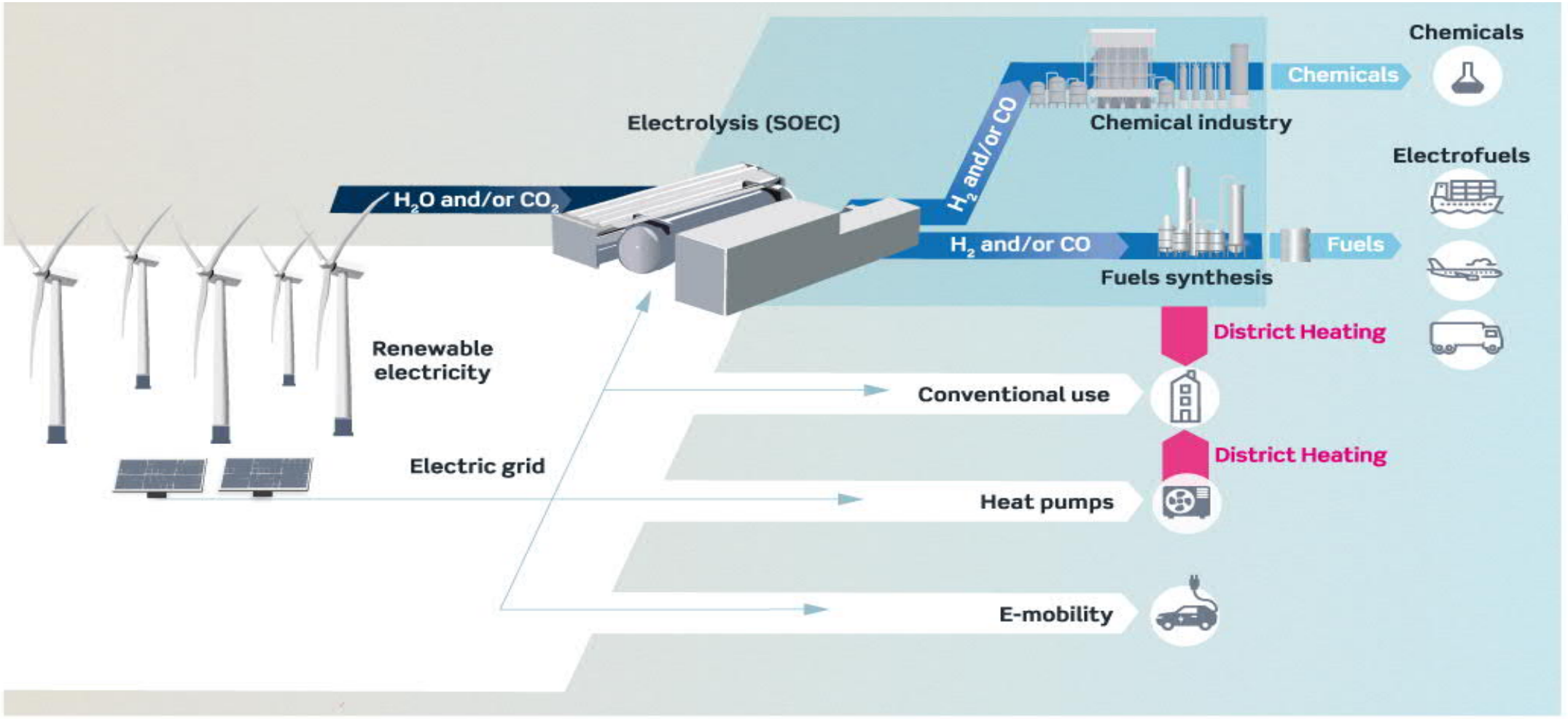
H2 consumption



*water electrolysis made up ~0.03%

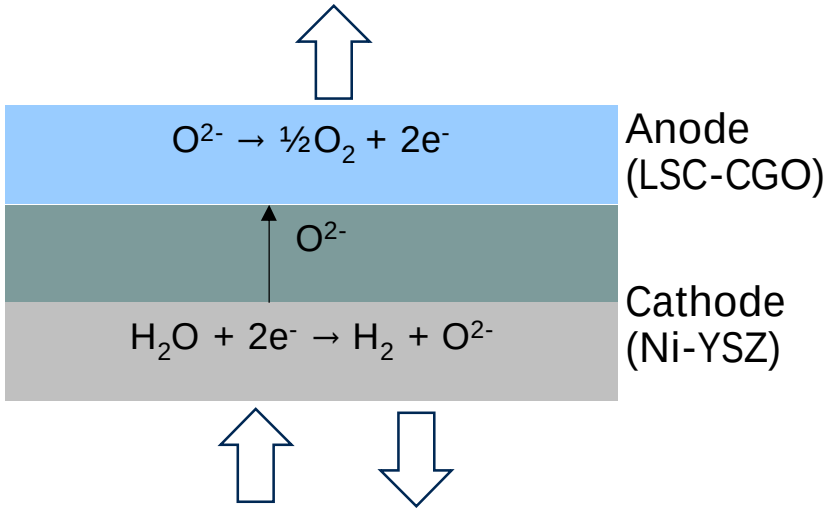
Source: IEA, Global Hydrogen Review, 2021

