LCRI LOW-CARBON RESOURCES INITIATIVE

EPRI GTI ENERGY

EXECUTIVE SUMMARY

COST AND PERFORMANCE SUMMARY—ELECTROLYSIS

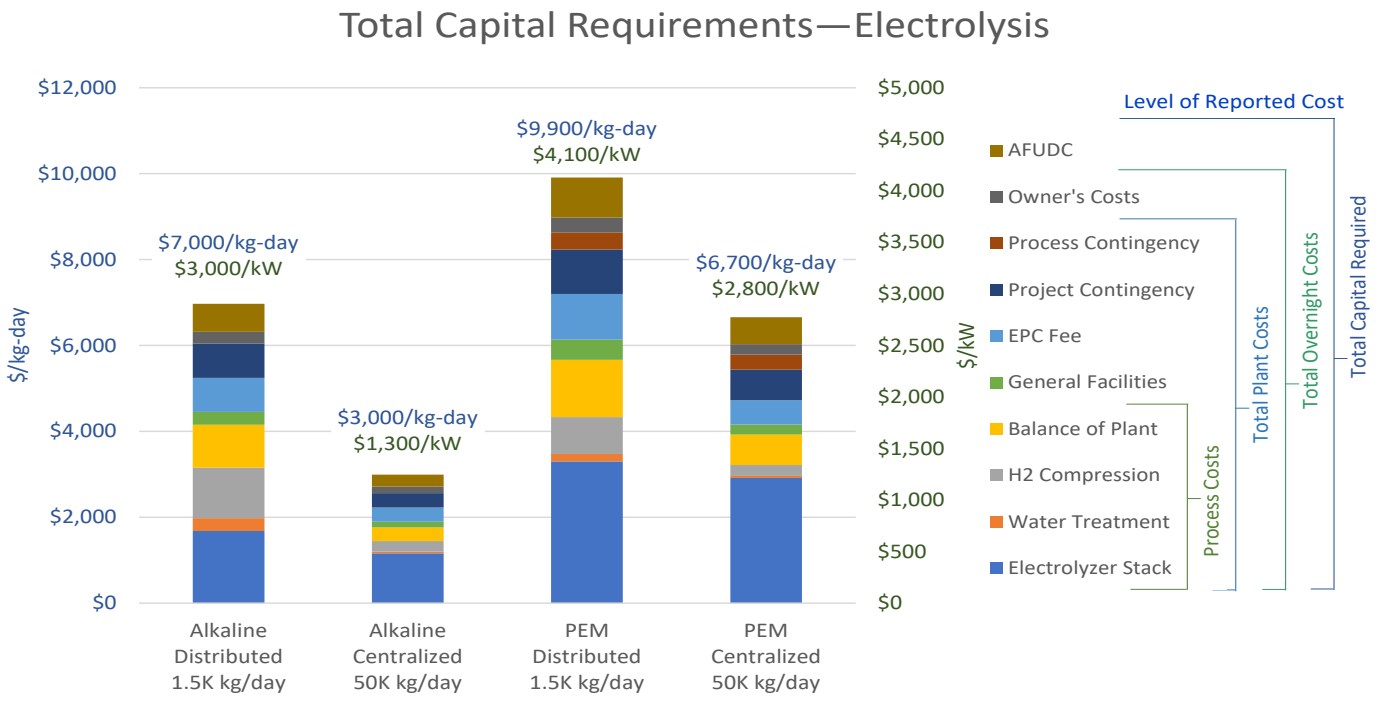
Electrolysis, the production of hydrogen from water and electricity, could play an important role in decarbonizing the economy. Hydrogen can serve as a carbon-free energy carrier for applications that are difficult to electrify directly and as a medium for energy storage with long duration and significant scalability. Additionally, electrolyzer facilities could provide grid-balancing services, fluctuating load with the availability of intermittent energy.

Although electrolysis has existed for more than a century, research efforts in recent years have achieved cost reductions and performance improvements. The difference in scale of deployment historically versus what is forecasted also creates uncertainty for utility planners that are incorporating hydrogen into their strategies. Therefore, reliable electrolyzer cost and performance data taking these factors into consideration will be vital for planners and modelers.

