Renewable Fuels for Clean Dispatchable Power Generation

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LCRI/EPRI Energy Supply

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EPRI and the LCRI

Advancing **safe**, **reliable**, **affordable**, and **clean** energy for society through **global collaboration**, **science** and **technology innovation**, and **applied research**

ABOUT US

Founded in 1972, EPRI is the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries and its members represent 90% of the electricity generated and delivered in the United States.

$420M Annual Global R&D

Together, we are Shaping the Future of Energy

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KEY ASPECTS

Nonprofit
Chartered to serve the public benefit, with guidance from an independent advisory council.

Thought Leadership
Systematically and imaginatively looking ahead to identify issues, technology gaps, and broader needs that can be addressed by the electricity sector.

Independent
Objective, scientific research leading to progress in reliability, efficiency, affordability, health, safety, and the environment.

Scientific and Industry Expertise
Provide expertise in technical disciplines that bring answers and solutions to electricity generation, transmission, distribution, and end use.

Collaborative Value
Bring together our members and diverse scientific and technical sectors to shape and drive research and development in the electricity sector.

Low-Carbon Resources Initiative

FOCUS

Multiple options and solutions to establish viable low-carbon pathways

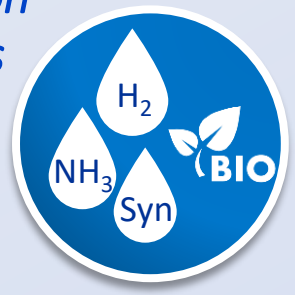
Technologies for hard-to-decarbonize areas of the energy economy

Affordable, reliable, and resilient integrated energy systems for the future

RESEARCH AREAS

Hydrogen **Ammonia** **eFuels** **Biofuels**

Production Pathways



Integrated Systems

Storage & Delivery

End Use Applications

VALUE

Independent, objective research leveraged by global engagement and collaboration

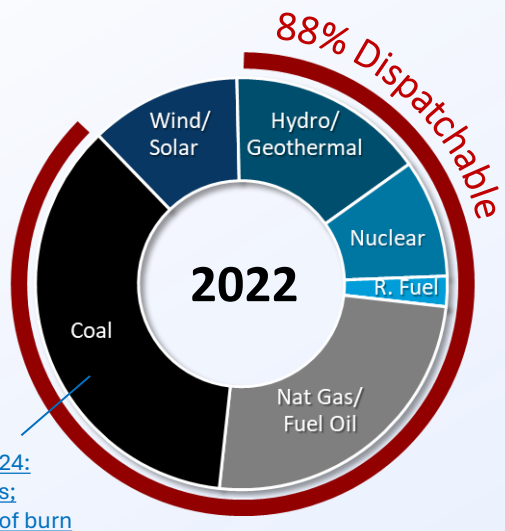
Comprehensive approach to low-carbon value chain and technology analyses

High-impact results from technology evaluations, and safety, environmental, and economic assessments

