Grid Modernization Study: New Jersey Board of Public Utilities

Prepared for:

New Jersey Board of Public Utilities

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List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ACE	Atlantic City Electric
ADMS	Advanced Distribution Management System
AMI	Advanced Metering Infrastructure
ATO	Approval to Operate
CEC	California Energy Commission
CHP	Combined Heat and Power
CPUC	California Public Utilities Commission
DER	Distributed Energy Resource
DERMS	Distributed Energy Resources Management System
DRP	Distribution Resource Planning
DOE	Department of Energy
DOER	Massachusetts Department of Energy Resources
EDC	Electric Distribution Company
EMP	Energy Master Plan (2019 update)
EPIC	Electric Program Investment Charge (California)
EPRI	Electric Power Research Institute
FERC	Federal Energy Regulatory Commission
F&R	Finding / Recommendation
GWRA	Global Warming Response Act (2019 update)
HCA	Hosting Capacity Analysis
ICA	Integrated Capacity Analysis
IEEE	Institute of Electrical and Electronics Engineers
IEEE 1547	IEEE Standard for Interconnection and Interoperability of DERs with Associated Electric Power Systems Interfaces
IOU	Investor-Owned Utility
IREC	Interstate Renewable Energy Council
JCP&L	Jersey Central Power and Light
KPI	Key Performance Indicator
KW	Kilowatt
MW	Megawatt
MFR	Minimum Filing Requirement
MSSIA	Mid-Atlantic Solar and Storage Industry Association
NEETRAC	National Electric Energy Testing, Research & Applications Center
NEM	Net Energy Metering
NJ	New Jersey
NJ BPU	New Jersey Board of Public Utilities
ORU	Orange and Rockland Utilities
PJM	PJM Interconnection, LLC
PG&E	Pacific Gas and Electric
POI	Point of Interconnection
PPA	Power Purchase Agreement

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Acronym/Abbreviation	Definition
PSE&G	Public Service Electric and Gas
PTO	Permission to Operate
PV	Photovoltaic
RECO	Rockland Electric Company
Rule 21	Electric Rule 21 Interconnection Tariff (California)
SCADA	System Control and Data Acquisition
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SEIA	Solar Energy Industries Association
SGIP	FERC Small Generator Interconnection Procedures
SIS	System Impact Study
SLD	Single-Line Diagram
VAR	Volt-Amps Reactive
WG	Working Group

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Executive Summary

New Jersey (NJ) has embarked on an ambitious clean energy strategy to achieve 100% clean energy and to reduce state greenhouse gas emissions 80% below 2006 levels by 2050. The State's 2019 Energy Master Plan (EMP) outlines how to proceed in seven key areas. Grid Modernization focuses on activities related to Strategy 2: Accelerate Deployment of Renewable Energy and Distributed Energy Resources (DER). The strategy is focused on the development of offshore wind and in-state renewable energy resources, including community solar and zero-emission DERs. A grid modernization strategy underpins connecting the EMP's target for 7,500 megawatts (MW) of offshore wind, 17,000 MW of solar energy and 2,500 MW of energy storage by 2035, while paving the way for higher DER adoption levels to achieve the long range deeper decarbonized energy systems envisioned in the 2019 update to the Global Warming Response Act (GWRA). The NJ economy will benefit from increased local jobs, private sector investments, accelerated clean resource adoption and improved resilience. A modernized grid is part of a broader solution set that can enable other incentives and accelerators that support the state's ongoing work to realize a clean energy future.

It is generally accepted that in order to meet EMP goals, NJ will need to adapt current processes and strategically modernize the electric grid. Guidehouse was retained by the New Jersey Board of Public Utilities (NJ BPU) to assist staff in the grid modernization effort related to how NJ could increase renewable resource interconnection for DER. The effort followed a series of steps to assess areas for additional research and potential improvement.