TOPSOE SOLUTIONS ENABLE THE ENERGY SYSTEM OF THE FUTURE WITH HIGH-PERFORMANCE ELECTROLYSIS AND CLEAN FUELS & GREEN-MADE CHEMICALS



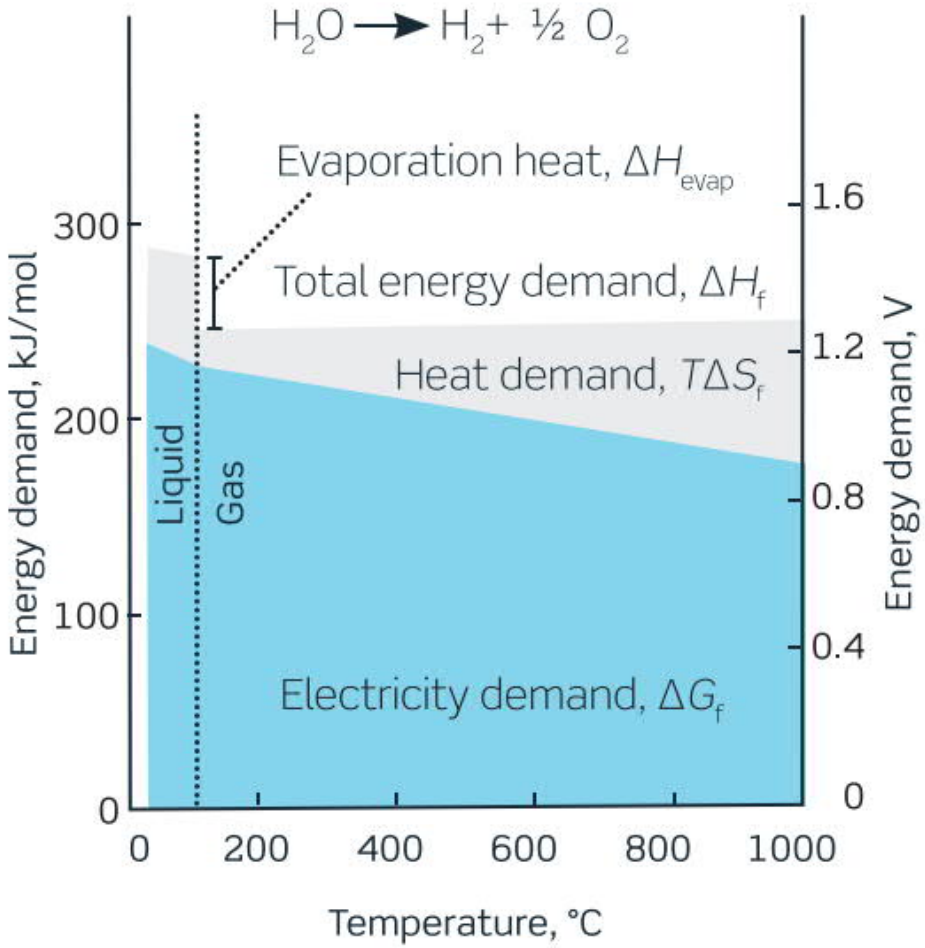
HOW SOEC ELECTROLYSIS WORK

SOEC electrolysis



Stack power consumption

3.1 kWh/Nm^3 H_2



THE DEVELOPMENT PATH OF TOPSOE'S SOEC TECHNOLOGY

