

Building a clean future
with world-class

Power
X



9. MARCH 2022
POWER-TO-X TEMADAG
HØJE TAASTRUP



KARSTEN KLEMENS HANSEN
CEO

High Temperature Electrolysis Technology in Power-to-X

DYNELECTRO AT A GLANCE

- DynElectro is a Power-to-X company with innovative electrolysis technologies
- Founded in 2018 by Søren Højgaard Jensen, based on 20 years of research in Fuel Cell & Electrolysis Technology
- Developed game-changing operating technology for High temperature electrolysis (solid oxide)
- Co-create Electrolyzer systems with module & system manufacturers

Key facts

- +12 mddk (funding)
- Employees (2018: 1, 2022: 7)
- Patent applications in process: 4
- EUDP Project (DynAmmonia) granted
- Young Researcher Rambøll Award Winner
- Breakthrough Energy (Bill Gates Foundation) Nominee

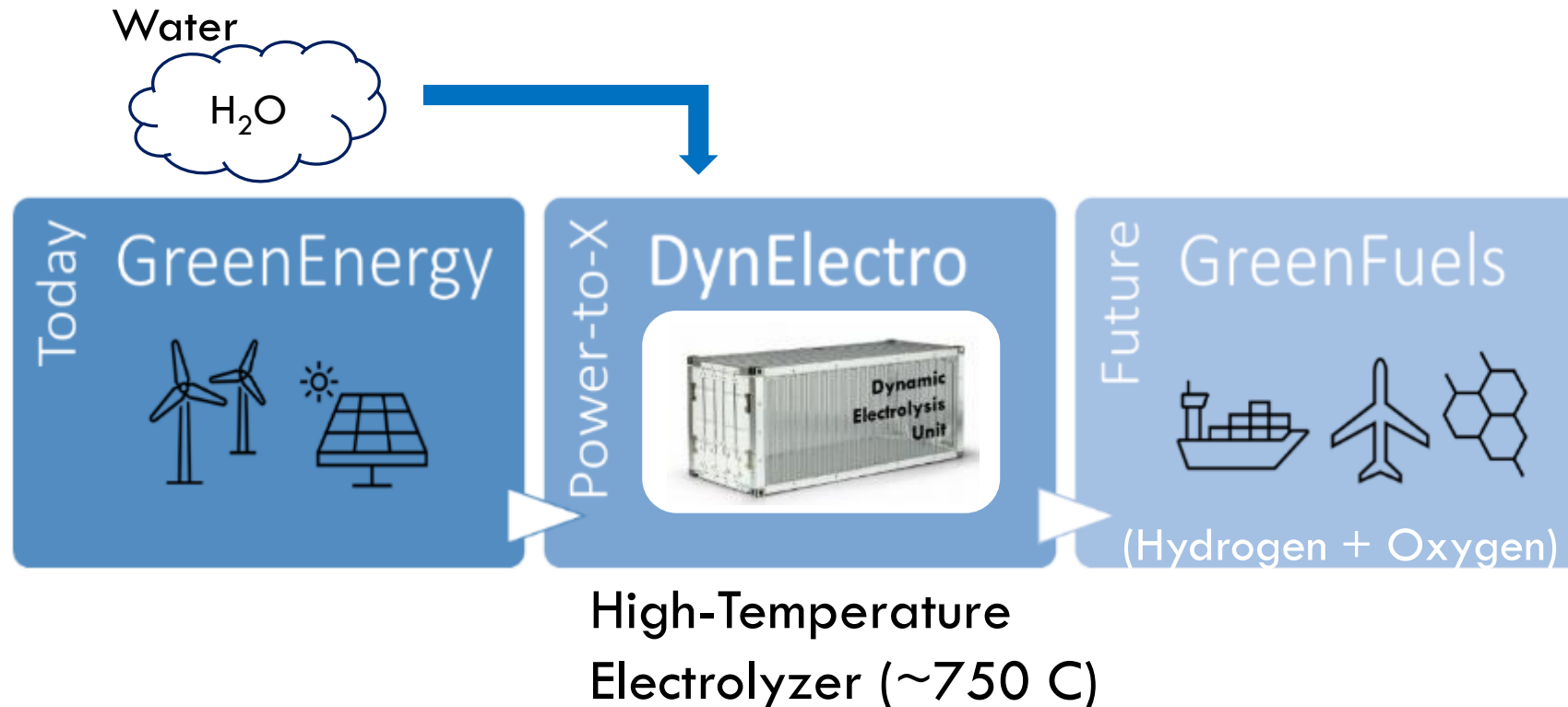
SUSTAINABLE DEVELOPMENT GOALS



OUR MISSION

Building a clean future

- We provide breakthrough operating electrolysis technology to enable green hydrogen production from renewable energy with the highest efficiency