Figure ES-1. Methodology Overview

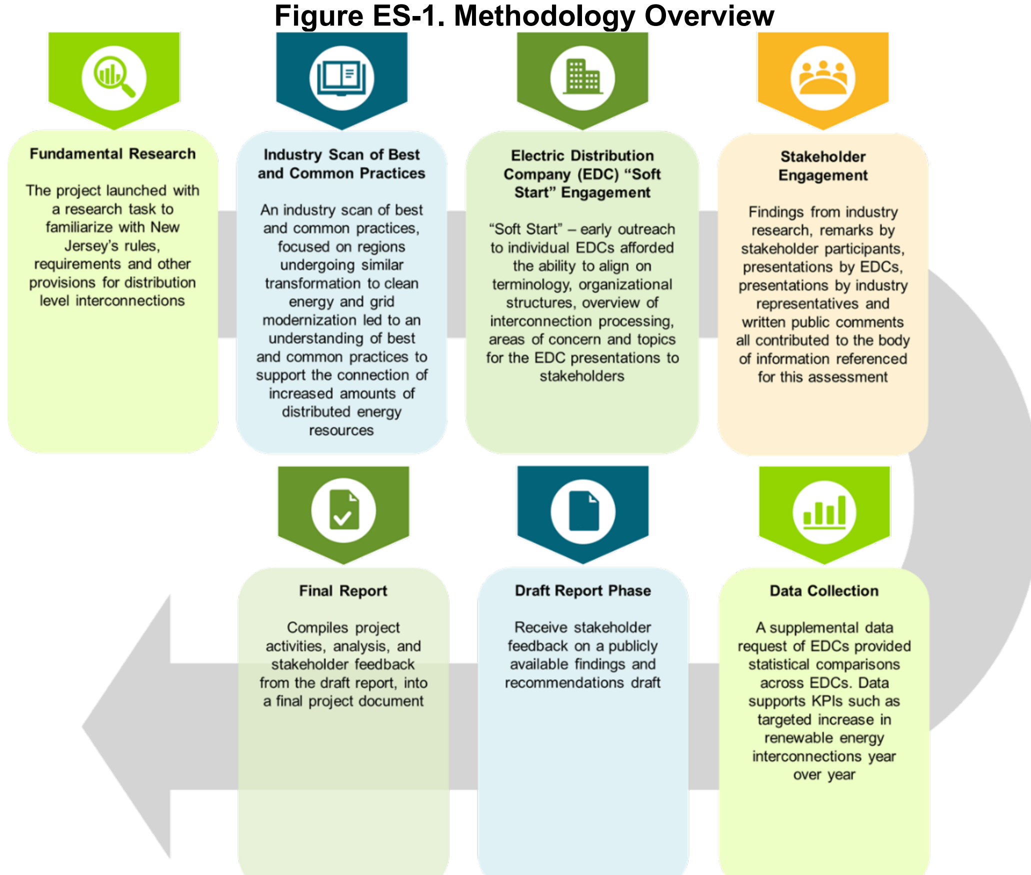

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Table 1-1 lists all nine primary findings of this study. The findings and recommendations are further detailed in Section 5 of this report. Key findings and recommendations include the following three:

Finding #1: N.J.A.C.14:8-5 currently references IEEE 1547-2003 however IEEE has released a 2018 version IEEE 1547-2018 and an amendment IEEE 1547a-2020.

There is no process in place to assure that NJ will remain aligned with the most recent standards on an ongoing basis, including IEEE 1547.

Recommendation #1:

a) NJ should adopt the latest version of IEEE 1547 as amended and supplemented for NJ (IEEE 1547-2018 / IEEE 1547a-2020) and establish a process to refresh the standards in alignment with industry practices.

b) NJ BPU should promptly update N.J.A.C.14:8-5 to indicate the latest version adopted in NJ is IEEE 1547-2018 / IEEE1547a-2020 as amended and supplemented.

c) NJ BPU should establish an annual review process to assure NJ will remain aligned with the most recent standards, including IEEE 1547, on an ongoing basis.