Solid Oxide Fuel Cell (SOFC) developed in the '80s

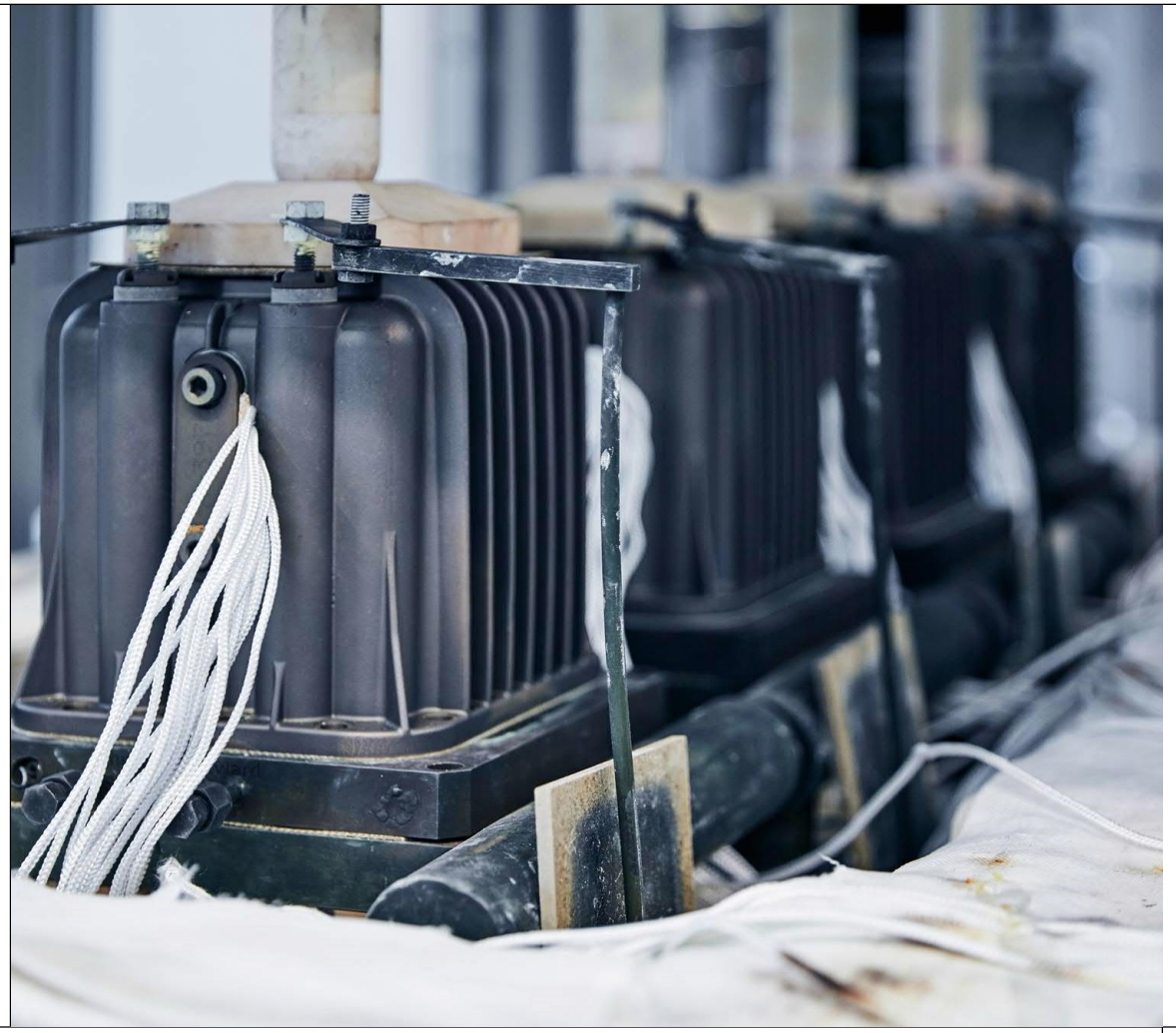
- SOFC cell and stack can also be used as SOEC
- Electrolysis of both water and CO_2

Focus on SOEC since 2015

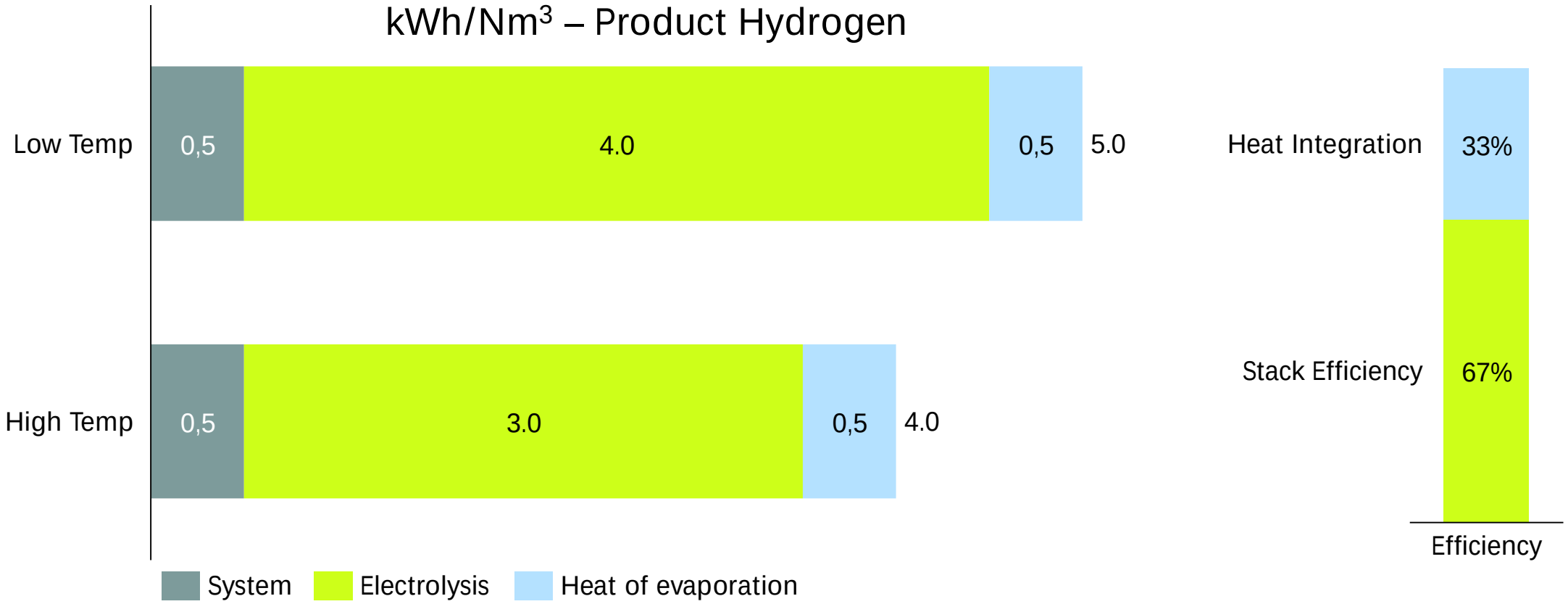
- Demonstration and industrial SOEC units since 2015
- SOEC cell and stack further improved