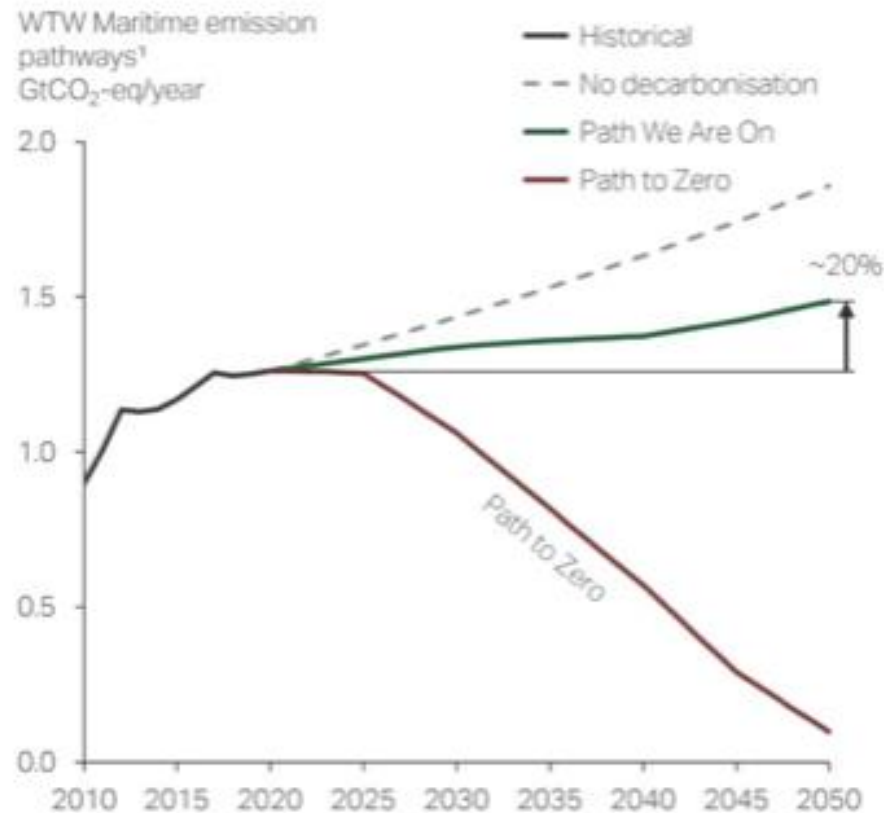


WE NEED TO ACT NOW

Resource needs

Renewable energy	33 TWh
PtX capacity	6,6 GW
CO ₂ capture	2-2,5 Mt
CO ₂ -reduction	5,4 Mt

<https://www.danskeenergi.dk/sites/danskeenergi.dk/files/media/dokumenter/2021-10/PtX-anbefalinger-Power-to-X-strategi-skal-indfri-baade-klima-og-erhvervspotentialer.pdf>



IMO, IEA, Clarksons and Techno-economic model MMM Center for Zero Carbon Shipping

HVOR ER VI I DAG DET DANSKE BRINTLANDSKAB

Annoncerede brint- og PtX-projekter samt produktionssteder i Danmark pr. 10. december 2021



~6,6 GW in 2030
(70% CO₂-reduction)

