Special Report (sample)

Emerging Players in Water Electrolyzers for H2 Production

2023

CONTENTS

GLOSSARY

Term	Description
AEM	**Anion Exchange Membrane (electrolyzer)**
AWE	**Alkaline Water Electrolyzer**
CC	**Carbon capture**
PEM	**Polymer Electrolyte Membrane (electrolyzer)**
SOEC	**Solid Oxide Electrolysis Cell (electrolyzer)**

INTRODUCTION

About this report:

- ✓ Hydrogen has been widely accepted as a sustainable alternative fuel that would propel the world through several decades to come. In order to utilize hydrogen sustainably, it must be produced via greener methods. Electrolysis of water is currently the most promising technology as it provides flexibility to use both renewable or conventional energy and doesn't cause unwanted emissions during its production. At present, both scale and cost of hydrogen production are rather unfavorable, and the technology is continuously evolving. Several emerging players are actively working on different water electrolysis technologies to address the current challenges and pave way for the rapid technology adoption.
- ✓ This report aims at providing a comprehensive overview of leading players active in water electrolyzers. These players can be **start-ups and middle scale companies having their proprietary water electrolysis technology**. Well established companies, conglomerates, research institutions and laboratories have not been captured in this report.
- ✓ Scope of the report covers leading players active in water electrolysis technologies such as **PEM, AWE, AEM, and SOEC**. Each company profile outlines the technology, financials, targeted market and intellectual property of the player. Further, a 20-point assessment within Aranca 5 Factor Assessment Framework has been provided for each player.

Relevant audience:

- ✓ Established companies and conglomerates willing to explore and acquire certain start-ups.
- ✓ Venture capitalists (VCs), institutional and individual investors.
- ✓ In general, companies looking at commercialized water electrolysis technologies

Note: Report contents can be customized based on user requirements. Accordingly, report coverage shall be reduced or expanded to the specific areas of interest.

Major Electrolyzer Technologies and Their Characteristics

Parameter	Technology			
	PEM	AWE	SOEC*	AEM*
Energy Efficiency	Medium	Medium	High	Medium
Current Density	High	Low	Low	Medium
Modularity	High	Low	Medium	High
Lifespan	Medium	High	Low	Medium
Operating Cost (OPEX)	Low	Medium	High	High
Capital Cost (CAPEX)	High	Low	High	High

Note: Above are generic technology characteristics as reported in literature, there could be variations based on configurations and designs.

** Currently not significant at industrial scale*

REPORT OVERVIEW

30 companies actively working in the domain of water electrolyzers for H2 Production

- Comprises of established and emerging technologies for water electrolysis
- Holistic assessment in terms of IP, technology, financial, ecosystem and organization
- Technology developers and manufacturers range from start-ups to potential disruptors*
- In depth analysis and key observations for each company based on Aranca's 5 factor assessment framework

Information covered on each company

Company information

- ✓ Website, year of establishment, headquarters, key personnel, etc.
- ✓ Size (employee count, revenue, funding, etc.)
- ✓ Awards and recognition

Technology

- ✓ Technology readiness level (TRL)
- ✓ Feedstock, conversion process and output
- ✓ Patents and research collaborations

Commercialization

- ✓ Applications and markets
- ✓ Product details (form, chemistry, trade name, etc.)
- ✓ Business partnerships, investments