Finding #2: There are opportunities to streamline and automate the interconnection process. Applications are sent back to customers by EDCs due to missing or incorrect information,[1] which can cause delays. Interconnection application status and key information is tracked using a different process and different software for each EDC, particularly for Level 2 and Level 3 interconnection requests, including key milestones such as timelines, schedule and budget for upgrade commitments, and construction timelines. This makes it difficult for the NJ BPU to monitor interconnection process KPIs across EDCs. Additionally N.J.A.C.14:8-5.6 (Level 3) does not state required timelines for key milestones.

The EDCs do not collect fees for Level 1, yet a large percentage of applications are presently Level 1, with a projected increase of Level 1 applications in the future. For example, an increase in smaller (Level 1 <= 10 kW) interconnection applications is expected due to a projected increase in DER aggregation projects enabled by the adoption of FERC Order 2222.

[1] Public Stakeholder Meeting #3.1

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Recommendation #2:

Interconnection Application Software

a) EDCs that do not have an auditable electronic application tracking process shall set in place interconnection application software that will provide a structured approach for data intake and notifications for all interconnection Levels.

b) EDCs shall install or upgrade to a portal-based software application platform capable of tracking key information throughout the interconnection application process. Such a platform would, at a minimum, be easily customizable and capable of tracking and automating the permitting process, documenting generation type and capacity, timelines, schedule and budget for upgrade commitments, and construction timelines, as well as reporting out this information in an easily auditable format. In addition, the platform would be designed to share files and information securely and efficiently between the EDC and the customer, with effective audit capability for the NJ BPU.

c) The software shall be capable of generating automatic email and online notifications to the customer with the goal of enforcing clearly defined tariff timelines, reducing the turnaround time for missing data. The software should be designed to improve the accuracy and consistency of data entry and facilitate cross-department intake of application information. The NJ BPU should establish a working group to balance the need for transparency and access by a broad set of stakeholders while maintaining the privacy of customer data, and security of other sensitive data pertaining to the electric grid.

d) NJ BPU to require EDCs to collect and store electronically KPIs such as number of applications with missing data, applications with complete information, and achieved timelines for all interconnection applications at all interconnection Levels. This information already exists within interconnection applications, however, it is not easily accessible in a usable format to stakeholders or NJ BPU.

e) NJ BPU to compare KPIs relative to N.J.A.C. 14:8-5 timelines and require EDCs to implement application process improvements within a specified timeframe as necessary to reduce discrepancies between N.J.A.C. 14:8-5 and EDC actual interconnection application timelines.

f) NJ BPU to direct the working group to consider specifying milestones and associated maximum timelines for Level 3 projects.

g) EDCs to make an FAQ webpage to provide guidance useful to interconnection customers engaging in the interconnection process.

h) The EDCs shall develop an interconnection dispute resolution process for NJ BPU review and approval, to be included on the EDC FAQ webpages. As part of a dispute resolution process the EDCs should identify an ombudsman to handle customer interconnection complaints.

Application Fees

i) The NJ BPU should set a range for Level 1 application fees for utilities that use Level 1 fees informed by the state comparisons in Section 4of this report. NJ BPU should consider adopting the Level 1 application fees as recommended in IREC's Model Interconnection Procedures.[2]

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Finding #3:

Existing online EDC hosting capacity maps, including data update schedule and underlying approach to calculating interconnection and integration capacity headroom, reveals inconsistencies across EDCs.[3]

Hosting capacity information is inconsistently labeled across EDCs resulting in the quantity of closed circuits potentially being overestimated by stakeholders[4]

