Overview

Plug Power’s Deployment
Where we are Stack Technology
Where we are Going
What we Need
What Worries
PLUG INTEGRATED Solutions Ecosystem

- Power Source
- Produce and Liquefy Hydrogen
- Transport Hydrogen
- Store & Handle Hydrogen
- Dispense Hydrogen
- Use Hydrogen
The Global Leader in hydrogen solutions

Plug Power has been a leader in hydrogen solutions for 25 years.

As the world’s most comprehensive hydrogen energy services company, Plug Power has built a global footprint in hydrogen generation, hydrogen supply, services and equipment.

Plug Power is also the world’s largest user of liquid hydrogen and has built more hydrogen refueling stations than anyone in the world.
Global accounts rely on Plug

- Oil & Gas: Shell, bp, Total, Chevron, ExxonMobil
- Retail Distribution: IKEA, Lowe's, Walmart, Nike, Ace Hardware
- Food Distribution: Kroger, Coca-Cola, Wegmans, LIPARI, ASDA
- Logistics: FedEx, DHL, FM Logistic, ULINE
- Automotive: BMW, GM, Honda, Michelin, Mercedes-Benz
- Comms: AT&T, Southern Company, PG&E, T-Mobile, Verizon
## Electrolyzer Systems: Versatile and Scalable

<table>
<thead>
<tr>
<th></th>
<th>1 MW System</th>
<th>5 MW System</th>
<th>10 MW System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>200 Nm³/hr, 425 kg/day</td>
<td>1000 Nm³/hr, 2125 kg/day</td>
<td>2000 Nm³/hr, 4250 kg/day</td>
</tr>
<tr>
<td>Stacks</td>
<td>One 1 MW Allagash Stack</td>
<td>Five 1 MW Allagash Stacks</td>
<td>Ten 1 MW Allagash Stacks</td>
</tr>
<tr>
<td>Solution</td>
<td>Fully containerized solution (standard 40 ft / 12.2m ISO container)</td>
<td>Includes full BoP for turnkey simplicity</td>
<td>Includes full BoP for turnkey simplicity</td>
</tr>
<tr>
<td>Convenience</td>
<td>Scalable Drop-and-Play convenience</td>
<td>Efficient, scalable solution for large volume H₂ plants</td>
<td>Efficient, scalable solution for large volume H₂ plants</td>
</tr>
</tbody>
</table>
1 MW Allagash Stack platform

Best-in-class price-performance in the production range from 30 Nm³/hr to 400 Nm³/hr

The Allagash Stack is at the heart of our 1, 5, and 10 MW modular system building blocks
ENOUGH CAD DRAWINGS!
Overview

Plug Power’s Deployment
*Where we are Stack Technology*
*Where we are Going*
*What we Need*
*What Worries*

Source: The Hydrogen Council
1st Generation 1 MW ALLAGASH

- 7-Cell Allagash

- 20,000 Hour Seven Cell Demonstration
  - <2.0 V at End
  - <2.0 mV/1000h voltage rise
  - No measurable membrane thinning
- 20 Full Stacks Delivered

20,000 Operating Hours
Overview

Plug Power’s Deployment
Where we are Stack Technology
Where we are Going
What we Need
What Worries
DRIVING SCALE: FIRST PEM GIGA FACTORY

Rochester, NY
Australia, South Korea, France facilities also announced

375 Jobs Created
2.0+ Gigawatts output
500+ MW Of Electrolyzers
1+ GW Electrolyzer
60,000+ Fuel Cell Stacks

7M+ MEAs
7M+ Bi-Polar Plates
Green H₂ Onsite generation

375 Jobs Created
2.0+ Gigawatts output
500+ MW Of Electrolyzers
1+ GW Electrolyzer
60,000+ Fuel Cell Stacks

Annual Capacity (EOY 2023)
Second Generation 1 MW Allagash

- Maintain Reliability of 1st Generation
- Designed for Manufacturing
  - Greatly Reduce Waste Generated
  - Labor Reduction
    - ~75% Reduction
    - Online Quality
- Enhanced Performance/Capability
Strong Reduction in Cost while Improving Performance in the Near Term

Cost Reduction Pathways:
1. Stack Hardware
2. Frame
3. Gaskets
4. Anode Package
5. Cathode Package
6. Separators
7. MEA

Gen 1 Gen 2 Gen 2 Volume 2025

Stack Cost $/MW

Efficiency (Pressure Adjusted HHV) Comparison at 600 psia

Current Density (mA/cm²)
Efficiency

15% Reduction in Energy Cost
Almost 50% Reduction in Stack Cost

2020
2022
2024

kWh/kg

54.8 58.7 68.5

41 45.7 51.4

60% 65% 70% 75% 80% 85% 90% 95% 100%
Overview

Plug Power’s Deployment
Where we are Stack Technology
Where we are Going
What we Need
What Worries
Enough Iridium?

- ~10 MT/year
- Pt is ~200 MT/year

- **Current Baseline:** 0.2 kg Ir/MW
  - If all Ir used in PEM electrolysis; 50 GW/year
  - Added Solar/Wind Capacity: 50 GW/year
  - 20% Penetration would be high

- **Beta-Tested Technologies**
  - 500 GW/year
  - With 20% Penetration of all new wind and solar would use 2% Supply

*Figure 3. Annual added renewable capacity. [Renewable Energy Market Update 2021 / Renewable electricity / Renewables deployment geared up in 2020, establishing a "new normal" for capacity additions in 2021 and 2022](https://www.iea.org/).*
What if There was no Iridium?

AEM and Pt-Based technologies are a viable alternative

- 10% more energy needed with Pt
  - Assume $0.02/kWh
  - 50 kWh/kg
  - Adds $0.10/kg H₂
Overview

Plug Power’s Deployment
Where we are Stack Technology
Where we are Going
What we Need
What Worries

Source: The Hydrogen Council
What Worries? Expanding Supply Chain

• Supply Chain Gaps in
  • Catalyst Manufacturing
  • Catalyst Coating
  • Anode PTL
  • Cathode PTL
  • Washers
  • Titanium Forming
  • Coating