Low-Carbon Resources Initiative

The Need for Clean AND Resilient Power

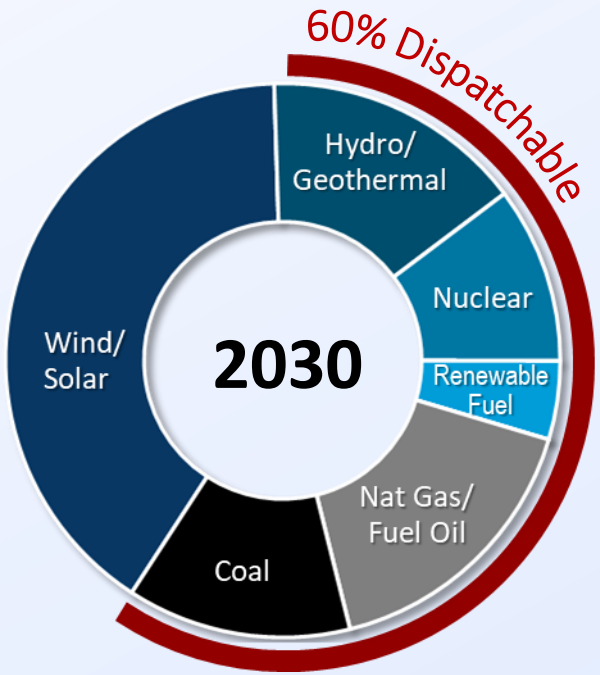
Resiliency Under Pressure



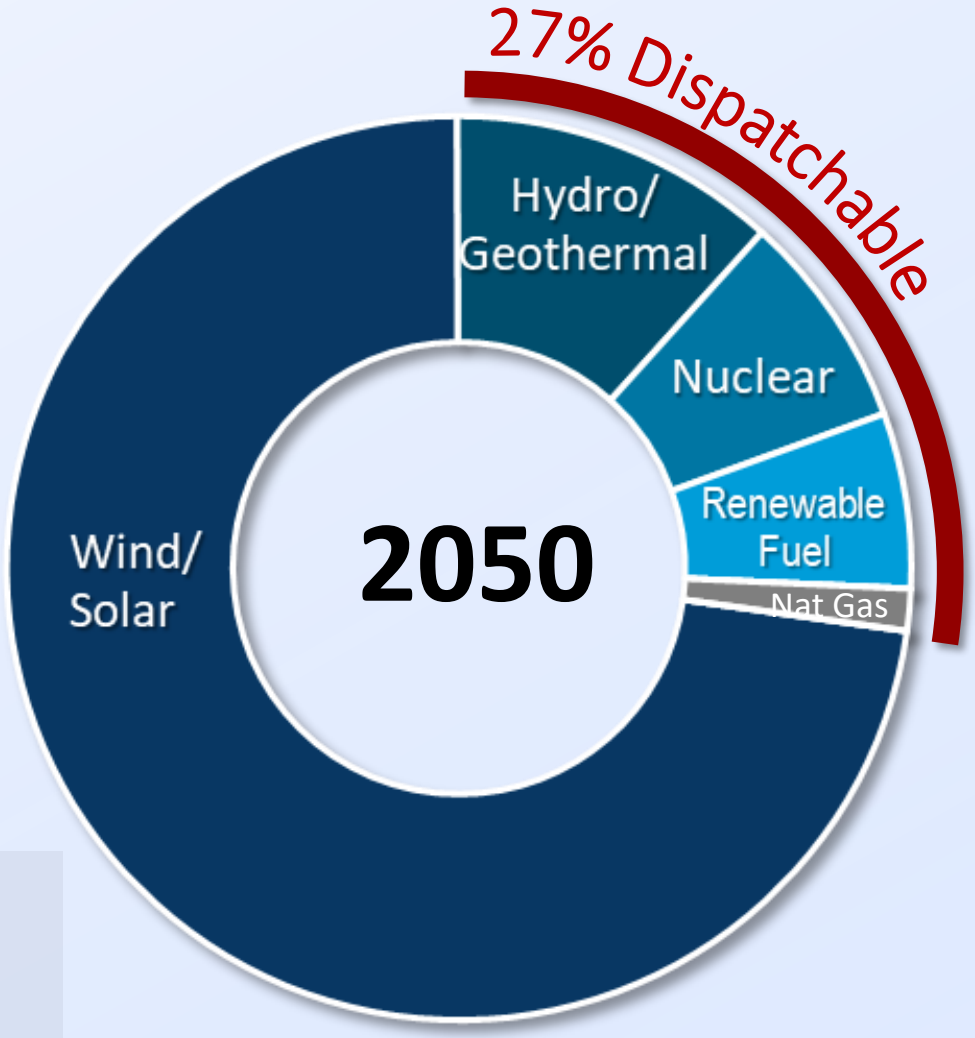
March 2024:
134M tons;
144 days of burn

29,033 TWh

Source: IEA Net Zero 2050 Roadmap



38,207 TWh



76,838 TWh

Globally, wind/solar triple by 2030; double again by 2050

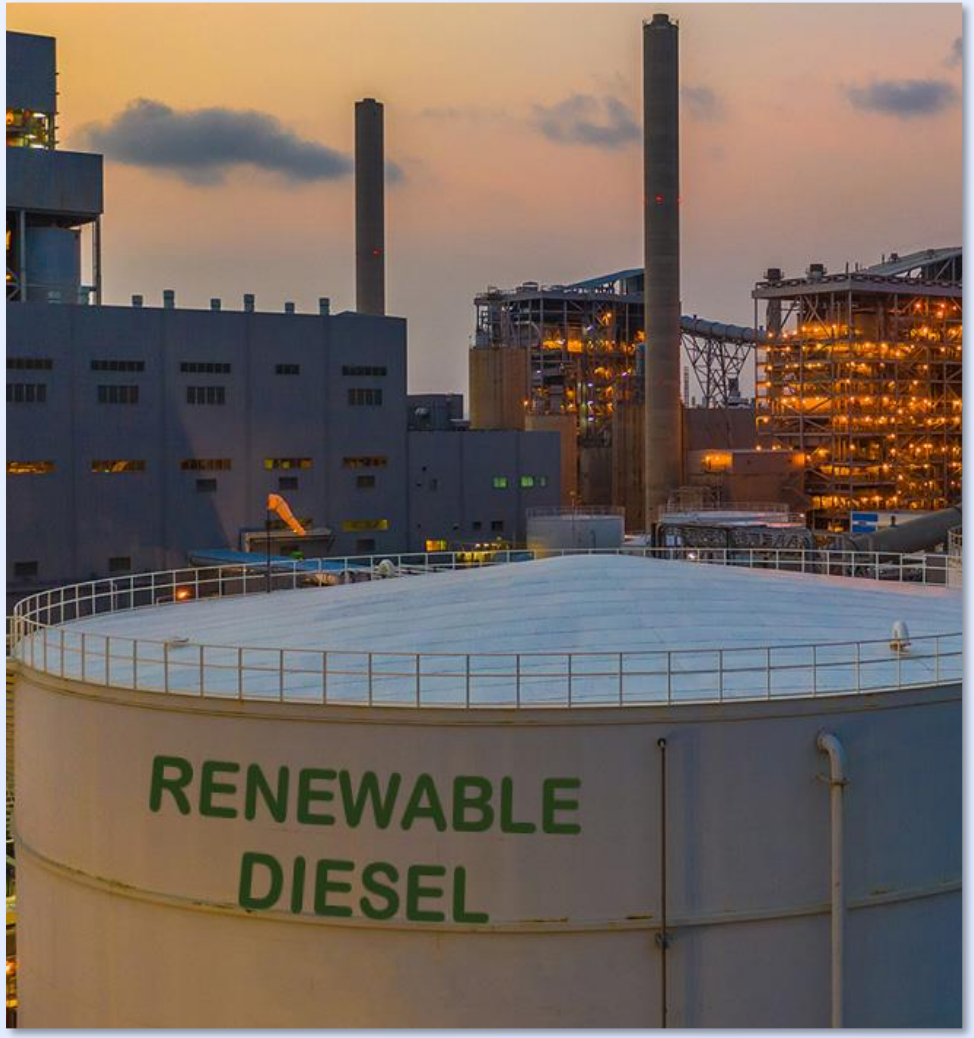
Abated fossil declines to <1% by 2050; Renewable fuels offset 6%

Coal declines from 36% to zero by 2050, as does on-site fuel storage

Reduced generating system capacitance increases energy resiliency challenge

The Need: Clean AND Resilient Power Supply

- As with coal, liquid fuels enable substantive on-site fuel storage to support on-demand power
- Liquid fuels such as kerosene, ULSD, #2 and #4 oil are currently used for backup/peaking generation and are supported by large efficient distribution networks
- Renewable alternative fuels like renewable diesel, jet (SAF), ethanol and methanol can be used as near-term direct/near-direct fuel replacements
- These fuels can support critical energy resilience AND reduce lifecycle GHG emissions, improve local air quality, and enable transition and renewal pathways for critical assets and the communities they support



Renewable liquid fuels can be stored on-site to support clean on-demand power generation

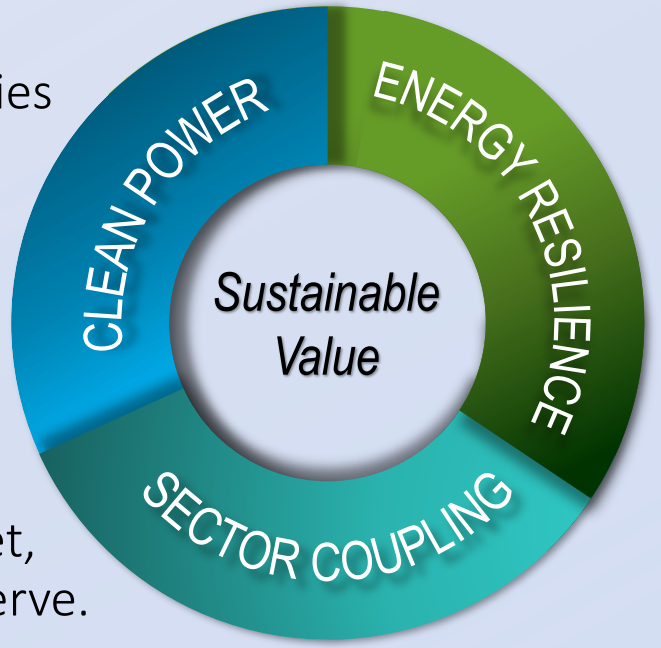
EPRI Renewable Fuels Portfolio

EPRI Renewable Fuels Research Portfolio

Identify, analyze and demonstrate how **Renewable Fuels** can improve **energy system resiliency**, enable **sector coupling**, and inform **integrated, multi-horizon asset, fleet, and enterprise level clean energy strategies**

VISION & PURPOSE

- Create an ***integrated, multi-horizon*** research portfolio that examines the unique and valuable role of **Renewable Fuels** in delivering ***clean, secure, resilient energy.***
- Provide ***knowledge, resources,*** and ***technical leadership*** to advance clean, resilient power generation and inform enduring **Renewable Fuels** transition strategies.
- Establish and lead a ***Renewable Fuels Collaboration Network*** that connects utilities with clean fuels ***producers***, ***suppliers***, ***anchor consumers***, and ***researchers*** to leverage ***collective knowledge***, ***resources***, ***best practices***, and ***opportunities***.
- Characterize vital ***Power-Fuels*** connections and interdependencies across the energy economy that create ***Integrated*** Renewable Fuels opportunities.
- Create practical, ***fleet-focused transition roadmaps*** that support **clean, flexible, resilient** power generation, maximize ***the contribution*** of today's generation fleet, and create ***long-term sustainable value*** for utilities and the communities they serve.