Recommendation #3:

a) The NJ BPU should convene a working group, including the EDCs, to determine and enhancing hosting capacity methodology, consistency, and hosting capacity map data granularity and update schedule. The first task of the working group should be to identify inconsistencies across EDC hosting capacity methodologies and subsequently direct the EDCs to implement consistent approaches. The working group shall consider items such as the following in identifying improvements to the methodology:[5] [6]

   a. Update EDC business process manuals to require uniform data content, granularity, and refresh frequency for capacity map tools according to industry standard methods

   b. Assess potential security issues associated with posting sensitive information, and consider implementing a sign-in procedure to access the capacity maps

   c. Update capacity maps at least yearly, or when change in generation on a feeder exceeds an EDC-specified amount, or when the aggregate change in load exceeds an EDC-specified amount

   d. EDCs to clearly label their maps with detailed legends explaining what the data means, and consider developing a shared lexicon to label their maps

   e. Require identification of potentially limiting equipment requiring a system upgrade on the hosting capacity maps (e.g., voltage controllers, protective relays, communication systems, conductor ampacity, etc.)

   f. NJ BPU to specify, and EDCs to provide, a uniform unit cost guide for system upgrades that includes a range of costs based on current pricing information. The information would be clearly labeled with the limitations of use and non-binding nature of the cost guides which are high-level estimates for

[2]IREC, https://irecusa.org/resources/irec-model-interconnection-procedures-2019/

[3] Some EDCs calculate a theoretical maximum available capacity based on assumed feeder loading whereas others calculate a range of capacities based on actual loads and point of interconnection

[4] Public Stakeholder Meeting #3.2

[5] IREC, NREL, April 2022. Nagarajan, A., Zakai, Y. Data Validation for Hosting Capacity Analyses irecusa.org/wp-content/uploads/2022/04/Data-Validation-for-Hosting-Capacity-Analysis-Final.pdf

[6] IREC, Key Decisions for Hosting Capacity Analyses, September 2021, p.8: irecusa.org/wp-content/uploads/2021/10/IREC-Key-Decisions-for-HCA.pdf

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information only. As the range of cost would be based on high-level estimates (e.g., +/- 25%), developers/customers would still need to consult with the EDCs regarding more precise cost estimates for system upgrades based on detailed engineering studies.

g. If project applications are abandoned based on system upgrade cost, cause data should be captured at the time the customer exits the application

Table 1-1. Study Findings

Finding and Recommendation (F&R)	Finding Summary
F&R #1	N.J.A.C.14:8-5 IEEE 1547 reference is out of date
F&R #2	There are opportunities to streamline the interconnection process
F&R #3	Existing online EDC hosting capacity maps are inconsistent across EDCs
F&R #4	There is no way to accelerate interconnection projects within the NJ interconnection rules
F&R #5	NJ does not have an interconnection tariff and EDCs do not have EDC-specific business process manuals or handbooks to enact the existing rules
F&R #6	The application queueing and cost allocation process in NJ is serial
F&R #7	Alternative cost allocation and cost recovery options for accelerated interconnection of renewables have not been evaluated in NJ
F&R #8	EDCs do not currently submit integrated DER plans as recommended in the EMP
F&R #9	There is no mechanism for renewable resources co-located with non-renewable resources to receive full credit for their renewable generation under the NEM program

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1. Background, Project Purpose, and Approach

The NJ power grid was well designed to meet the needs of a prior paradigm where the output of large energy centers (power plants) was delivered to load centers. Today's energy portfolio includes more DER. Further, NJ is modifying its approach to include lower or net zero carbon emissions as it prepares for future electrification. Renewable resources have a different output pattern around which other production and consumption deployment must adapt, including emerging technologies such as energy storage. The grid itself is impacted by an increasing frequency of severe weather events. Correspondingly, efforts are being made to expand the reliability reinforcements to include grid resilience. A modern delivery system that is efficient and flexible serves NJ customers with clean, affordable, and reliable energy.

