EPRI

BACK POCKET INSIGHT

P178 RESOURCE PLANNING FOR ELECTRIC POWER SYSTEMS

KEY INSIGHTS

- Diversification reduces technology, fuel supply, infrastructure, and deployment risks.
- Early investment in gap-rightsizing technologies can reduce the need to build capital- and time-intensive generation and transmission projects.
- Innovation and demonstration efforts can reduce cost and performance uncertainty and expand the set of viable options for planning.
- Cross-sector coordination on infrastructure and early stakeholder engagement can support deployment feasibility and lower costs.

From Architecture to Action: Near-Term Priorities for Scaling Dispatchable Clean Resources

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

A zero-emissions grid architecture relies on a portfolio of dispatchable emissions-free resources (DEFRs). High capacity factor DEFRs such as advanced nuclear, geothermal, and fossil plants equipped with carbon capture and storage (CCS) can provide a stable and continuous supply of clean electricity. Low capacity factor DEFRs such as hydrogen and biofuels can support during periods of extreme system stress, when renewable output is low and/or demand is high. Gap-rightsizing DEFRs such as long-duration energy storage (LDES) and virtual power plants (VPPs)can help reshape demand profiles and support effective utilization of other resources.

Achieving this architecture requires actions that advance readiness across all three resource groups. Given uncertainties in technology maturity, infrastructure readiness, costs, and project timelines, near-term efforts may need to emphasize approaches that maintain optionality, mitigate risk, and support system robustness under a range of plausible pathways to a zero-emissions grid.

In 2025, EPRI supported the New York State Energy Research and Development Authority (NYSERDA) in a technoeconomic assessment of technologies capable of achieving a zero-emissions grid by 2040 (Zero by 40: Technoeconomic Assessment). This brief highlights selected insights from that work. For additional insights from the study, visit esca.epri.com.

Diversification as a Risk Mitigation Approach: Levels of technology readiness, infrastructure requirements, community acceptance, etc., vary across technologies. Pursuing a diverse set of resources may reduce the risk associated with overreliance on any individual technology. Additionally, different DEFRs are better suited to different geographic regions, making a mix necessary to best meet system needs.

Early Investment in Enabling Technologies: Gap-rightsizing technologies, such as energy storage and VPPs, along with grid-enhancing technologies, including grid-forming inverters and dynamic line ratings, can increase operational flexibility and support more efficient use of clean generation. Deploying these technologies early could reduce the need of capital-intensive generation and transmission infrastructure.

Accelerating Innovation:
Most DEFR technologies are not yet ready for commercial deployment. Targeted research, standardization, and demonstration projects may help reduce uncertainty in cost and performance characteristics and shorten future deployment timelines. Advancing multiple technologies toward commercial readiness could increase the range of available viable options.

Cross-Industry Infrastructure Sharing:
Clean fuels such as hydrogen and biofuels, as well as CCS may contribute to emissions reductions in sectors outside the power system. Coordination among sectors to develop transportation and storage infrastructure in strategic locations could support more efficient deployment and lower costs.

Stakeholder Engagement:
Early engagement with technology developers, end-users, and communities may support technology deployment. Coordination with federal and state agencies and industry organizations could facilitate market development and contribute to cost reductions.

Flexibility in Planning and Regular Reassessment:
Regular evaluation of technology progress and incorporation of flexibility into resource planning processes may help reflect updated information and capture potential improvements.

In summary, near-term actions that expand optionality, enhance grid flexibility, and enable coordinated infrastructure development could improve readiness of resources required for a zero-emissions grid.

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