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COLLABORATIVE (ROWEC)

Expanding New Jersey's Nuclear Generation Capacity

Rowan Energy Collaborative (ROWEC)
Rowan University

The Rowan Energy Collaborative (ROWEC)

"

ROWEC's mission is to serve as a connector, collaborator, and resource for identifying and implementing energy solutions that meet the complex needs and opportunities of today and tomorrow."

~ Marie Cassanova, ROWEC Program Director

ROWAN'S NUCLEAR TEAM: (Standing, from left,) Owen McGlynn, Pei Li, Chris Peters, Yolanda Mack, Mark Magyar, Marie Casanova, William Riddell, Ethan Cantor, Dan Carrasco and Stuti Jha. (Seated, from left,) Fiona Currie, Ladarion Hardison, Max Owens and Kul Kapri

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Our Project

1. Study the financing and construction of Vogtle Units 3 and 4 (GA), Watts Bar Unit 2 (TN), four SMR reactors being built in Ontario, and the Palisades Nuclear project (MI).
2. Analyze the fiscal, regulatory, technical, environmental, supply chain, labor, safety and interconnection issues involved in moving forward on PSEG Nuclear, Holtec Oyster Creek SMR and other potential projects.
3. Analyze the impact on costs of expanding capacity through new nuclear plant construction compared to investment in large-scale solar, new natural gas plants or offshore wind power generated in other states,
4. Explore financing options for nuclear power plant construction, including direct state government investment or financing and/or multi-state pension fund investment.

Presentation Outline

01 Regional Planning & Plant Siting

02 Grid Interconnection

03 Economics & Finance

04 Public Policy

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01

Regional Planning & Plant Siting

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M.S., Urban & Regional Planning
Cert. Geospatial Science & Methods

Why Nuclear? Why Now?

Clean Energy

Climate Change

Energy Demand

Political Will

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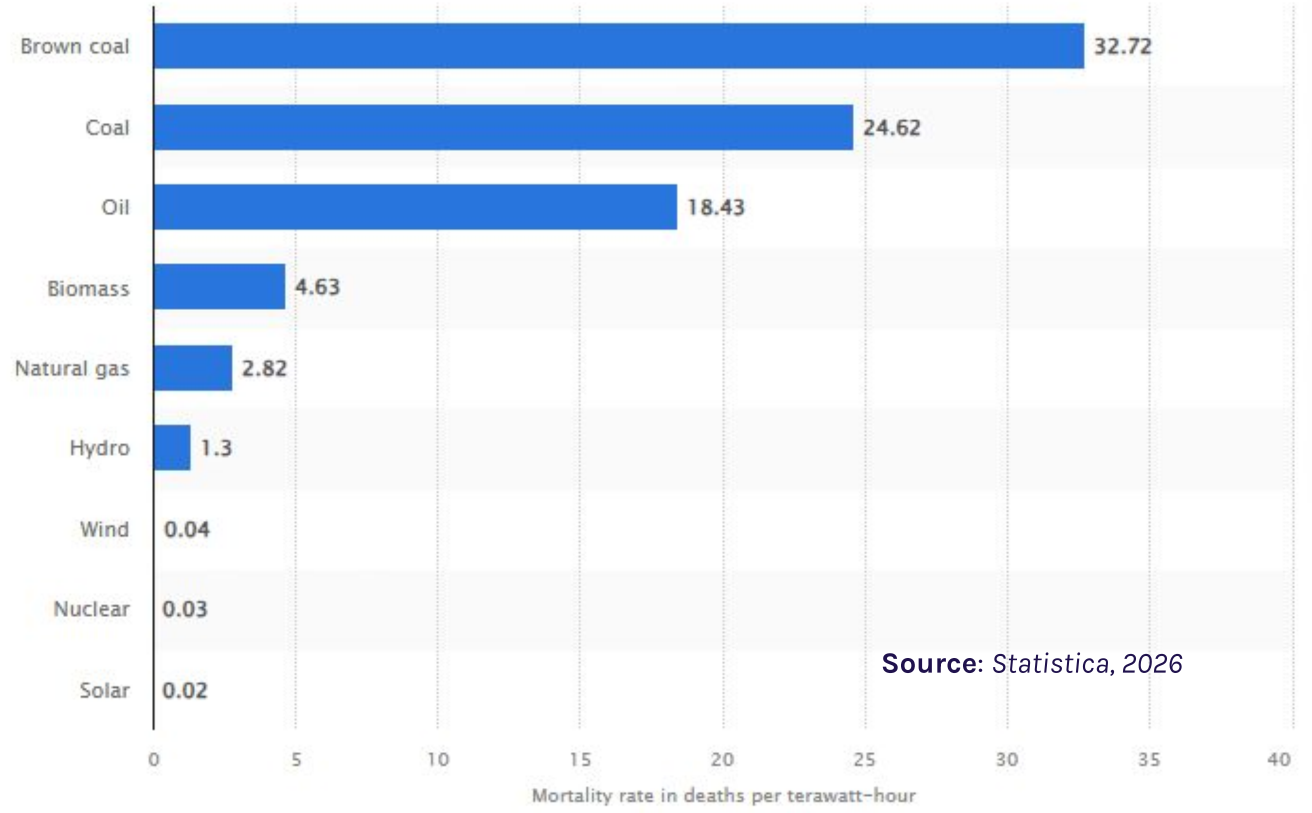
How Does Nuclear Compare?



