



Info@DynElectro.dk DynElectro.dk

dynamic electrolysis | energy storage | power-to-x solution







Who we are

Innovation

Impact



INNOVATION REDUCES GREEN HYDROGEN COSTS



Founded in 2018 after 20 years of research in **fuel cell and electrolysis** technology



Game-changing operating technology for solid oxide electrolysers



Co-create electrolyser systems with leading module/system manufacturers



Eight colleagues developing with over **100 man-years** of expertise



Over **2 million Euros** invested in innovation protected by four (pending) patents



Agreements with global enterprises



CO-CREATING INNOVATIVE PTX SOLUTIONS



ELECTROLYSIS — THE BUILDING BLOCKS



• Lifetime

Temperature
variance

Efficiency

• Electricity costs up to 85% of green hydrogen costs

Upscaling

- Market pull
- Technology push



BUILDING BLOCKS — HOW THEY FIT TOGETHER





INNOVATION



Unique patented operation eliminates nickel migration, removes temperature variations and extends lifetime

UNIQUE AND PATENTED



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**.



STABILISES TEMPERATURE



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

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

EXTENDS LIFETIME BY 5X



*Lower degradation means prolonged lifetime

Increasing resistance leads to poor performance (ca. 2-year lifetime).

Decreasing resistance indicates improved performance (ca. 10-year lifetime).



UNDER THE MICROSCOPE — A CLOSER LOOK



Reference (from factory)

Nickel particles (white dots) evenly distributed. The 'active electrode' shown in dashed-line.



Conventional operation



Nickel particles have migrated away from the active electrode (i.e., you can see the 'clumping' of white particles – this shows the 'Nickel migration').



Patented AC:DC operation

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Nickel particles stay in the active electrode (i.e., optimal performance is achieved by eliminating Nickel migration).

Published in: Journal of Power Sources: Volume 523, 1 March 2022, 231040 (https://www.sciencedirect.com/science/article/pii/S0378775322000647?via%3Dihub

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BENEFITS OF INNOVATION

Improve:

• Extend stack life time

- from 2 up to 10 years by reducing degradation rate of the stack
- Manage fluctuating renewable power
 - Has been a key barrier to technology upscaling
- Validated at component level

Reduce:

- Carbon footprint
- Fewer components
- Compact system design (small footprint)

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• Minimises waste heat



20X INCREASE IN EFFICIENCY & PRODUCTION*



For the techies:

Cell voltage (production, output): SOE has lower cell voltage (i.e., higher efficiency) than AE.

Current density (efficiency):

PEM and SOE have higher current density (i.e., higher production rates) than AE. High current density is preferred to low current density since high current density decreases CAPEX per production volume.

SOE >> PEM or AE

SOE has high efficiency <u>and</u> high production; this has a significant and direct correlation to CAPEX.

*Current density between alkaline electrolysis (AE) and solid-oxide electrolysis (SOE) technology

LAB SCALE TO FIELD SCALE





PARTNERS

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TESTIMONIALS

EUROPEAN ENERGY

" DynElectro's technology can potentially

increase the competitiveness

of Power-to-X plants for methanol production, and therefore DynElectro can become a significant partner for European Energy in commercial Power-to-X on a large scale"

> Søren Knudsen Kær Head of Technology

SIEMENS Gamesa

"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

RAMBOLL

" DynElectro has made inventions and holds rights to several significant patents that have the potential to lead to a significant breakthrough

for hydrogen technology and Power-to-X"

Eva Ravn Nielsen Chief Consultant Power-to-X

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INDUSTRIAL PHD — CELL INNOVATION













ROADMAP: INTEGRATED, 10-YEAR HORIZON



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COMPETITIVE LANDSCAPE — AMMONIA

Technology	Current	Best-in-class	DynElectro
Description	AE (alkaline electrolysis)	SOE (solid-oxide electrolysis)	SOE with AC:DC
Stack Lifetime	10 years	2 years	10 years ⁽¹⁾
Conversion efficiency (ammonia)	55% efficiency	74% efficiency	74% efficiency
Dynamic operational capability	Limited	Limited	Excellent
Compact design	1 (baseline)	2x improvement	5x improvement ⁽²⁾
CAPEX and OPEX	Significant auxiliary equipment required	Significant auxiliary equipment required	<50% CAPEX/OPEX reduction
Ammonia (EUR/t) ⁽³⁾	440	460	300

(1): demonstrated with modelling and validated at the component level

(2): compact design is in the concept stage; based on eliminating temperature stabilising hardware

(3): costs excludes CAPEX for hardware (e.g., power electronics, ammonia synthesis reactor) common for all technologies



COMPETITIVE LANDSCAPE — HYDROGEN

Technology	Current	Best-in-class	DynElectro
Description	AE (alkaline electrolysis)	SOE (solid-oxide electrolysis)	SOE with AC:DC
Stack Lifetime	10 years	2 years	10 years ⁽¹⁾
Conversion efficiency (system)	74% efficiency	84% efficiency	84% efficiency
Dynamic operational capability	Limited	Limited	Excellent
Compact design	1 (baseline)	2x improvement	5x improvement ⁽²⁾
CAPEX and OPEX	Significant auxiliary equipment required	Significant auxiliary equipment required	<50% CAPEX/OPEX reduction
USD/ kg H ₂ (2030) ⁽³⁾	3.00 – 5.00	1.50 – 3.00	<1.50

(1): demonstrated with modelling and validated at the component level

(2): compact design is in the concept stage; based on eliminating temperature stabilising hardware

(3): costs excludes CAPEX for hardware (e.g., power electronics, ammonia synthesis reactor) common for all technologies

DYNELECTRO: OPERATING TECHNOLOGY



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STABILISES TEMPERATURE



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Ambitious targets set by EU countries have been consolidated with Memorandum of Understanding signed in May 2022 to secure and prioritise supply

Twenty leading European electrolyzer manufacturers have agreed to increase combined annual capacity to17.5 GW by 2025

EU capacity less than 1.75 GW

46.334 følgere 1m • **S**

ICYMI: The European Commission and 20 CEOs of leading European #electrolyser manufacturing companies, signed a joint declaration, committing to increase the EU's manufacturing capacity to 17.5GW by 2025.

#HydrogenNow #Hydrogen #H2View https://lnkd.in/eu7YNZdb

Se oversættelse





Danish announced projects have committed 7 GW by 2025

EU SIGNING CEREMONY: AMBITIONS TO PRODUCTS