Research Focus Areas

Fleet Refueling

Utilize renewable fuels to support clean resilient power generation, maximizing the contribution and life-span of today's thermal power generation fleet

Renewable Fuels Supply Chain Optimization
Process and supply chain models, system design framework, and operating targets to ensure robust and optimized renewable fuel supply for power generation

Fuel Origination, Characterization & Sourcing
Renewable Fuels Sourcing & Properties Database with production, combustion, and physiochemical properties

Operational Support
Guidance for GT, RICE, Boilers and balance-of-plant that enable a successful low-carbon fuels transition

Site & Community Impact
Assess Economic, Environmental, and Societal benefits associated with renewable refueling of generation assets

Power-to-Fuels (PtF)

Next generation power-derived fuels that enable indirect electrification, fleet integration and optimization, and cross sector energy coupling

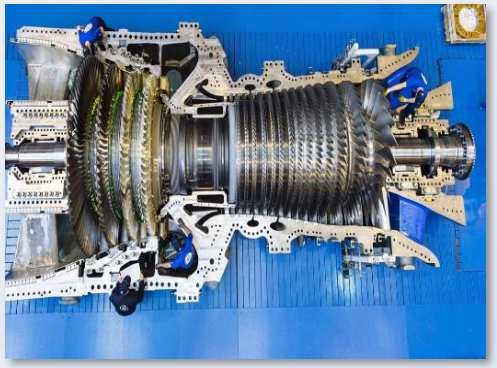
E-Fuels Market Intelligence
Track/analyze emerging e-Fuels markets; characterize development and adoption trends that may support generation load growth and Power-to-Fuels opportunities

E-Fuels Ecosystems
Characterize critical e-Fuels ecosystem enablers, such as surplus renewable power, biogenic CO_2, anchor markets

Sector Coupling
Assess prospects for eFuels deployment and cross-sector resource pooling, integration, and systemic efficiencies

E-Fuels Anchor Markets
Track/assess development in fuel-dominant anchor markets to ID collaborative Power-to-Fuels opportunities for utilities

Focus on Low-Carbon Fuels[1] for Power Generation



	Gas Turbines[2]	Dual Fuel RICE[3]	Boilers	Fuel Cells
Hydrogen	EPRI & OEM Testing	OEM Testing EPRI Testing on SI engine	EPRI Industrial Tests & OEM Testing	Commercial / EPRI Testing
Ammonia	EPRI & OEM Lab/Pilot Testing	Planned EPRI Demo & OEM Testing	Japan Demonstration & EPRI Testing Planned	Lab/Pilot Testing
Renewable Diesel	EPRI/TVA Johnsonville CT Demo *Completed Oct 2024*	Commercial	EPRI Pilot Testing	Lab/Pilot Testing
Ethanol	EPRI Lab Testing / Previously Demonstrated	OEM Testing	EPRI Pilot Testing	Lab/Pilot Testing
Methanol	EPRI Lab Testing	Commercial	EPRI Pilot Testing	Lab/Pilot Testing