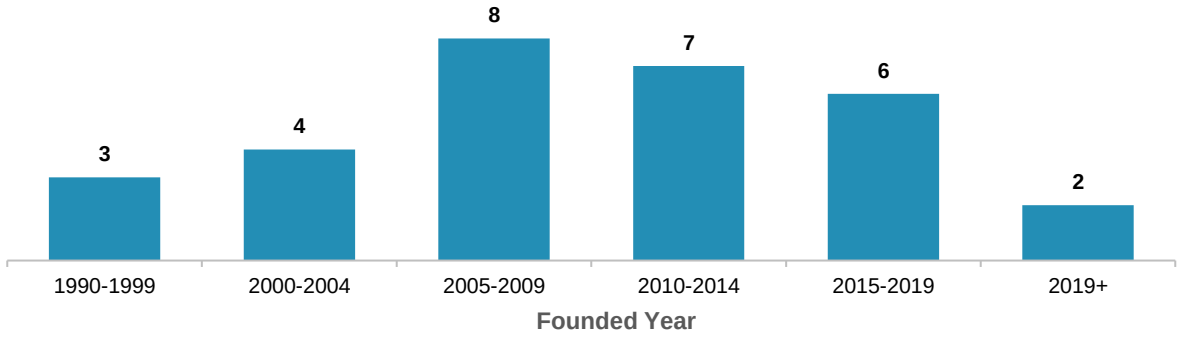
**Players with diversified business portfolio are excluded.*

HIGHLIGHTS

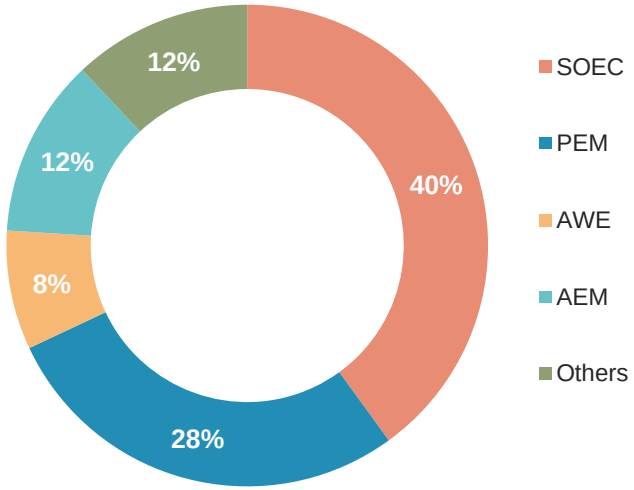
Summary

Companies covered	30
Geographic focus	Global
Products	Electrolyzers intended for hydrogen production via water electrolysis

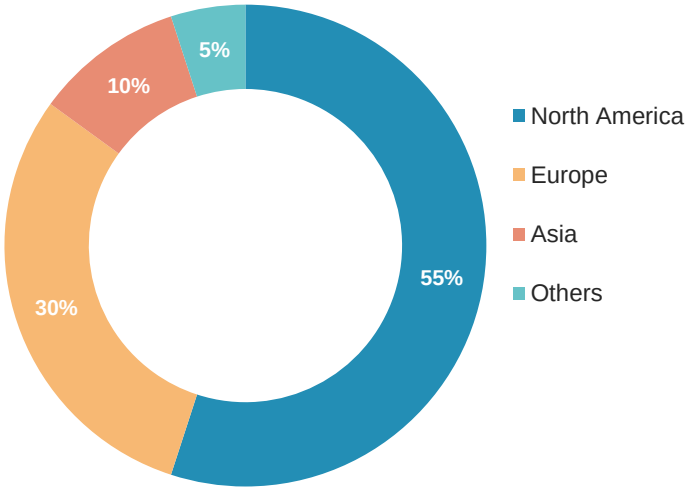
Companies By Maturity



Companies by Electrolysis Technology



Companies by Origin



RESEARCH METHODOLOGY

Methodology

- A comprehensive search was performed on various platforms to map relevant technology developers. Mapped entities were scrutinized for relevancy based on the technology and product offerings.
- Each relevant player was evaluated on five important factors namely intellectual property, technology, financials, ecosystem and organization (refer Aranca 4 Factor Framework for more details).
- Corporate players and diversified entities with partial focus on sustainable material technology were excluded.
- Focused secondary research was conducted for the captured players in order to capture relevant insights. In order to fill the gaps remaining after this, primary research was conducted, wherever necessary.
- Apart from identifying the targeted technologies, Aranca can extend the current study to provide support in:
  - ✓ Competition assessment
  - ✓ Market assessment and outlook
  - ✓ IP and commercial product landscapes
  - ✓ Route-to-market intelligence, e.g., key technologies, potential M&A targets, regulatory aspects, etc...