The NJ BPU is at the vanguard of thought leadership for the planning and implementation of rulemakings and programs to achieve the NJ EMP goal of 100% clean energy by 2050[7] and the GWRA[8] goal to reduce state greenhouse gas emissions 80% below 2006 levels by 2050. The EMP outlines a seven-strategy approach that lays the path to meet these challenges. The NJ BPU, in partnership with other agencies, is ensuring that NJ generates, uses, and manages its energy in ways that are consistent with economic, climate, and societal demands to realize EMP goals. NJ BPU's mission is to provide a safe, reliable, resilient, and affordable energy system for all NJ residents and businesses.

1.1 Energy Master Plan

The origin of this work is to meet the ambitious goals in the NJ EMP to achieve 100% clean energy by 2050. The NJ BPU seeks to "[build] a traceability framework for implementation recommendations to be derived, prioritized, and deployed."[9]

The current grid modernization work aligns with the following sections of the EMP, listed in order of highest relevance to this report. The intent of this work is to create actionable objectives for regulators and legislators, distribution and transmission system operators, and other stakeholders to bring the EMP goals within reach. Meeting the goals in the EMP requires collaboration of stakeholders and entities beyond those involved in producing this report.

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[7] 2019 New Jersey Energy Master Plan (EMP), Pathway to 2050, nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf

[8] New Jersey's Global Warming Response Act 80x50 Report, nj.gov/dep/climatechange/docs/nj-gwra-80x50-report-2020.pdf

[9] Correspondence from NJ BPU staff to Guidehouse, February 8, 2022.

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1.1.1 EMP Strategy #2 Accelerate Deployment of Renewable Energy and DER

The following EMP Strategy #2 goals are central to NJ interconnection reforms.

Near-Term Goals

ST2.1.5 Update interconnection processes to address increasing distributed energy resources and electric vehicle charging

ST2.3 Maximize local (on-site or remotely-sited) solar development and distributed energy resources by 2050.

Long-Term Goals

ST2.1.1 Meet the 50% Renewable Portfolio Standard by 2030 and explore possible regulatory structures to enable New Jersey to transition to 100% clean energy by 2050

ST2.1.6 Develop mechanisms to compensate distributed energy resources for their full value stack at the regional and federal level.

ST2.3.6 Develop mechanisms for achieving 600 MW of energy storage by 2021 and 2,000 MW of energy storage by 2030.

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1.1.2 EMP Strategy #5 Decarbonize and Modernize NJ Energy System

The following EMP Strategy #5 goals are central to NJ grid modernization.

Near-Term Goals

ST5.1 Plan for and implement the necessary distribution system upgrades to handle increased electrification and integration of distributed energy resources

ST5.1.1 Require utilities to establish Integrated Distribution Plans to expand and enhance the location and amount of distributed energy resources and electric vehicle charging on the electric distribution system

ST5.1.3 Assess integration of Volt/Var Control.

ST5.1.4 Instruct utilities to propose and adopt non-wires solutions

Long-Term Goals

ST5.1.2 Support bidirectional grid power flow and modernize interconnection standards.

The intersection of Grid Modernization with Electric Transportation, for example, falls within the categorization of the electric vehicle (EV) charging equipment as a form of DER as part of a broader trend toward electrification of sectors that currently consume non-renewable energy. Deploying these devices to the distribution grid through a modern hybrid DER system allows for intelligent optimization and coordination of recharging and discharging of vehicle batteries through intelligent automated control signals. Through the same system, the batteries may provide grid support in the future. The rise of DER aggregation requires preparation for the impacts and opportunities of EV aggregation touching the interconnection and integration process that drives grid modernization.