Source: *Statistica, 2026*

Fossil Fuel

8.7 million deaths from FF Combustion

Cardiopulmonary Diseases, premature death, equity

Nuclear

Chernobyl: 46 deaths

Fukushima: 0 deaths

Source: *World Nuclear Association, 2026,*

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Research Topics

Environmental Monitoring & Impacts

Emergency Management & Security

Community/ Regional Planning Near Reactor Sites

Storage of Nuclear Waste

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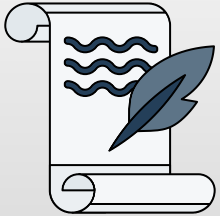
Strategies



1. Literature Review

What does the research say? How can this knowledge be applied?

2. Geospatial Analysis

What locations in New Jersey are most suitable for nuclear plants?

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Strategic multi-criteria framework for nuclear plant siting: Integrating AHP, EWM, and Game Theory with GIS

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ARTICLE INFO

Keywords:
Nuclear power plant site selection
GIS
AHP
EWM
WLC
Game theory

ABSTRACT

This study investigates the integration of Game Theory with Multi-Criteria Decision-Making (MCDM) methods, specifically the Analytic Hierarchy Process (AHP) and the Entropy Weight Method (EWM), to enhance the site selection process for nuclear power plants (NPPs). While AHP determines criterion weights based on expert opinions, EWM employs data-driven approaches; Game Theory strategically unifies these methods by reconciling discrepancies in weight assignments and accounting for interactions among criteria. This integrated approach enables a balanced evaluation of critical factors (such as safety, environmental protection, infrastructure accessibility) in NPP site selection. After deriving final criterion weights via Game Theory, the Weighted Linear Combination (WLC) method was implemented in a Geographic Information System (GIS) environment to produce a comprehensive suitability map. The analysis revealed that 49.48 % of the study area meets the suitability threshold, with 19.82 % classified as perfectly suitable and 29.66 % as very suitable. Fault lines, main roads, and protected areas were the three most significant factors for site selection. For instance, fault lines ensure seismic safety, main road accessibility enhances operational efficiency, and protected areas support environmental sustainability. This comprehensive approach provides decision-makers with robust guidance for establishing NPPs in safe, environmentally sensitive, and logistically efficient locations. By integrating Game Theory with traditional MCDM methods, this framework minimizes potential methodological discrepancies, thereby contributing to more reliable and sustainable nuclear energy infrastructure planning. Consequently, the findings enhance the decision-making process and ensure the secure, efficient, and environmentally responsible placement of nuclear facilities.

1. Introduction

Throughout history, humans have depended on energy production for various purposes such as heating, manufacturing, and commerce. With the advent of the Industrial Revolution in the 18th century, the demand for energy increased significantly (Smil, 2017). Consequently, societies turned to fossil fuels to fulfill growing demands for heating, transportation, and industrial production (Fouquet, 2014). However, due to the risk of fossil fuel depletion and their detrimental effects on the economy and environment, reliance on fossil fuels has increasingly been perceived as problematic. In response, technological innovations and scientific advancements have led humanity to develop alternative energy sources and promote energy diversification (Agyekum et al., 2021; Azam et al., 2023; Flaksman et al., 2021). One of the most important components of this energy diversity is nuclear energy.