KEY FINDINGS

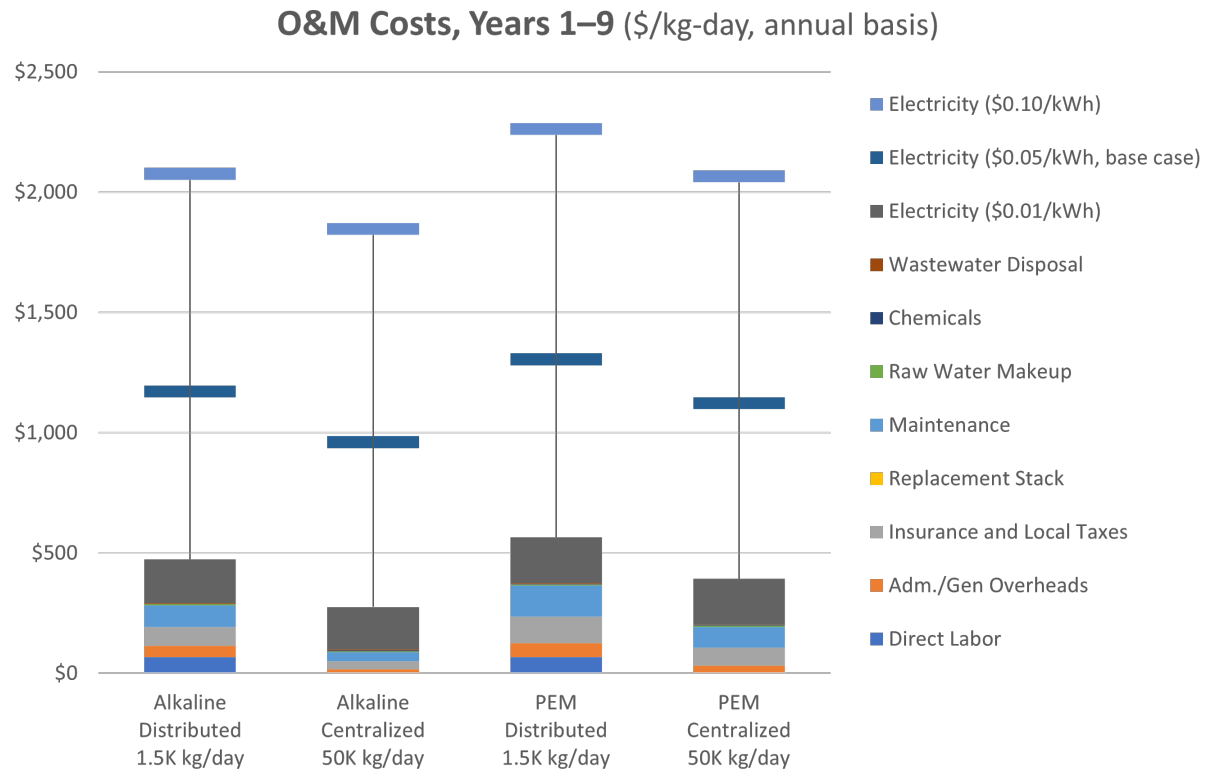
- Electrolysis stack costs represent from 24–33% (distributed) to 39–44% (central) of total capital requirements.
- Capacity factor, electricity price, and tax credit assumptions influence levelized hydrogen production costs.
- Cost and performance vary by technology type (alkaline, proton exchange membrane, solid oxide electrolysis cell, anion exchange membrane).
- The Inflation Reduction Act section 45V production tax credit could significantly help the economic viability of electrolysis.

The following are selected graphics and tables from the report.



Total Capital Required ($/kg-day)	Alkaline Distributed 1,500 kg/day	Alkaline Centralized 50,000 kg/day	PEM Distributed 1,500 kg/day	PEM Centralized 50,000 kg/day
Electrolysis Stack	1,681	1,161	3,301	2,914
Water Treatment	300	42	171	49
H_2 Compression	1,173	244	862	254
Balance of Plant	1,000	318	1,333	708
Total Process Costs	**4,153**	**1,765**	**5,667**	**3,924**
General Facilities	300	132	467	236
EPC Fee	793	330	1,067	566
Project Contingency	800	334	1,033	710
Process Contingency	0	0	400	350
Total Plant Costs	**6,047**	**2,561**	**8,633**	**5,786**
Owner's Costs	270	153	343	244
Total Overnight Costs	**6,317**	**2,714**	**8,976**	**6,030**
AFUDC	653	279	933	627
Total Capital Required	**6,970**	**2,994**	**9,909**	**6,657**

Costs are listed in 2Q2021 U.S. dollars. Figures are rounded to the nearest dollar.



Years 1–9 O&M Costs ($/kg-day, annual basis)	Alkaline Distributed 1,500 kg/day	Alkaline Centralized 50,000 kg/day	PEM Distributed 1,500 kg/day	PEM Centralized 50,000 kg/day
Direct Labor	67	4	67	4
Adm./Gen. Overheads	47	13	59	27
Insurance and Local Taxes	79	33	109	75
Replacement Stack	0	0	0	0
Maintenance	91	38	130	87
Fixed Costs	**283**	**88**	**364**	**193**
Raw Water Makeup	4	4	5	5
Chemicals	1	3	1	3
Wastewater Disposal	3	3	3	3
Electricity ($0.01/kWh)	181	177	191	189
Electricity ($0.05/kWh, base case)	905	887	957	943
Electricity ($0.10/kWh)	1,809	1,773	1,914	1,887
Variable Costs (base case)	**913**	**897**	**966**	**955**
Total O&M (base case)	**1,196**	**985**	**1,331**	**1,148**

Costs are listed in 2Q2021 U.S. dollars; capacity factor = 90%; water = $0.39/liter. Stack replacement assumed in year 10. Figures are rounded to the nearest dollar.

The full report looks at the costs of stack replacements, sensitivities affecting levelized costs of hydrogen, operational flexibility, operating temperature and pressure, staffing requirements, water usage, end uses for hydrogen, section 45V of the Inflation Reduction Act, global project announcements, and areas for future research.

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The Low-Carbon Resources Initiative

This report was published under the Low-Carbon Resources Initiative (LCRI), a joint effort of the Electric Power Research Institute (EPRI) and GTI Energy addressing the need to accelerate development and deployment of low- and zero-carbon energy technologies. The LCRI is targeting advances in the production, distribution, and application of low-carbon energy carriers and the cross-cutting technologies that enable their integration at scale. These energy carriers, which include hydrogen, ammonia, synthetic fuels, and biofuels, are needed to enable affordable pathways to economy-wide decarbonization by mid-century. For more information, visit www.LowCarbonLCRI.com.

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