TVA Johnsonville Press Release

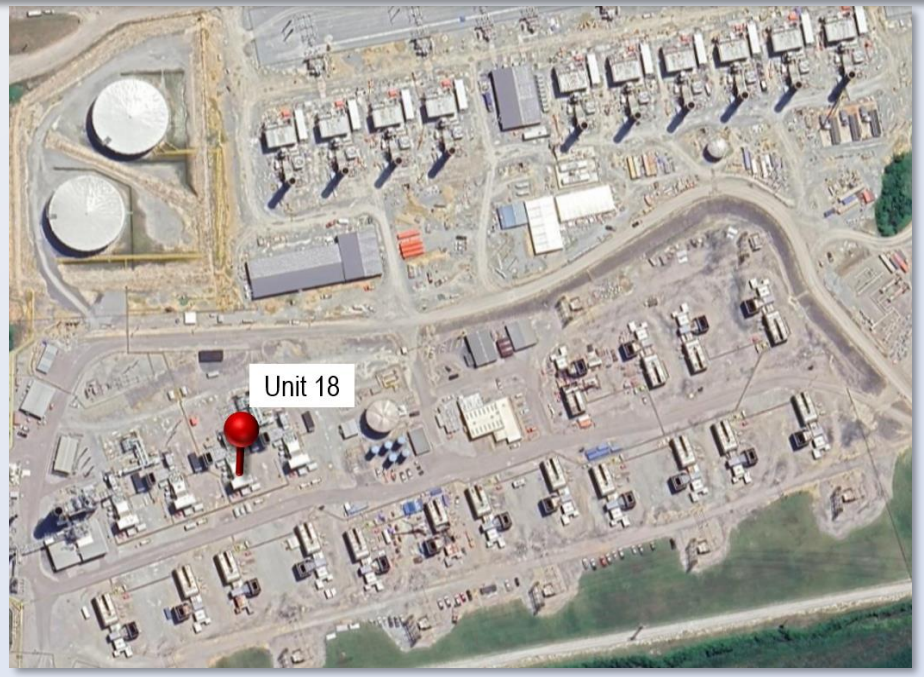
[1] Includes low-carbon fuels produced via biofuel and e-Fuel pathways; [2] DLN combustor technologies; [3] Status varies depending on stationary, marine, spark ignited, and dual fuel models

Demonstration Project

Renewable Diesel for Dispatchable Power

TVA Johnsonville CT Plant Renewable Diesel Demonstration

TVA Johnsonville CT Plant



TVA's largest peaker and diesel distribution hub

20 Simple cycle + 10 aeroderivative GTs (1,800 MW)

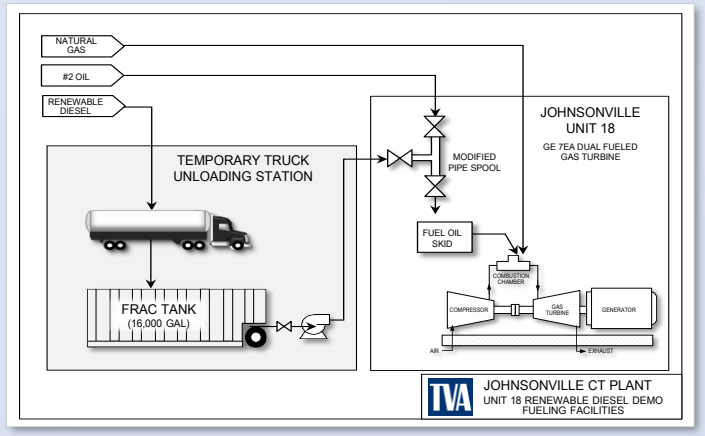
Tested on Unit 18, GE 7EA SCGT (76 MW, built 2000)

Located on 700 acres, 80 miles west of Nashville, TN

Built in 1975 adjacent to TVA coal plant (closed 2017)

The Test Plan & Demonstrated Results

- Neste R99 Renewable Diesel supplied by Global Partners
- Temporary truck unloading station and 16,000 frac tank with spill prevention
- Modified pipe spool to tie Renewable Diesel supply into existing fuel oil system
- Test duration of 4 hours; 30,000 gal of R99 (4 trucks)

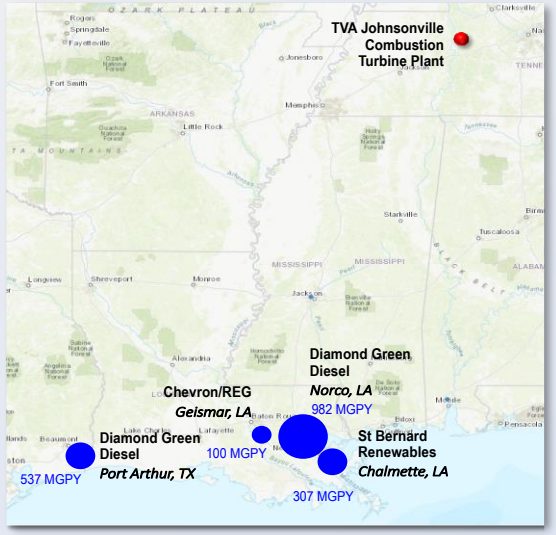


- Test Stages: 1) Base case assessment with ULSD, 2) natural gas to R99 transition, 3) startup/shutdown, ramping, and full load (76 MW) on R99
- Test Parameters: Power output, fuel usage, water injection, and stack testing for particulate matter, CO, CO_2, O2, NO, and NO_2
- Results: Confirmed Renewable Diesel as "drop-in" fuel with potential for LC CO_2 reduction of up to 75%; saw lower NOx and filterable $PM_{2.5}$
- Carbon Abatement Cost (Indicative): (1) LCCA ~ $200/MT CO_2
- Alt. LCCAs: RNG (LFG) ~ $345, RNG (WWS) ~ $660, eGas (DAC) ~ $900