Figur 3: Brint- og PtX-projekter i Danmark

<https://brintbranchen.dk/wp-content/uploads/2021/12/Brint-i-tal-2021-1.pdf>

MARKET POTENTIAL

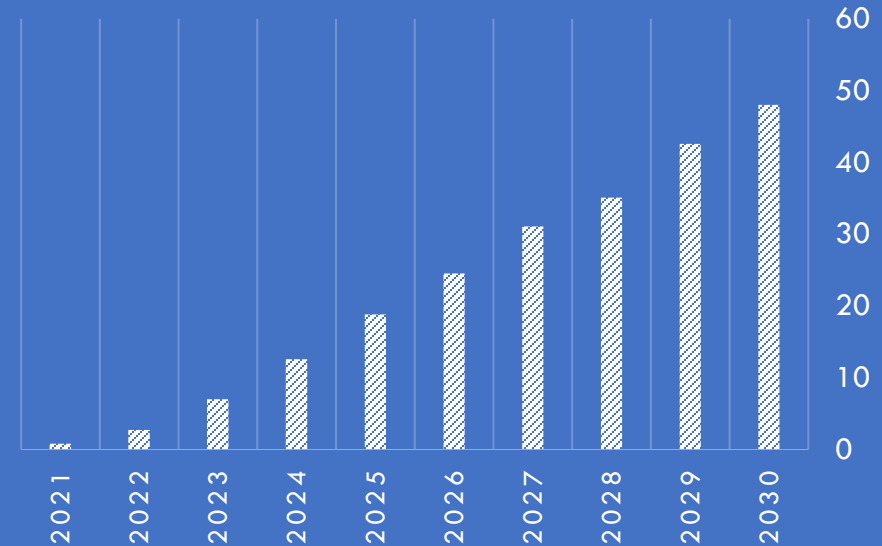
*"EU and collaborating countries target: **80 GW** of renewable hydrogen electrolyzers by 2030...*

*...by 2050, with annual sales in the range of **€630 billion.**"*

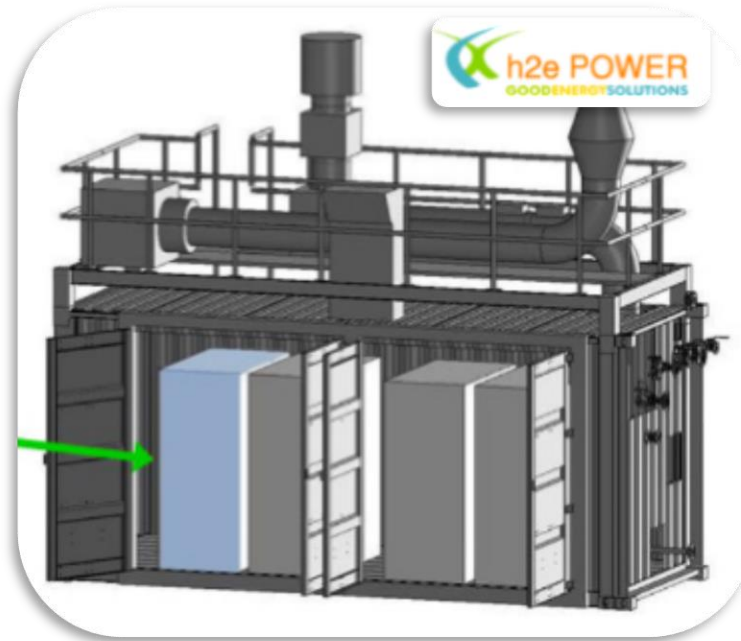
Communication from the commission to the **European parliament**, the council, the European economic and social committee and the committee of the regions a hydrogen strategy for a climate-neutral Europe

8/07/2020

10-YEAR EU OUTLOOK POWER-TO-X MARKET (BILLION EURO)