Design of 500 MW SOEC stack manufacturing plant

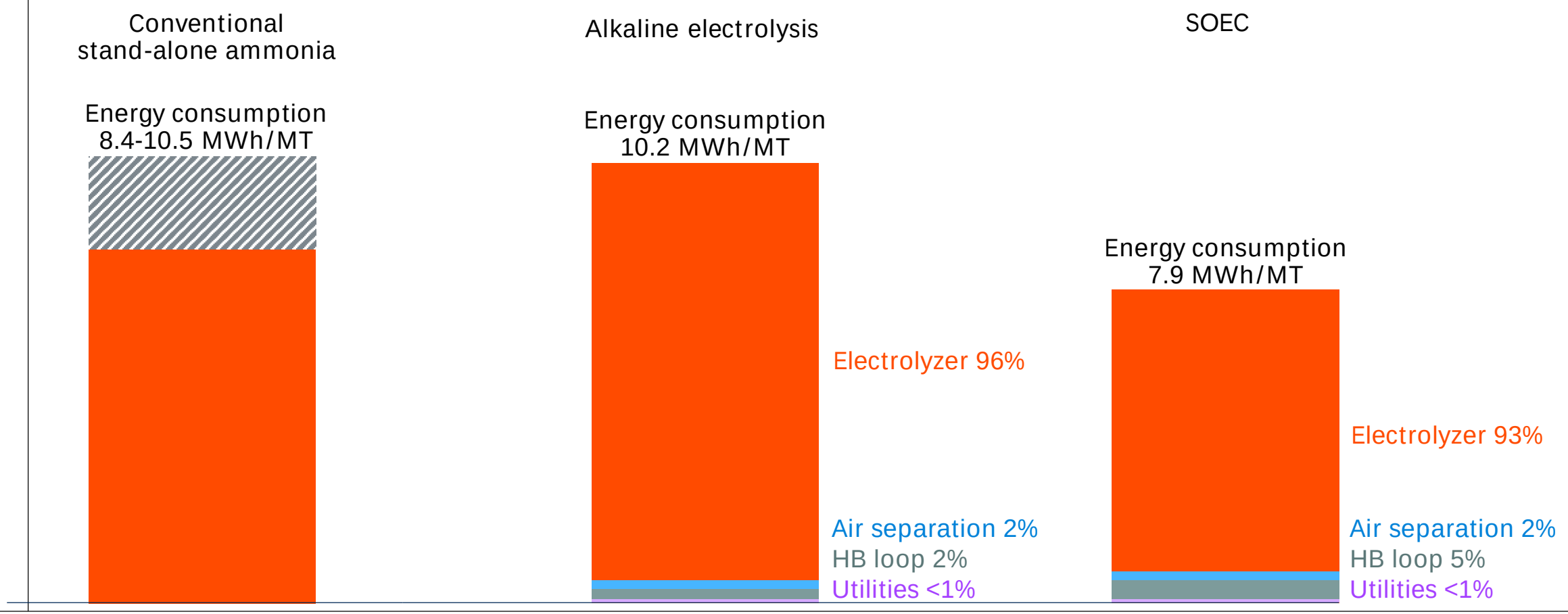
- Scheduled start-up in 2024
- Expansion to 1.1 GW/5 GW