1) Levelized Cost of Carbon Abated $(LCCA)_{\Delta R99}$ = $Cost_{\Delta R99}$ / $\Delta CI_{\Delta R99}$; CARB certified CI, Includes RIN Retirement/Excludes RECS; 2) Based on NA natural gas PL avg 67 kg/MMBtu + 2024 Henry Hub avg $2.19/MMBtu

TVA Johnsonville Site Transition to Renewable Diesel

Renewable Diesel Supply



The Johnsonville CT Plant receives diesel by barge on the Tennessee River

The Tennessee River is accessible to the Ohio and Mississippi River, draws fuel supply from the USGC and USMC (PADD 1/2)

4.3 billion GPY of Renewable Diesel is produced in US, 2.36 billion GPY of which is produced on the USGC and has barge access to the Mississippi River

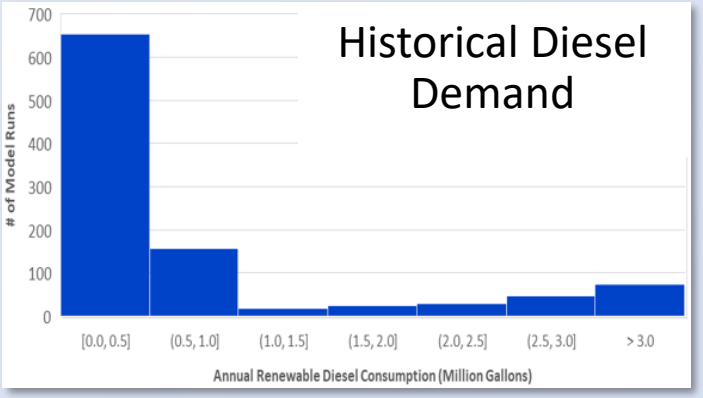
Diamond Green Diesel is the largest US producer of Renewable Diesel (>1.5 billion GPY produced in USGC)

Existing USGC Renewable Diesel production is sufficient in scale and can be accessed via existing river barge routes to fully supply the Johnsonville site.

Dynamic Supply Chain Analysis

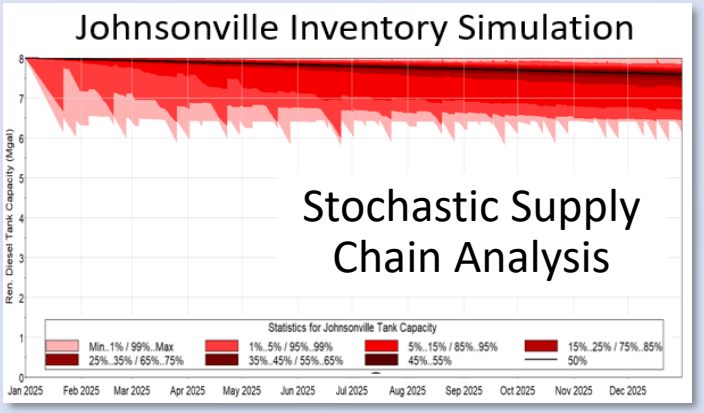
Demand Distribution

Analyzed daily diesel consumption for prior 7 years Johnsonville site to establish demand histogram for input to inventory simulation



Supply Chain Modeling

Based on Demand Distribution with Renewable Diesel supplied by barge from USGC sources, conducted dynamic supply chain analysis (stochastic model, 1000 cases, 5-year inventory trends) to assess the feasibility of existing tankage and prospective supply channels