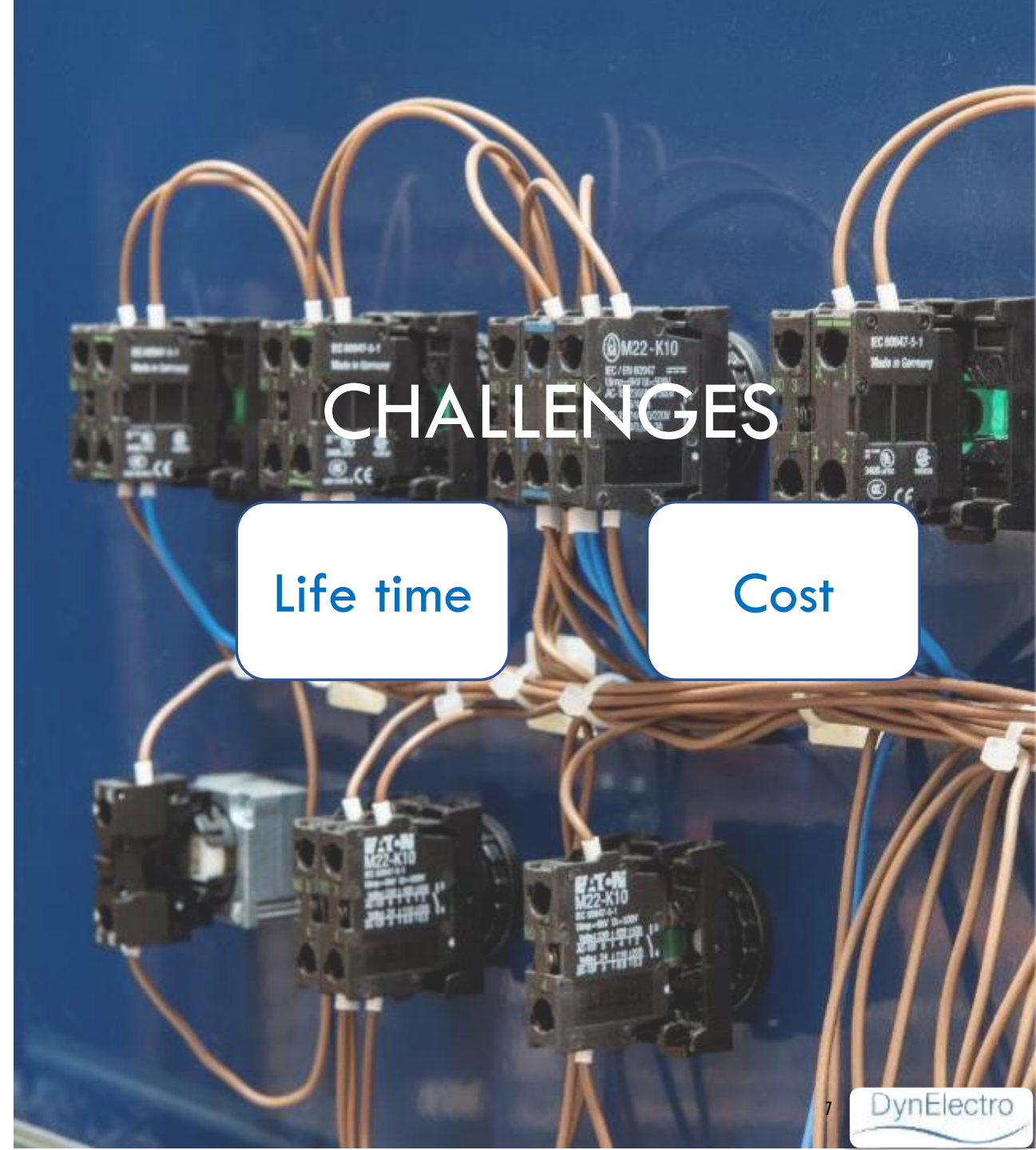
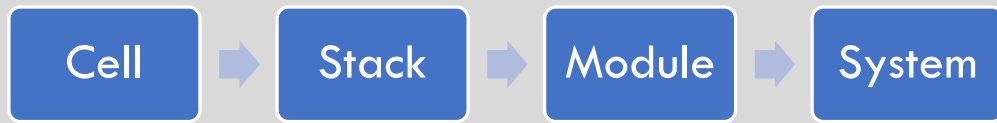
HIGH TEMPERATURE ELECTROLYSIS MANUFACTURERS