As part of the evolving smart energy framework—which increasingly emphasizes the integration of low-carbon technologies, system-wide sustainability, and data-informed energy governance—nuclear energy occupies a pivotal role in the global energy sector (Lund, 2024). It holds economic significance not only because of its low operational and fuel costs, but also due to its low carbon emissions, which help avoid carbon taxes, reduce costs associated with environmental compliance, and enhance long-term investment appeal under climate-focused energy policies. For instance, countries such as France and the United States have relied extensively on nuclear power to ensure energy security and support industrial growth. Although greenhouse gas (GHG) emissions were not a primary concern when these nations initially developed their nuclear fleets, the role of nuclear energy in reducing GHG emissions has since become an important justification for maintaining and expanding nuclear capacity in the context of climate change mitigation. Furthermore, the long lifecycle of NPPs—often spanning several decades—facilitates stable electricity generation and supports long-term energy planning (Nuclear Energy Agency, 2021). This stability also positions nuclear power as a dependable baseload source,

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What Factors are Important?

What Factors are Important?

- Seismic Activity
- Cooling Water
- Major Roads
- Protected Areas
- Airports
- Population

Source: Başeğmez, 2025

How it's Implemented

ArcGIS Pro

Spatial Analysis & Mapping Software

WLC

Final Weights
+
GIS Criteria Layers

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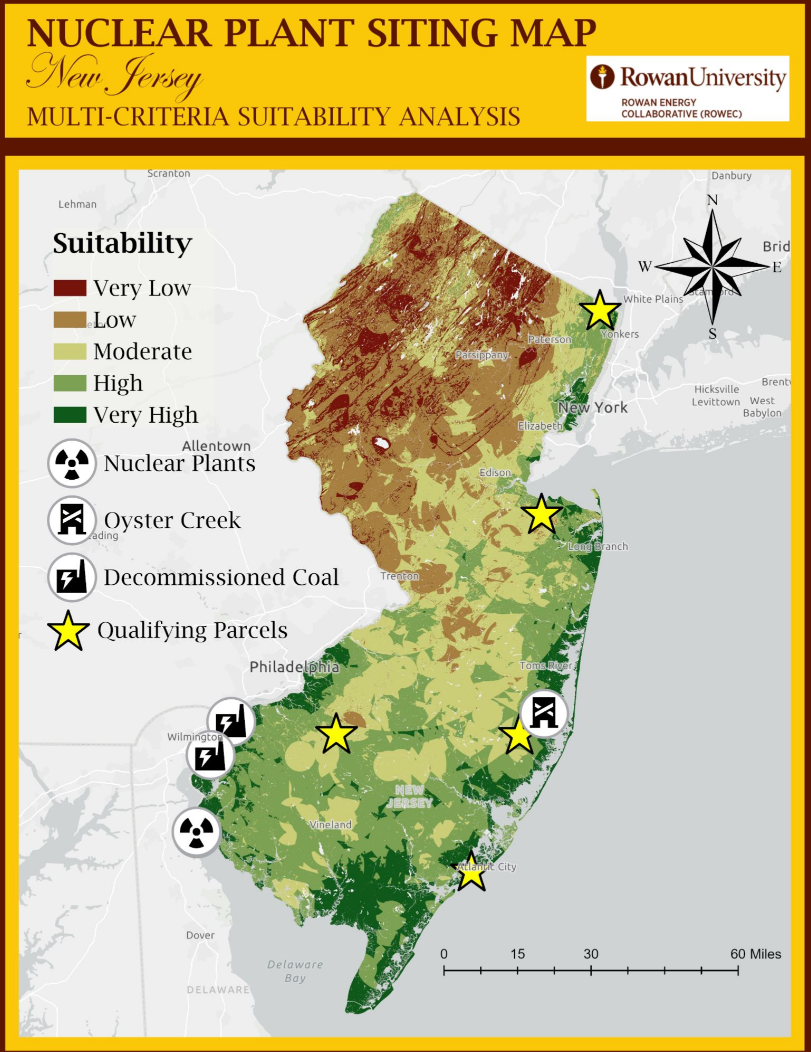