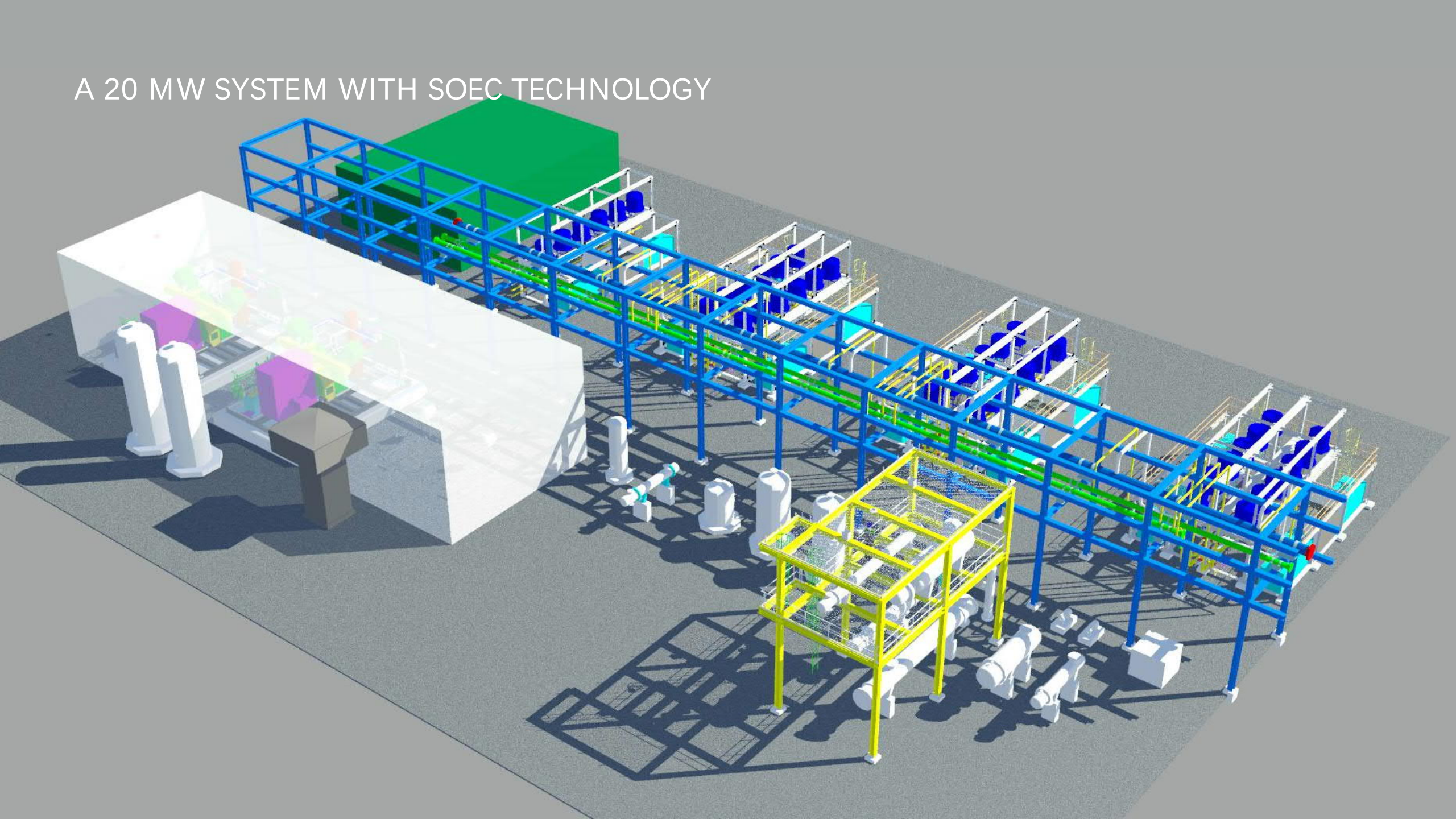
SOEC IS SIGNIFICANTLY MORE EFFICIENT THAN LOW TEMPERATURE ELECTROLYSIS



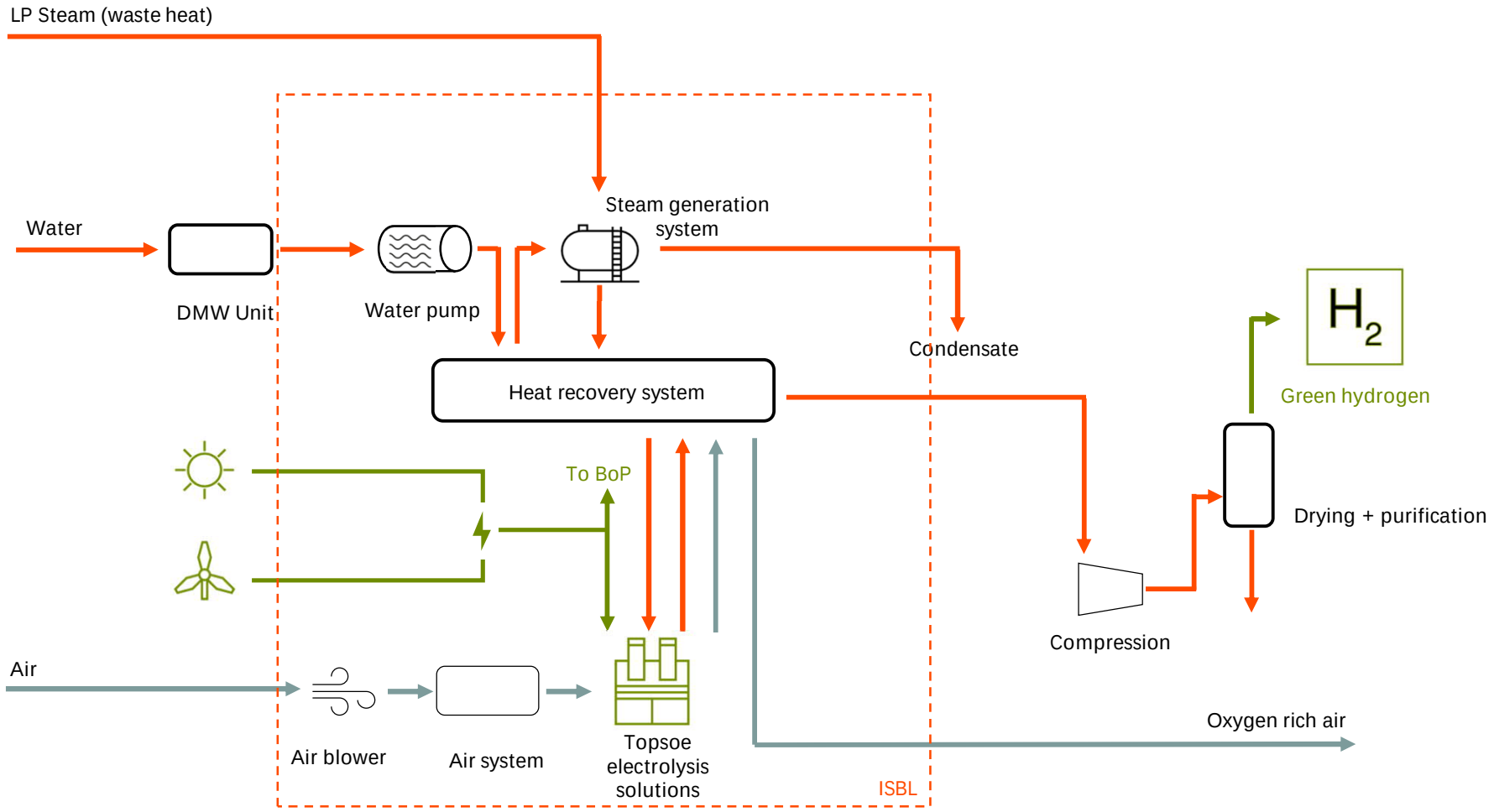
SOEC'S ADVANTAGES BECOMES SIGNIFICANT AT PLANT LEVEL



A 20 MW SYSTEM WITH SOEC TECHNOLOGY



GREEN HYDROGEN BY SOEC



PLOT IN HERNING NEAR JYSKE BANK BOXEN

3D RENDER OF THE FACTORY

HERNING PLANT - FROM MARCH 2023

THE RENEWABLE DISTRIBUTED & DYNAMIC AMMONIA PLANT (REDDAP)

- Worlds first dynamic green ammonia plant
- Directly coupled to renewable power
- 200 mill DKK project
- 81 DKK funding granted from