Scale: 0.1 – 1 MW

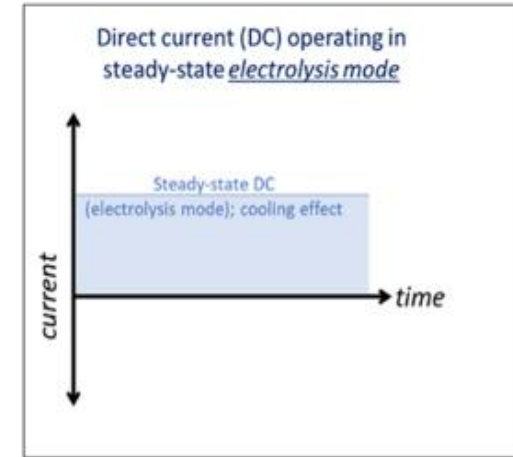
HIGH TEMPERATURE ELECTROLYSIS BUILDING BLOCKS

- High efficiency is important since electricity comprises up to 85% of the green hydrogen cost
- Technology is scalable

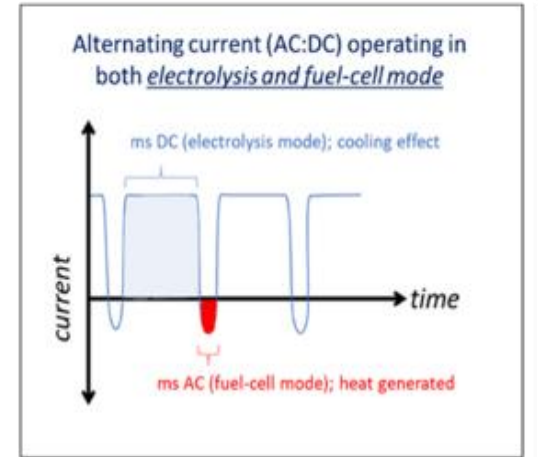


DYNELECTRO TECHNOLOGY

- Stabilising temperature reduces system CAPEX/OPEX up to 50% by eliminating thermal regulation components and subsequent maintenance and operating costs

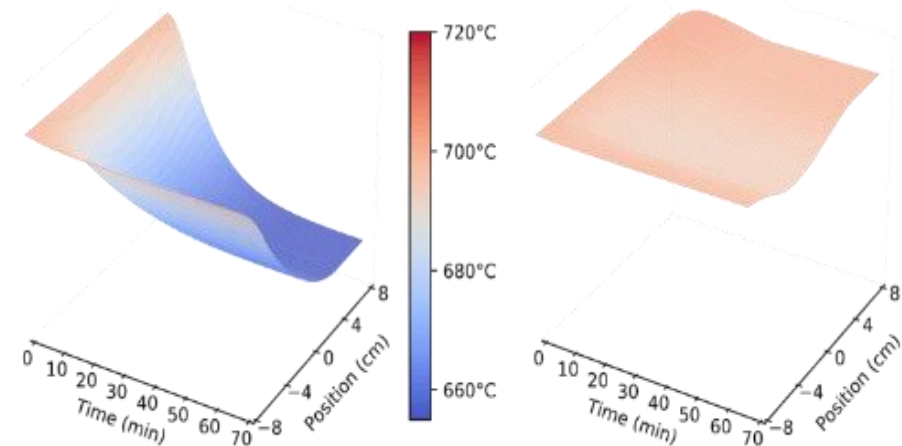


Conventional operating mode uses direct current (DC) delivered in a steady state. Heating is required to stabilise stack temperature.



DynElectro's patented operating mode which uses an alternating current rapidly switching between electrolysis and fuel-cell mode resulting in temperature stabilisation.

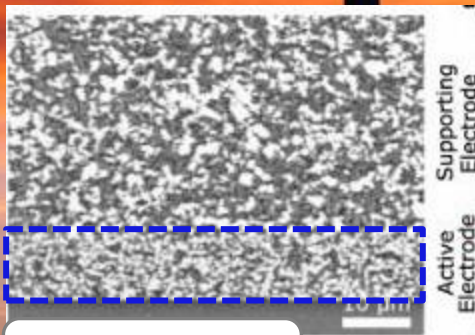
Temperature inside SOE stack: conventional operation (left) and patented operation (right)



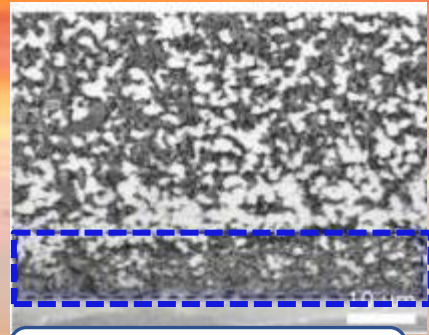
Reference: "Electrothermally balanced operation of solid oxide electrolysis cells" Submitted Aug. 17th 2021 to Nature Communications.