02
Grid Interconnection Screening

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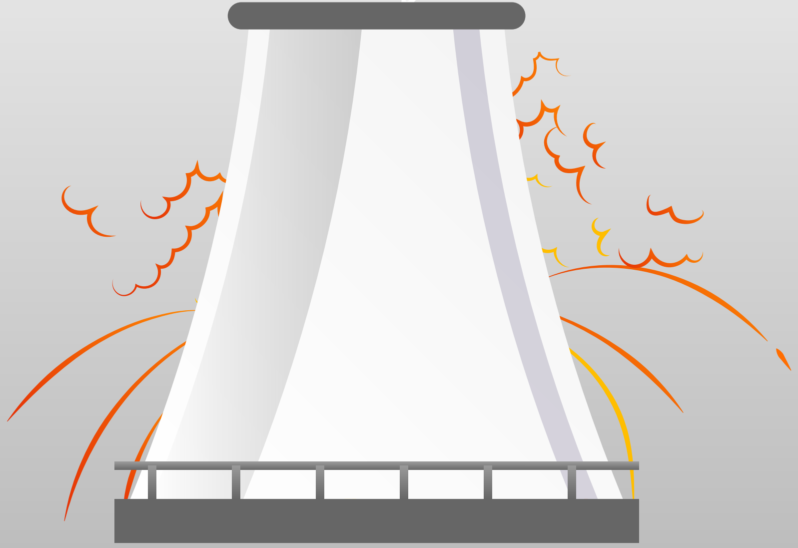


Grid Interconnection Guiding Entities

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

UNITED STATES NUCLEAR REGULATORY COMMISSION

pjm

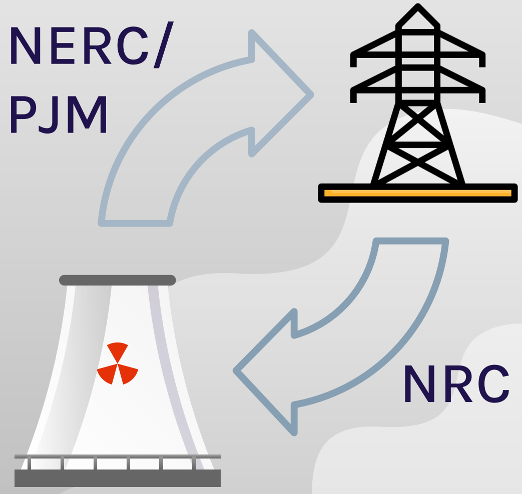
- Ensures the reliability and security of the bulk power system in North America
- TPL-001 - Transmission System Planning Performance Requirements

- Ensure the safe use of radioactive materials and nuclear energy
- 10CFR Part 50 Appendix A - General Design Criteria for Nuclear Power Plants

- Ensure the reliable and efficient operation of the electric grid in its service area
- Manual 14A - New Services Request Process

Grid Interconnection Policy Interpretations

- NERC/PJM: A nuclear plant interconnection should **not cause unacceptable disturbances** to the bulk power system following a plant trip or other disturbance
- NRC: Provide at least **two independent** and reliable **offsite power sources** to ensure emergency safety systems remain operable



<u>Implementation</u>

- Analyzing Existing Substations for Interconnection
- NERC/PJM: High Voltage Substations (≥230kV)
- NRC: Substations with ≥2 Independent Transmission lines

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Transmission and Substations

