

P178 RESOURCE PLANNING FOR ELECTRIC POWER SYSTEMS



KEY INSIGHTS

- Low capacity factor resources serve as dispatchable peaking capacity to maintain grid reliability during intervals of high demand and/or low renewable generation.
- Bio-based drop-in fuels utilize existing infrastructure but face feedstock limits, whereas large-scale hydrogen deployment may require new transport and storage infrastructure.
- Lifecycle emissions and resource intensity, including land and water usage, vary across different fuel production pathways and power generation technologies.

Flexible Resources in a Zero-Emissions Grid: Deploying Dispatchable Peaking Assets

by Anand Kumar, Romey James, Todd Gorgian, and Robin Bedilion

Maintaining reliability in a zero-emissions grid requires dispatchable, firm capacity to manage extreme periods of system stress. Certain dispatchable emission-free resources (DEFERs), such as hydrogen, renewable natural gas (RNG), and renewable diesel (RD), provide fast-ramping capabilities and duration-unlimited output, contingent upon fuel availability. These resources are characterized by high operating-to-capital cost ratios, primarily driven by fuel prices. Consequently, they are expected to operate at low capacity factors, serving as peaking capacity during intervals of high demand and/or low variable renewable generation.

Technology Readiness and Deployment Timelines

RNG and RD are drop-in replacement fuels for existing natural gas (NG)- and distillate-fired plants, so the power plants, fuel transport, and storage infrastructure already exist. This compatibility minimizes the need for new infrastructure buildouts. However, the fuel availability is constrained by feedstock supply limits and competition from other sectors. Hydrogen production technologies including electrolyzers and steam methane reforming with carbon capture & storage (SMR with CCS) are commercially available.

However, the infrastructure for large-scale transport and storage is less mature. Large-scale deployment is expected to require the development of shared, multi-sector infrastructure to be cost-effective.

Most fuel production and power generation technologies for low capacity factor resources have estimated project lead times of less than five years. However, building out associated infrastructure, such as pipelines and large-scale storage, could extend these timelines.

Emissions Profile and Other Considerations

The emissions profiles of low capacity factor resources depend on fuel production pathways and power generation technologies.

Fuel Production and Combustion:

Hydrogen produced via electrolysis using zero-emission electricity (green or pink hydrogen) results in zero greenhouse gas (GHG) emissions. Hydrogen produced via with SMR with CCS (blue hydrogen) can capture 90%+ of emissions at the point of fuel production.

RNG and RD can achieve near-zero net GHG emissions on a lifecycle basis, depending on the feedstock. However, their gross emissions at the point of combustion remain comparable to those of fossil fuels.

Resource Intensity: Electrolytic hydrogen production is expected to consume significant amounts of fresh water. Additionally, the land use required for the renewable generation powering electrolyzers, or for cultivating purpose-grown bioenergy crops, may be substantial.

Cost Dynamics

Fuel cost is the primary driver of the high cost of electricity for low capacity factor resources. Prices for hydrogen, RNG, and RD are expected to be considerably higher on a dollar-per-MMBtu basis than reference NG or fossil distillate prices. These high operating costs reinforce the expectation that these resources will operate when their value to the grid is highest.

2040 Readiness	Blue H ₂			Green H ₂			RNG			Renewable Diesel	
	Retrofit CT	New CT	Fuel Cell	Retrofit CT	New CT	Fuel Cell	Existing CT	New CT	Fuel Cell	Existing CT	New CT
Technology Readiness											
Infrastructure Readiness											
Supply Chain Readiness											
Project Lead Time											

Technology Readiness of select low capacity factor DEFRRs. Fully green indicates an advantage for the technology, while fully yellow indicates a challenge for the technology, with partial shading indicating the technology falls in the middle.

RESEARCH CONTACT

Romey James
RJames@epri.com

Anand Kumar
AKumar@epri.com

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