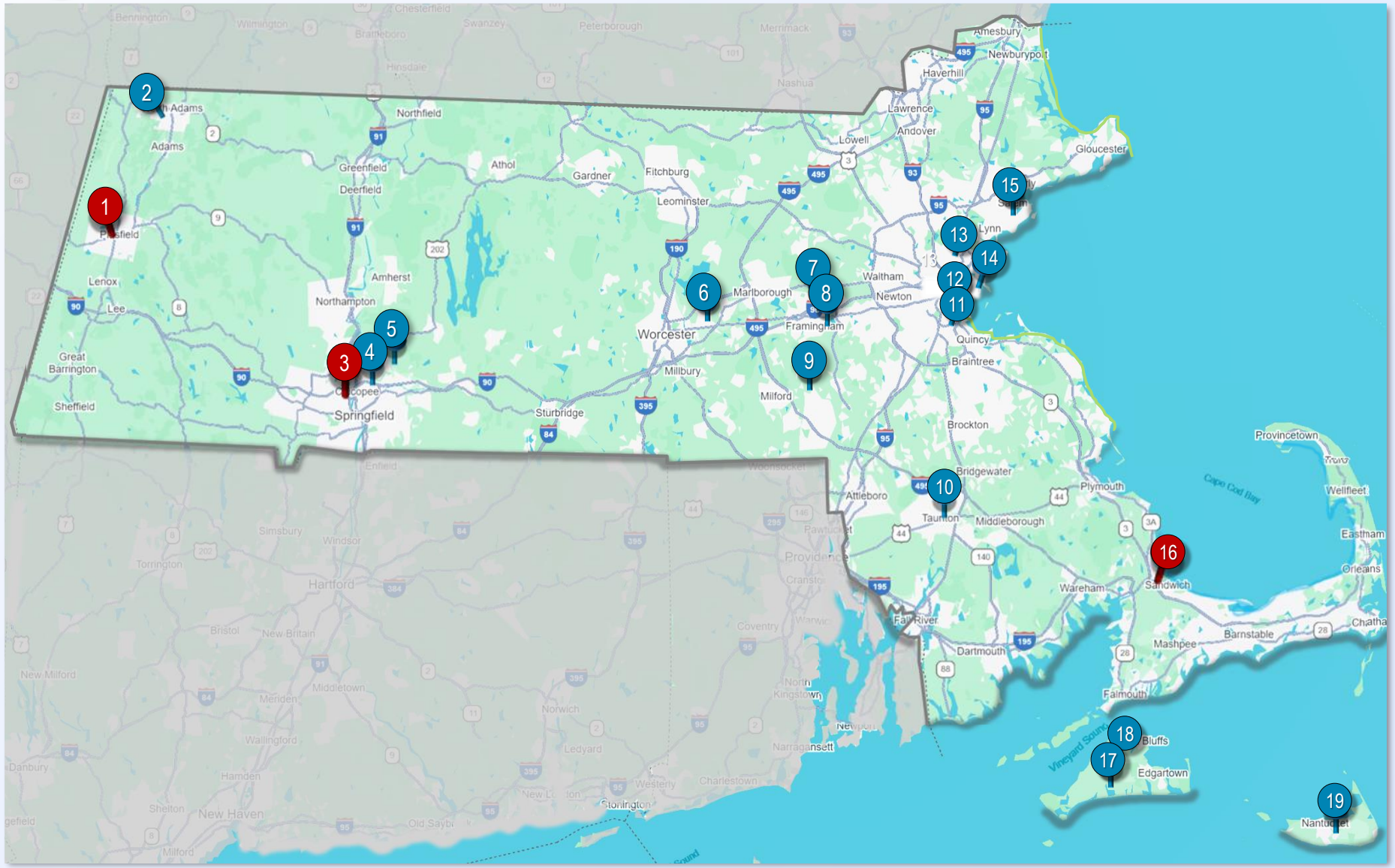
Existing Johnsonville tankage, unloading racks, fuel management systems can reliably support a full range of peaking and backup generation scenarios based on historical gird and site operational data