TOPSOE

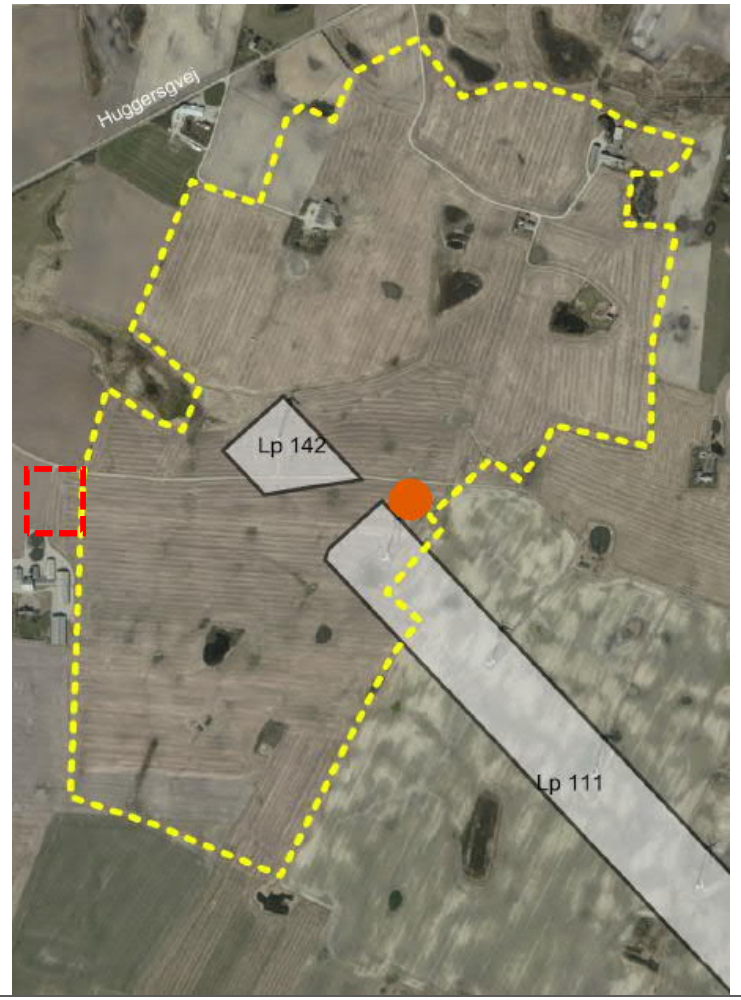
Vestas®

SKOVGAARD ENERGY
POWER TO UNFOLD

EUDP

The Energy Technology Development and Demonstration Programme

POWER-TO-AMMONIA
PREVENTION OF 8200 TONS CO2 EMISSIONS TO THE ATMOSPHERE



Wind turbines

Solar cells

Power-to-X

12 MW

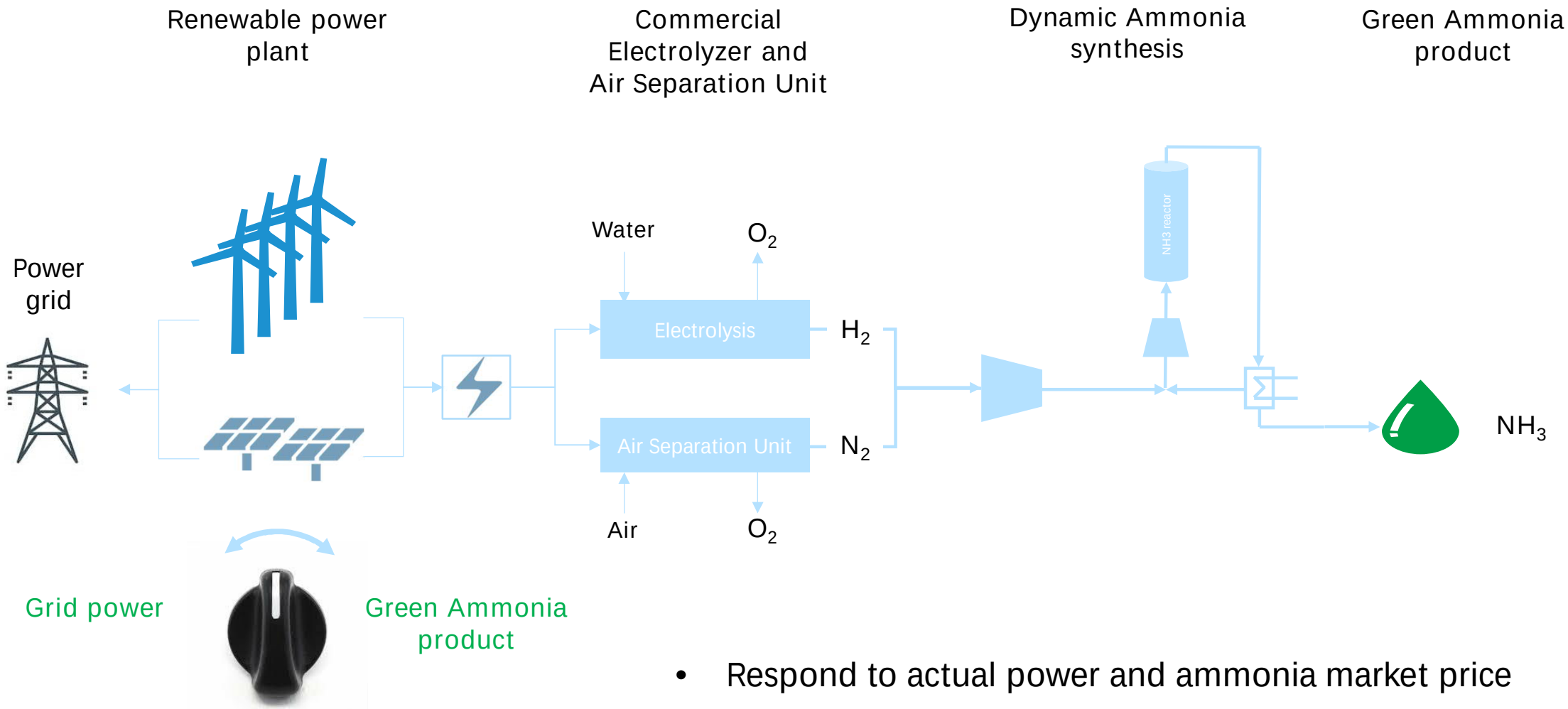
Existning Wind turbines
6 x 2 MW Vestas V90