Information Sources

Following paid and public sources of information were referred (not exhaustive):

- Patents on databases such as Thomson Innovation and Questel Orbit
- Scientific literature published on databases such as ScienceDirect, ResearchGate, Scopus, SpringerLink and Wiley Online
- Company websites, product brochures and news/media sections
- Industry associations and Government sources such as European Commission, The European Food Safety Authority (EFSA), and The U.S. Food and Drug Administration (FDA)
- Specific publications/magazines on sustainable dairy products
- Other commercial databases such as Factiva, Bloomberg and EMIS to capture/validate company-specific information
- Aranca internal knowledgebases and industry experts

ARANCA 5 FACTOR ASSESSMENT FRAMEWORK

Factor	Parameter	Score (1−5); higher is better					Min	Max
Intellectual Property	No. of Patents						3	15
	Forward Citations							
	Patent Status							
Technology	Novelty						5	25
	Scope							
	Scalability							
	Competitiveness							
	TRL							
Financials	Total Funding						5	25
	Funding Rounds							
	Type of Investor							
	No. of Investors							
	Revenues							
Ecosystem	Target Industry Size						3	15
	Policies & Regulations							
	Environmental Impact							
Organization	Global Presence						4	20
	Employee Size							
	Active Years							
	Awards/Recognition							

Notes:

- Total score is obtained by adding the individual factor scores.
- For uniform representation, final score is normalized on a 0-100 scale and factor scores are adjusted accordingly.

CONTENTS

Technology-wise List of Companies (*Illustrative; overall 30 companies are covered*)

PEM

H2U TECHNOLOGIES

AWE

HYMETH

SOEC

H2ELECTRO

AEM

Versogen
The Hydrogen Generation.

Players NOT covered in the Report

PLUG POWER
Cummins
SIEMENS energy
nel
ITM POWER
Air Liquide
McPhy
GREEN HYDROGEN SYSTEMS
sunfire
Sunfire GmbH
elogen
thyssenkrupp
AsahiKASEI

HYMETH

Website: Link **Est.:** 2016 **HQ:** DENMARK

HYMETH is a green solutions provider in the domain of energy and environment. It is an emerging player in water electrolysis through its augmented alkaline electrolyzer technology. It primarily offers electrolyzer for hydrogen production and carbon capture technology.

Technology

- Process: Modified Alkaline Electrolyzer
- Key products: HYAEON (low-temperature high-pressure electrolyzer) and HYNACE (carbon capture system)
- TRL: Demonstration system

Financials

- Total revenue: N/A
- Total invested amount: $ 1.9 mn
- Investors: VF Venture, Antler, Sustainable Energy Angels, InnoEnergy

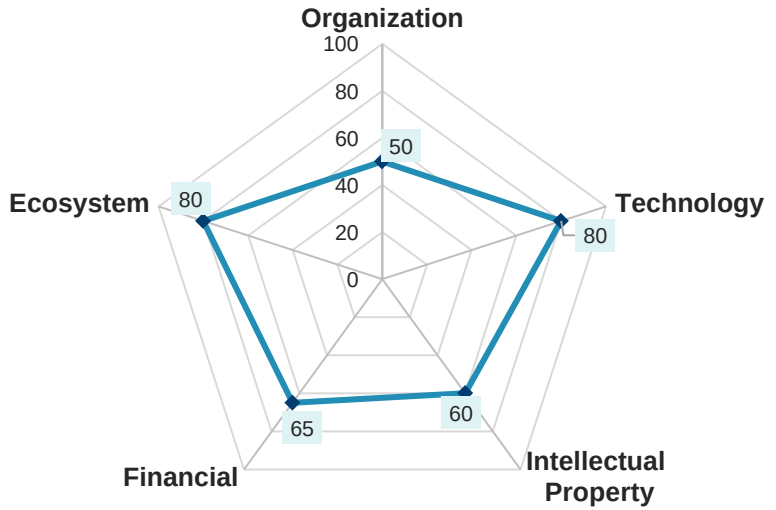
Operating locations

- HQ: Denmark

Applications

- Energy, mobility, chemicals, etc.