New Jersey

LOCATION CONTEXT

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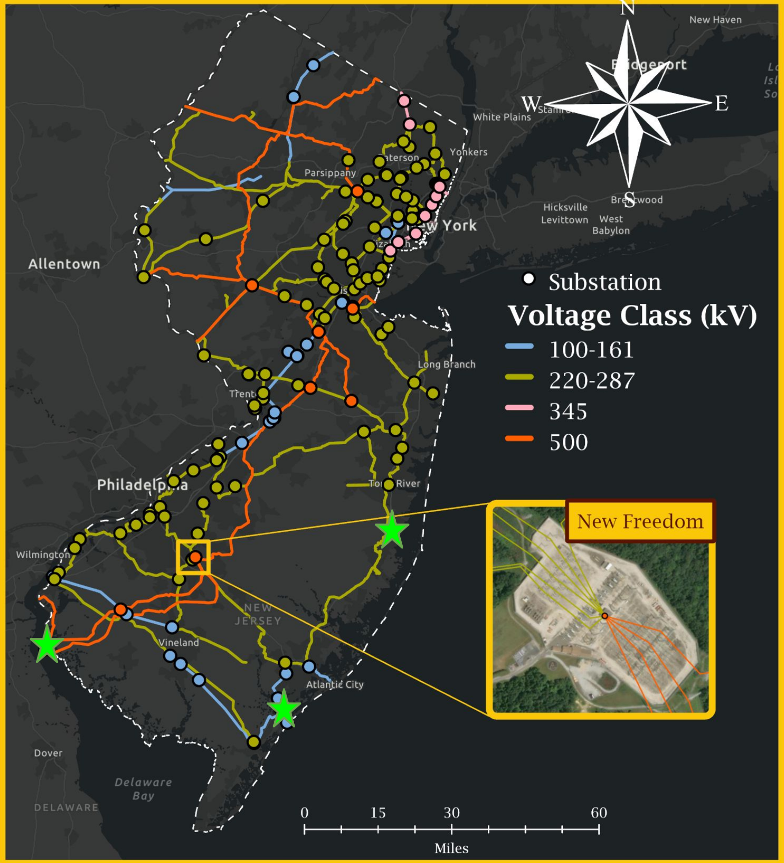
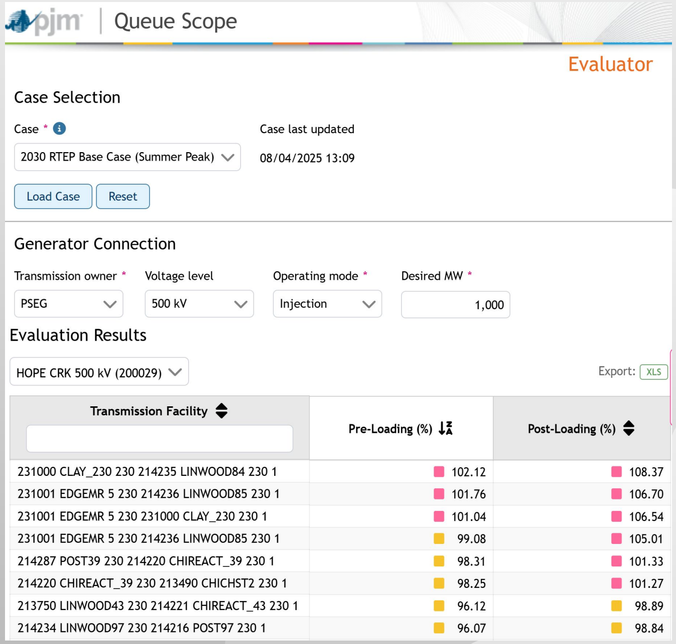


Grid Interconnection Screening Tools

PJM Queue Scope


pjm | Queue Scope

Evaluator

Case Selection

Case * | Case last updated
2030 RTEP Base Case (Summer Peak) | 08/04/2025 13:09

Load Case | Reset

Generator Connection

Transmission owner *: PSEG
Voltage level: 500 kV
Operating mode *: Injection
Desired MW *: 1,000

Evaluation Results

HOPE CRK 500 kV (200029)

Export: XLS

Transmission Facility	Pre-Loading (%)	Post-Loading (%)
231000 CLAY_230 230 214235 LINWOOD84 230 1	102.12	108.37
231001 EDGEMR 5 230 214236 LINWOOD85 230 1	101.76	106.70
231001 EDGEMR 5 230 231000 CLAY_230 230 1	101.04	106.54
231001 EDGEMR 5 230 214236 LINWOOD85 230 1	99.08	105.01
214287 POST39 230 214220 CHIREACT_39 230 1	98.31	101.33
214220 CHIREACT_39 230 213490 CHICHST2 230 1	98.25	101.27
213750 LINWOOD43 230 214221 CHIREACT_43 230 1	96.12	98.89
214234 LINWOOD97 230 214216 POST97 230 1	96.07	98.84

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03
Economics & Finance

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B.S., Accounting

Economic Research Goals

Costs

Construction and capital costs for nuclear power plant construction.