Fuel Supply is viable and prospective Johnsonville supply chain is resilient

Renewable Diesel

High-Level Assessment of MA Supply

Massachusetts Liquid Fueled Power Plants

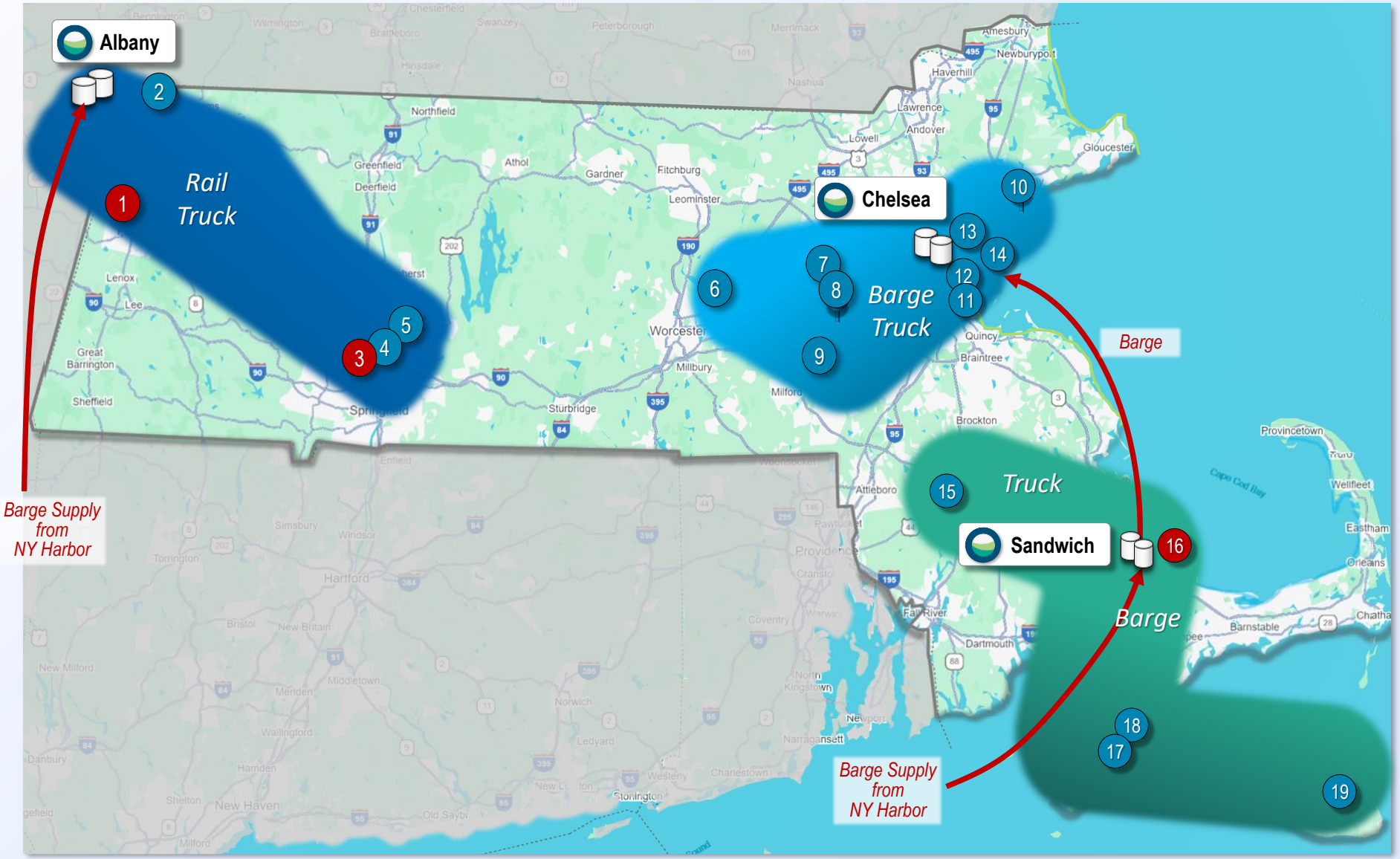


Plant/ Location	Capacity
1. Milepost Power (Pittsfield)	**181**
2. Williams College (Williamstown)	7
3. Cogentrix (West Springfield)	**229**
4. Front Street (Chicopee)	8.4
5. Stony Brook (Chicopee)	446
6. Shrewsbury	14
7. Framingham State University	3.2
8. Constellation (Framingham)	31
9. Constellation (Medway)	123
10. City of Taunton	10
11. U Mass (Boston)	8.1
12. Mass Bay Transit Authority	50
13. Signature Breads (Chelsea)	1.5
14. Deer Island WWTP (Winthrop)	56
15. Wilkins Station (Marblehead)	5
16. Canal Power Plant (Sandwich)	**1,578**
17. Vinyard Reliability (West Tisbury)	5.6
18. Vinyard Reliability (Oak Bluffs)	8.4
19. Nantucket Electric Co.	20.5

Massachusetts has ~2.5 GW of installed liquid fueled power generation capacity*

*Source: EIA

Prospective Renewable Diesel Fuel Supply Channels



Plant/Location	Supply Corridor
1. Milepost Power (Pittsfield)	Albany
2. Williams College (Williamstown)	
3. Cogentrix (West Springfield)	
4. Front Street (Chicopee)	
5. Stony Brook (Chicopee)	
6. Shrewsbury	Chelsea
7. Framingham State University	
8. Constellation (Framingham)	
9. Constellation (Medway)	
10. Wilkins Station (Marblehead)	
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Renewable Diesel is now received/stored/shipped at Albany, soon at Chelsea, accessible to Sandwich

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Final Thoughts

EPRI Renewable Fuels Network

Fall 2025 Renewable Fuels Workshop

The **EPRI Renewable Fuels Network** engages stakeholders from across the low-carbon fuels ecosystem to enable and advance fuel-based clean energy solutions in support of a clean and resilient energy economy.

As its core mission, the **EPRI Renewable Fuels Network** will *connect* talent, resources, and leadership from a broad spectrum of renewable fuels markets and value chain segments, to *create* a unique multi-sector industry fuels collaborative with the *collective capability* to envision, develop, and deploy economy-scale renewable fuels solutions.

Hosted by **EPRI** and the **LSU Center for Energy Studies**, the **Fall 2025 Renewable Fuels Workshop** will bring renewable fuels stakeholders together to facilitate connections and cross-sector knowledge transfer. The event includes technical presentations, panel discussions, and immersive tours where participants can share experiences with renewable fuels and share challenges and opportunities with other network members.

Registration Opens July 2025

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