SOLUTION

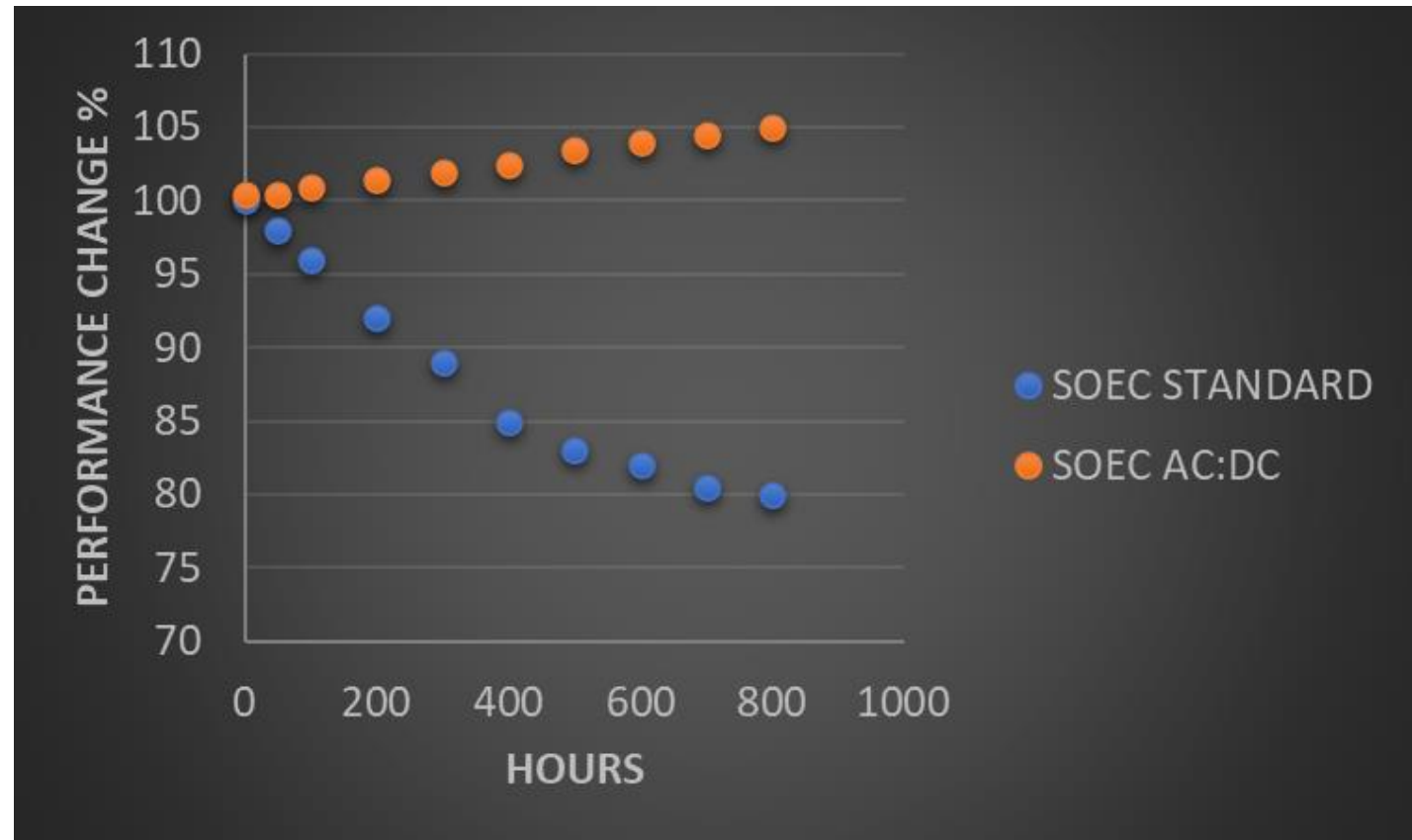
- DYNELECTRO'S operating Technology improves performance and extends life-time up to 5X
- Standard operating SOEC declines to 80% Pf after 6-800 h



SOEC AC:DC



STANDARD SOEC



...”EnergiNet+energistyrelsen market report (2021):
...SOEC lifetime estimate; 10 years in 2040”...

