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# Myths about the Green Transition

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Esben Sorensen, Plug Power Copenhagen PTX Conference, June 2024

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# Myths about the Green Transition



The Green Transition is "All Talk" and "No Action"



The technology is not ready yet



Electrolyzers are not available in sufficient scale



The economics don't add up



There is still lots of time to make this happen

#### **Complete Hydrogen Solutions**

#### An end-to-end hydrogen ecosystem



- US based company with subsidiaries across the globe
- Active in Electrolyzers, Fuel Cells, and everything in between
- 50 years of innovation
- ~ 3,500 employees
- World's largest user of liquid hydrogen
- In-house expertise on all aspects of the Hydrogen Ecosystem

#### PEM Technology Legacy

Best-in-class for reliable performance

# In 2020 Plug Power acquired Giner ELX, a leading producer of PEM Stacks.

- Superior PEM Technology delivers up to 99.999% purity at 40bar(g)
- High efficiency and availability
  - $_{\odot}\,$  80,000 hrs stack life expectancy.
  - $_{\odot}$  Instant load following capability (< 5 min)
- 1 MW stack, highest current density in the industry
- Lowest TCO on the market



#### 220+ Nm<sup>3</sup>/hr (MW Scale) Active Area: 1,250 cm<sup>2</sup> Pressure: 40 bar Nominal Current: 3,750A Current Density: 3A/cm<sup>2</sup>

30 Nm<sup>3</sup>/hr

3 Nm<sup>3</sup>/hr

0.05 Nm<sup>3</sup>/hr



#### Plug System Solutions - Engineering Leadership

Leveraging experiences from the Oil & Gas industry



### **PEM Electrolysis Technology**

- Simple Process Configuration feeding on water only
- Thin membrane (low resistance) allows achieving very high efficiencies
- Membrane is chemically and mechanically robust, allowing for high pressure differentials
- Negative differential pressure across membrane!
- Substantial economic and safety benefits
- Highest Hydrogen Supply Pressure on market





# Myth #1 The green transition is all talk and no action



#### Worlds largest liquid hydrogen supply network

Target: 500 TPD of liquid green H2 production



#### Peachtree Green Hydrogen Plant – 40 MW unit



#### Georgia Hydrogen Plants

~ 20 TPD Green Hydrogen Production



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#### Peachtree

- 17 TPD Green Hydrogen
- 8 x 5MW Plug PEM arrays
- 15 TPD Hydrogen Liquefaction
- Commercial operation Q1'24

#### Pathfinder

- 2.1 TPD gaseous green H2
- 1 x 5 MW Plug PEM arrays
- Commercial Operation Q4'22

1<sup>st</sup> of a network of liquid green hydrogen plants built, owned, and operated by Plug across the USA

#### Inside The Peachtree Plant







## **Green Hydrogen Network Expansion**

#### ~300+ TPD in Europe by 2028



#### Hydrogen generation sites

- One first site announced in Antwerp
- 2 GW-scale sites announced in Finland + 250 MW site
- Close to 20 sites under development throughout Europe
- 8-10 sites from 3<sup>rd</sup>-parties qualified for potential off-take of hydrogen

**GW-scale sites in the Nordics & Iberian Island** 

Smallers sites in continental Europe, closer to demand centers (<100MW)

#### **Projected Plug Electrolyzers:**

- Lhyfe (10 x 5 MW units)
- Acciona (50/50 JV) to build green hydrogen plants in Iberia
- Port of Antwerp (10 MW)
- H2 Energy, DK (1GW)
- Idomlund, DK (1 GW)
- 3 Sites in Finland (~ 2.25 GW)

**Plug Fuel Cells:** 

- Lidl, BMW, STEF, Carrefour, Ikea
- Renault / Hyvia (50/50 JV) targeting
  30% market share of the fuel cell
  LCV segment in Europe by 2030

#### Antwerp Project details



- Location: NextGen District
- Capacity: 100 MW
- Land area: 11.5 ha
- Volumes: 35 tons per day
- Delivery: Tankers, trailers and pipelines (mid-2026E)

- **Storage on-site:** >70t of liquid H2
- Electrical interconnection: 140 MVA
- Year started: 2022
- Status: FEED on-going



#### Plug's European Electrolyzer Achievements – 2023

*Europe: 50 MW+ electrolyzers commissioned and running in 10+ sites* 



# Myth #2 The technology is not ready yet



#### Our Key Electrolyzer Offerings



### The Allagash 1MW Stack & 5MW Unit

Ready for installation





#### ELX2125D – 5MW Electrolyzer

Fully containerized plant



## ELX4250D – 10 MW Arrays & Associated T&R

Hardware supply



# Myth #3 Electrolyzers are not available in sufficient scale



## Stacks produced at our own Gigafactory in Rochester, N.Y.



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Gigafactory Virtual Tour: https://3d.zuant.com/experience/plugpower/KJ66EE8SEe2i3O%2BCc7Lqpg/