Aranca 5 Factor Assessment 67/100



Note: Scores have been normalized on a 0-100 scale. Detailed analysis has been provided in the next slide.

Aranca View

- The company has developed an advanced and more efficient alkaline electrolyzer (claimed as the first electromagnetic electrolyzer) which is 40% cheaper and more flexible than conventional alkaline ones.
- The company has significant market potential as it is working on advanced version of the mature AWE technology by addressing its pain points such as higher opex and space requirements.

Overall Rating

HYMETH

Aranca 5 Factor Assessment

Final Score 67/100

Intellectual Property

- Strong IP portfolio with 10 patents
- Strong geographical coverage

Technology

- The electrolyzer is claimed as the first electromagnetic one.
- Targeting multiple industries by coupling its CO2 capture tech with HYAEON electrolyzers.
- HYMETH started its electrolyzer production plant in 2019. However, there is no further update on scale of production achieved.
- Catalyst used in the process is non-precious.

Financial

- The company has secured US $1.9 mn funding through two rounds.
- Investors are VCs.
- Revenues have not been disclosed.

Ecosystem

- The company has access to raw material sourcing in the countries such as China, Germany, US and India.
- Low-temperature operation and higher efficiency enhance it environment footprint.

Organization

- InnoEnergy, one of the investors, is co-funded by the European Union
- Increasing activities in North America markets

Criteria	Score: Low 1	2	3	4	High 5	Total
No. Of Patents				■		9
Forward Citations		■				
Patent Status			■			
Novelty					■	19
Scope				■		
Scalability			■			
Competitiveness				■		
TRL			■			
Total Funding			■			16
Funding Rounds			■			
Type of Investor				■		
No. of Investors				■		
Revenues		■				
Target Industry Size				■		12
Policies & Regulations				■		
Environmental Impact				■		
Global Presence			■			10
Employee Size		■				
Active Years			■			
Awards/Recognition		■				

HYMETH

Offering an enhanced version of the matured Alkaline technology with CC option, HYMETH has a potential to become a big player in the green hydrogen space

Patents

- Total 10 patents families, one has been granted and the rest are pending
- Significant geographical protection
- Patents relate to improvements in **stack assembly, electrode fabrication, electrolyzer design and catalyst system**.

Financial

- In 2021, HYMETH received Series 1 finding of **US $1.5 mn** from the investors such as VF Venture, Antler, Sustainable Energy Angels.
- With a seed round funding of US $0.4 mn, the company currently has total US $1.9 mn in funding.

Research and Development

- HYMETH started its electrolyzer production plant in 2019. Its units are claimed to have about 96% overall efficiency.
- Catalyst used in the process is non-precious and comprises of core-shell CuNiFe metal alloy electrocatalyst.
- Electromagnetism is also used in the conversion process.

Collaborations and Partners

- HYMETH partnered with Alfa Laval A/S for the initial production support in electrolyzer manufacturing.
- For testing purpose, it has also collaborated with Danish Technological Institute (DTI).

Our work

500+
Market & Business Advisory Projects

100+
Procurement & Supply Chain Projects

150+
Projects & Technology Assessments

ABOUT ARANCA

Growth Advisory
CXOs in Strategy, SBUs, Sales, Marketing, CI/MI, Innovation

Valuation & Financial Advisory
CFOs in Start-ups, PE/VC Firms, Corporate M&A Teams, Mid-market Companies

Technology | IP Research & Advisory
R&D, Tech Scouting, Open Innovation, IP Teams, Product Development

Investment Research & Analytics
Brokerage, Hedge Funds, IRPs, I-Banks, AMCs, Investor Relations

Decide Fearlessly

From startups to the Fortune 500, private equity and global financial firms, Aranca is the trusted research and advisory partner for over 2500 companies

www.aranca.com

aranca