Employment

Employment and labor information for existing nuclear power plants.

Economic Impact

Is building a new nuclear generator in New Jersey economically and socially beneficial?

Data Collection

Plants Include: Millstone, Seabrook Station, Hope Creek, Salem, Peach Bottom, Limerick, Susquehanna, Calvert Cliffs, North Anna, Surrey, McGuire, Catawba, Vogtle, Turkey Point, and St. Lucie.

- **Federal filings with agencies:** NRC, SEC, FERC, and EIA.
- **National Laboratories and Research Institutes:** NREL Annual Technology Baseline, Breakthrough Institute.
- **Company-specific documentation and press releases.**
- **Regulatory and Licensing Records.**

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Research Limitations

- Plant-Specific financial data is often redacted in official documentation.
- Nuclear costs can be difficult to isolate on consumer bills.
- Utilities frequently pool nuclear expenses with other infrastructure investments.

Annual Economic Impact

Millstone Power Station, Connecticut
~4,000 total jobs supported annually
$1.5+ Billion in total annual economic activity

Capital & Construction Costs

Susquehanna Nuclear Power Plant
$7.98 Billion total historical building cost
~$3,800/kW overnight capital cost (2010 USD)

Residential Pricing

Seabrook Station
~21¢ to 25¢ per kWh total average retail rate
~$130 to $150 average monthly household bill

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Relevance for NJ

Plant-Specific Employment

Rooted Local Jobs: (Unionized, high-wage, and cannot be outsourced)
The Regional Multiplier Effect: (Drives local business and tax revenue)

Construction Costs & Timelines

Capital Cost Challenge: (High overnight capital costs remain a major hurdle)
Data-Driven Risk Modeling: (Modern baselines directly inform state financing models)

Local Resident Energy Cost Analysis

Price Protection Benefit: (Insulates residents from volatile natural gas spikes)
Rate Stability Premium: (Protects local bills from fossil fuel market volatility)

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Financial Research Goals

Costs

Construction and financing costs associated with nuclear power plant construction.

Financing Methods

Methods used to finance the construction of nuclear power plants.

Transferability

How costs and funding methods would apply in New Jersey.

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Total Construction and Capital Costs

Low: Millstone Unit 1, $92 mil ($280 mil in 2026)

High: Vogtle Unit 4, over $10 billion

Overnight Cost per kW ($/kW)

Low: Turkey Point Units 3 & 4: $565/kW (2010)

High: Hope Creek: $7,803/kW (2010)

Vogtle Units 3 & 4: $12,500/kW (2024)

Construction Timeline

Low: Surrey Unit 1, about 4 years (1972)

High: Seabrook Station, about 14 years (1986)

Vogtle Units 3 & 4: about 10 years (2023 & 2024)

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Financing Methods-OptionsApp	Applicable in NJ
Cost of service or ratepayer recovery methods ● Used by Vogtle Units 3 & 4 ○ Nuclear Construction Cost Recovery Tariff, 7.65 bil cap	**No**
Tax-Exempt Revenue Bonds/Municipal Finance ● Municipalities and states partnerships (eg. MMWEC)	Yes
Equity & Capital Markets	Yes
Loans	Yes
Loan Guarantees ● Energy Policy Act of 2005 ● $12 bil in Vogtle loan guarantees	Yes
Federal Grants, Tax Credits, and Subsidies	Yes

Key Challenges to Project Financing

- Long construction timelines
- Cost overruns
- Loan default risk
- Bankruptcy risk