• 2.5+ GW/yr PEM Factory

- Opened 2022
- Current load 1.2 GW/yr
- Next facilities planned:
  - Europe
  - South Korea

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### Balance of Stack by Scalable Model

In-house Management & Strategic Outsourcing





#### Key component collaborations

- **Power Conversion System Suppliers**
- **PGM Suppliers & Recovery Institutions**
- Membrane Electrode Assembly Components
- **Utility Systems**

Seamless integration within our products

# Myth #4 The economics of green projects don't add up



## Sometimes the Economics do add up

Niches with possibilities for attractive economics

- Certain Hydrogen Applications
  - Hydrotreating, Hydrogen mobility, a.o.
  - Areas with Green Hydrogen Prices >> 10 €/kg
- Ammonia Front-end Debottlenecking Revamps
  - Utilization of sunk costs
- Green Methanol plants
  - Utilization of existing market pathways for green methanol
- eSAF plants
  - Advanced leglislation in place which secures Green
    Premiums

..... combined with

Attractive site

• Power cost, Infrastructure & Local Support

Yes - Average cost of power is high compared to average cost of NG – but that's not the point

# Myth #5 There is still lots of time to make this happen





# Which way?

#### Timeline – The Green Transition

Typical Green Fuel Schedules & Events influencing rate of transition

Delivery time for HV-transformer or large H2 compressor: ~ 3-4 years



#### **Getting Ahead of The Wave**

About 4 GW of Electrolysis capacity required just to meet EU Red-III Targets in 2030



GW ELX serving the Green Fuel Industry

## Facts about the Green Transition

# Conclusion

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Plug Power is living the Green Transition



The technology <u>is</u> ready and continuously being improved



Electrolyzers <u>are</u> and <u>will be</u> available in sufficient scale



Sometimes the economics do add up



The winners will be the companies that survive present challenges & get ahead of the wave

The Elements are there, but Legislation (Basis for Green Premium) is needed to Boost the Speed of the Green Transition

# Back-up slides



## Partnerships Enable Green Hydrogen Leadership





- ✓ On October 6<sup>th</sup>, 2021 Plug Power and SK E&S, part of South Korea's SK Group, formed a joint venture designed to accelerate the use of hydrogen as an alternative energy source in Asian markets
- This collaboration will provide hydrogen fuel cell systems, hydrogen fueling stations, electrolyzers and green hydrogen to the Korean and other Asian markets
- The partnership included a \$1.6B strategic investment from SK Group into Plug Power
- The partnership will leverage SK's leadership in chemicals, petroleum and energy as well as Plug's leading hydrogen platform





- ✓ On June 3<sup>rd</sup>, 2021 Plug Power and Renault Group launched the HYVIA JV
- ✓ Plug Power and Renault Group's 50/50 JV Leading the Way to a Complete Ecosystem of Fuel Cell Powered LCVs, Green Hydrogen and Refueling Stations Across Europe
- ✓ 2021: beginning of commercialisation with pilot fleet deployments
- ✓ 30%: Targeting market share of fuel cell LCV market in Europe by 2030





- ✓ On February 16<sup>th</sup>, 2021, Plug Power and Acciona announced plans to form a strategic partnership and joint venture
- ✓ The partnership aims for 20% market share of green hydrogen in Iberia by 2030, with total investment over €2 billion
- ✓ With a 10GW+ renewable power portfolio, Acciona is also Spain's largest 100% renewable power retailer
- ✓ The partnership looks to leverage Acciona's strong relationships in Iberia and Plug's leading hydrogen technology
- ✓ The partnership looks to accelerate the growth of the hydrogen economy in the industrial, mobility and pipeline gas sectors



#### JM Johnson Matthey Inspiring science, enhancing life

- ✓ On January 31, 2023 Plug Power and JM announced long-term strategic partnership to strengthen Plug's supply chain and help meet growing demand for fuel cells and electrolyzers
- ✓ JM will become an important strategic supplier of MEA components, providing a substantial portion of Plug's demand for catalysts, membranes, and catalyst coated membranes (CCM)
- ✓ JM brings security of supply of precious metals, and unique recycling capabilities
- Plug and JM will co-invest in a 5GW (scaling to 10GW over time) CCM manufacturing facility in the United States with production targeted to begin in 2025

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- ✓ On October 19, 2022 Plug Power and Olin launched a joint venture to begin with the construction of a 15-ton-per-day hydrogen plant in St. Gabriel, Louisiana
- ✓ The JV, named Hidrogenii, will support reliability of supply and speed to market for green hydrogen throughout North America, setting the foundation for broader collaboration Plug and Olin
- ✓ Plug will be the exclusive marketer of the JV's hydrogen and provide logistical support for delivery, while Olin will provide reliable hydrogen supply and operational expertise

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Green Hydrogen at Work<sup>™</sup>