50 MW

New PV power
91 hectar with bi-facial tracker PV panels

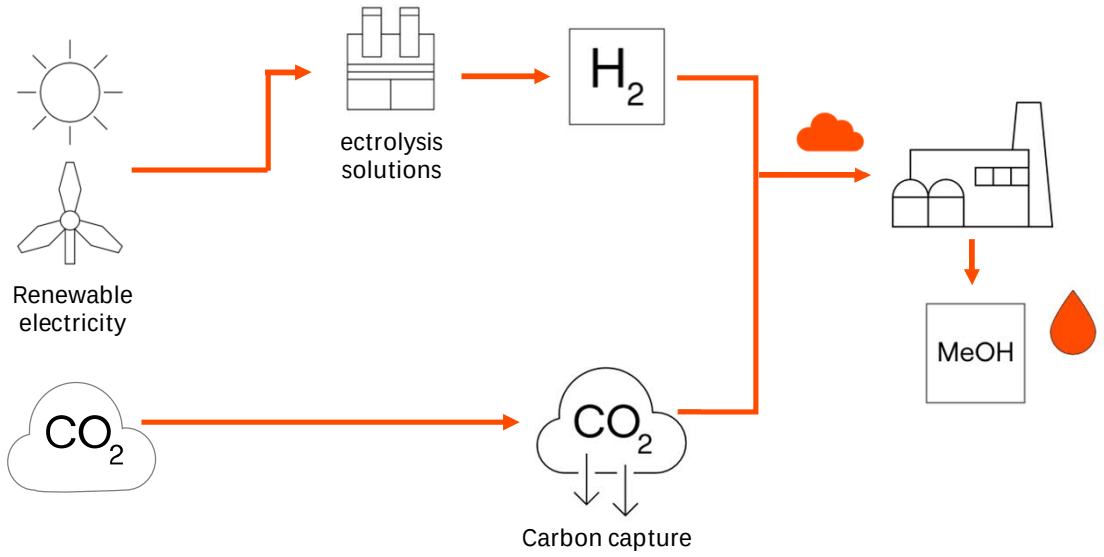
10 MW

24MTPD Power-to-Ammonia
Worlds first green ammonia plant in dynamic mode



- Respond to actual power and ammonia market price
- Dynamic operation between 10 and 100% load
- Produce Green Ammonia during curtailment

GREEN METHANOL BY SOEC



FLAGSHIPONE
PROJECT DETAILS

Location

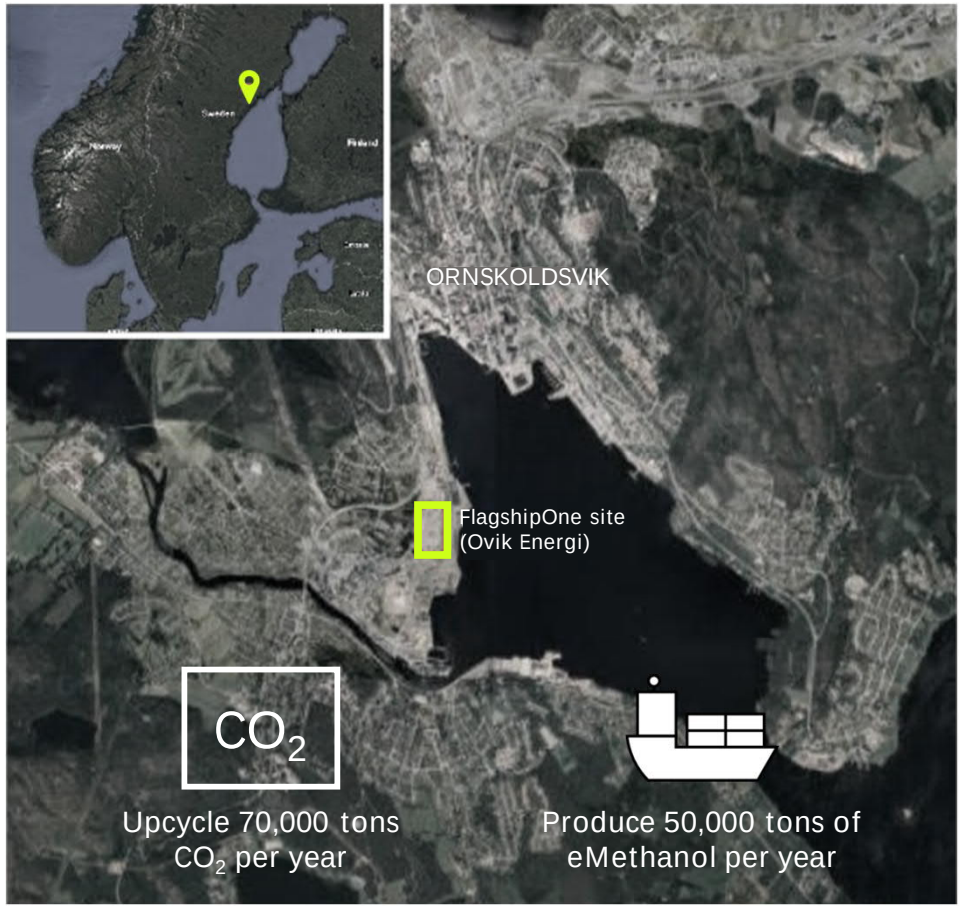
FlagshipONE will be co-located with Hörneborgsverket, a combined heat and power plant (CHP) from Övik Energi in Örnköldsvik, north-east Sweden. Biogenic CO2 emitted from the Combined Heat & Power plant (CHP) will be captured and used to produce the eMethanol.

Partnership

In January 2022, Ørsted acquired a 45 % ownership share in Liquid Wind's FlagshipONE.

TOPSOE Scope

ModuLite™ Plant with capacity of 50,000tons per year.




PERFECTING
CHEMISTRY
FOR A BETTER
WORLD
Thank you
TOPSOE