STATEMENTS

”DynElectro’s teknologi kan potentielt øge konkurrenceevnen for Power-to-X anlæg til metanol produktion, og derfor kan DynElectro blive en væsentlig samarbejdspartner for European Energy inden for kommerciel Power-to-X i stor skala”

Søren Knudsen Kær
Head of Technology

 EUROPEAN
ENERGY

”DynElectro har gjort opfindelser og har rettigheder til flere væsentlige patenter som har potentiale til at føre til et væsentligt gennembrud for brintteknologi og Power-to-X”

Eva Ravn Nielsen
Chief Consultant Power-to-X

 RAMBOLL

“The new SOEC technology from DynElectro extends the life-time of high temperature electrolysis, which could lead to substantial cost benefits in green ammonia production and is expected to be an important contributor to reaching net zero ambitions”

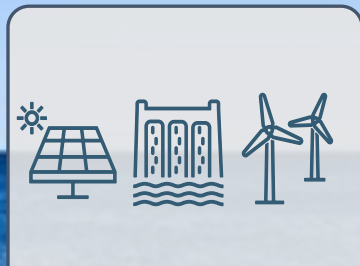
Finn Daugaard Madsen
Innovation Manager

 SIEMENS Gamesa
RENEWABLE ENERGY

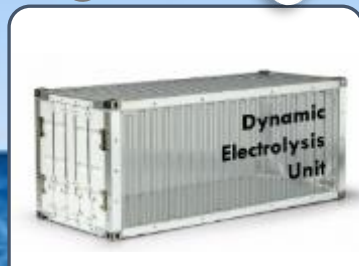
VALUE CHAIN

CO-CREATION

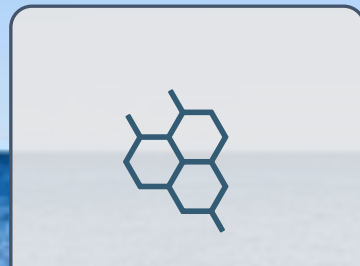
SYSTEM MANUFACTURERS
DynElectro



Renewable energy



Electrolysis



Fuel synthesis



Distribution



Market

SIEMENS
GAMESA

EUROPEAN
ENERGY

MAERSK

MILESTONES

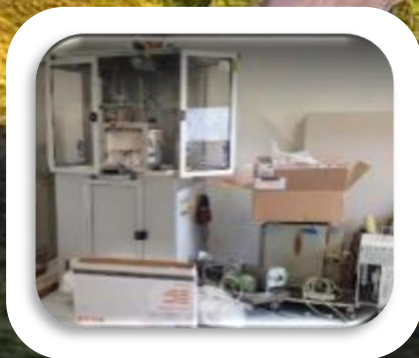
2020

2021

2022

2023

2024



CELL

SIZE:
0.05 kW



STACK

5 kW



STACK MODULE

20 kW



PROTOTYPE

150 kW



UPSCALE

1000 kW

INDUSTRY OUTLOOK

2023: KW – MW PROTOTYPES (LONG TERM TESTING)

2024: UPSCALING (REDUCED COST BY 30-40%)

2025: COMMERCIALIZATION

2027-2030: LARGE SCALE SYSTEMS (GW)

PARTNERS

SPONSORS



DynElectro

Building a clean future

BREAKTHROUGH
OPERATING
TECHNOLOGY FOR
HIGH TEMPERATURE
ELECTROLYSIS

ACCELERATING THE
GREEN TRANSITION
WITHIN HIGH-
EFFICIENCY
ELECTROLYSIS

TO REACH THE
CLIMATE TARGETS OF
CO₂ REDUCTIONS –
INDUSTRIES NEEDS
TO COLLABORATE

Karsten Klemens Hansen

CEO

DynElectro ApS

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