04

Public Policy

Daniel Carrasco
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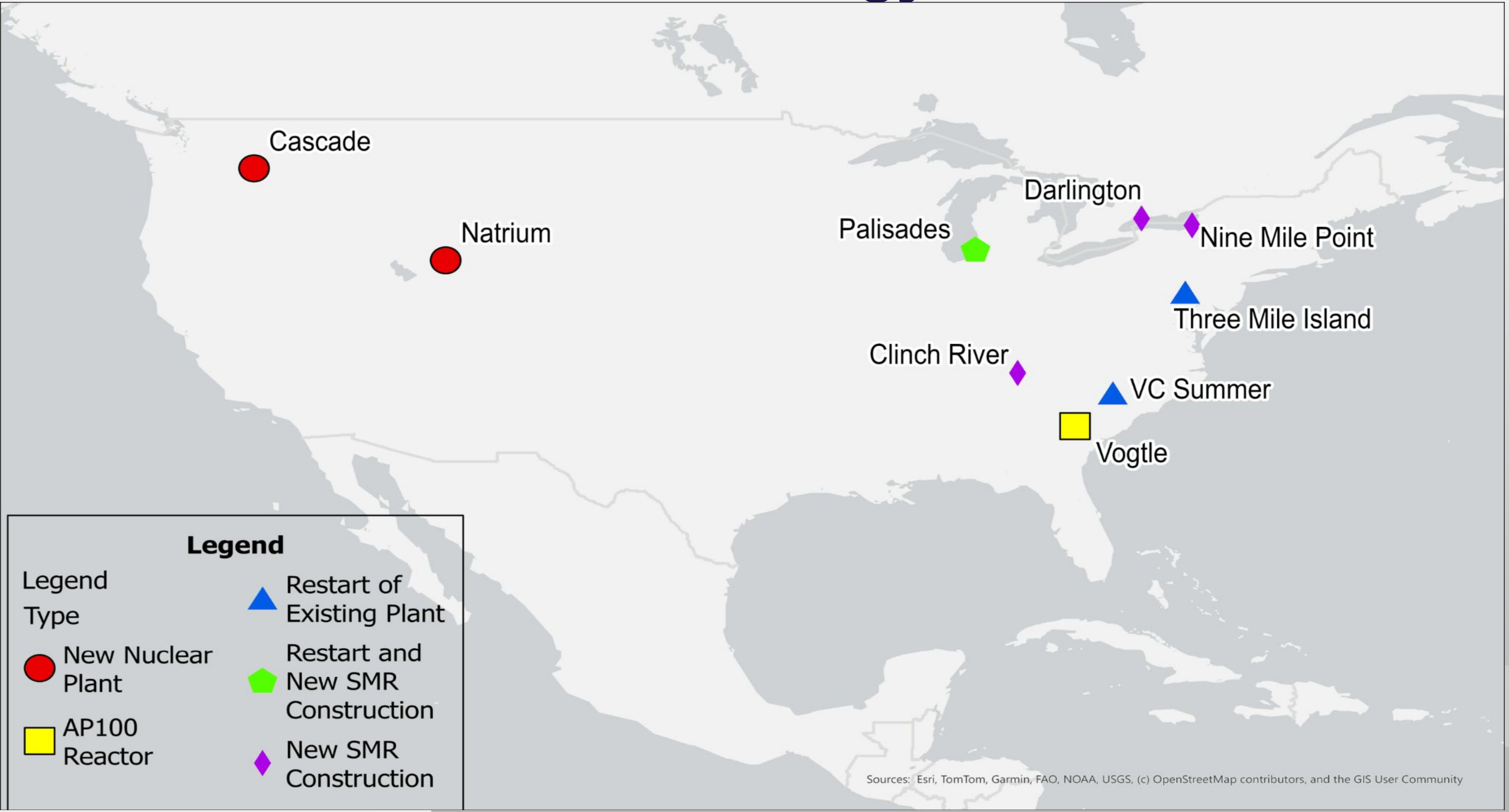
M.A., Public Policy

Nuclear Public Policy

- **Non New Jersey Plants Studied:** Palisades, Vogtle, Clinch River, Natrium, Nine Mile Point, VC Summer, Cascades, Three Mile Island, Darlington
- Nuclear expansion is accelerating across the United States and Canada.
- Non New Jersey states
- Federal, State Governments have committed to financial assistance:
  1. Department of Energy loans: Palisades($1.52 billion), Vogtle($12 billion), Three Mile Island$(1 billion).
  2. Department of Energy Generation III+ Small Modular Reactor Program Grant Award: Palisades($400 million), Clinch River($400 million), Nine Mile Point($17 million)
  3. State budget appropriations: Palisades($300 million), Clinch River($50 million)

Geographic Distribution of Selected North American Nuclear Energy Case Studies



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Thanks!

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