1.2 New Jersey Administrative Code (N.J.A.C.)

The N.J.A.C. is the official publication of the Office of Administrative Law, which contains all effective regulations adopted by state agencies. Title 14[10] pertains to the regulations that public

[10] N.J.A.C. Title 14, casetext website, casetext.com/regulation/new-jersey-administrative-code/title-14-public-utilities, referenced 2/13/2022

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utilities follow; Chapter 8 "Renewable Energy and Energy Efficiency"[11] contains the regulations for interconnecting generation to an EDC and Subchapter 5 "Interconnection of Class I Renewable Energy Systems"[12] provides the guidelines for the different interconnection processes. References in this document to "N.J.A.C.14:8-5" refer to Title 14, Chapter 8, Subchapter 5.

N.J.A.C.14:8-5 generally follows the FERC Small Generator Interconnection Process (SGIP) which is common for many states' interconnection processes. FERC did not provide prescriptive direction on some of the processes and the processes currently in place are outmoded for newer technologies such as energy storage or hybrid DER, especially in microgrid configurations.

N.J.A.C.14:8-5 is not a tariff. By contrast, California's Rule 21 Tariff provides in-depth process guidance, took 10 years to develop, and is under continuous refinement. Moreover, Net Energy Metering (NEM) policies can impact the interconnection process.

1.3 Study Purpose and Approach

The purpose of this Guidehouse study is to help NJ BPU reach their stated objectives focused on:

> *"[R]emoving barriers to, and improving the effectiveness of the interconnection process for DER adoption and integration with the electric distribution system"*[13]

and

> *"[C]lassify[ing] the specific topical elements of the grid modernization plan, which is focusing on tactical implementation of identified areas for improvement, specifically on the near-term grid interconnection related processes."*[14]

The study activities are designed to establish a baseline assessment for existing NJ resource interconnection processes, gather stakeholder feedback, and set a course for ongoing improvements to interconnection processes. The assessment guides NJ BPU in future rulemakings, tariffs, and legislation for NJ to achieve their EMP and GWRA goals. Grid modernization improvements reach beyond the narrow scope of interconnection reforms. This report provides information that can be leveraged for subsequent phases of the ongoing NJ BPU Grid Modernization program.

This Guidehouse study reviews the generator interconnection processes for the franchise service territories of the four investor-owned electric utilities (IOUs), the EDCs, Atlantic City Electric (ACE), Jersey Central Power and Light (JCP&L), Public Service Electric and Gas

[11] N.J.A.C. Title 14, Chapter 8, casetext website, casetext.com/regulation/new-jersey-administrative-code/title-14-public-utilities/chapter-8-renewable-energy-and-energy-efficiency, referenced 2/13/2022

[12] N.J.A.C. Title 14, Chapter 8, Subchapter 5, case text website, casetext.com/regulation/new-jersey-administrative-code/title-14-public-utilities/chapter-8-renewable-energy-and-energy-efficiency/subchapter-5-interconnection-of-class-i-renewable-energy-systems, referenced 2/13/2022

[13] NJ BPU staff

[14] NJ BPU staff

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(PSE&G), and Rockland Electric Company (RECO). Actions key to accelerating the pace of renewable energy interconnections to further state clean energy goals are:

1. Identifying gaps in the interconnection approval process for generators and other resources, reforming governing rules where practical, and deploying advanced technologies relative to industry best practices as identified by participating stakeholders.
2. Creating a roadmap that unifies and automates the underlying processes and tightly couples with formal EDC Integrated Resource Plans. The roadmap includes accommodations for participation in PJM Interconnection, LLC's (PJM) organized wholesale market for resources at or above 100 kilowatts (kW), as required under FERC Order 2222. Order 2222 compliance is presently under development by PJM and its stakeholders.

This Guidehouse study focuses primarily on item (1) above, including:

- The interconnection approval process for generators and other resources
- Governing rules reforms where practical
- Deployment of advanced technologies relative to industry best practices, and as identified by participating stakeholders

To develop findings and recommendations, Guidehouse study activities included:

- Review of N.J.A.C.14:8-5
- A stakeholder engagement process, including input from the four EDCs and non-EDC entities such as trade organizations, developers, technology providers, aggregators, and manufacturers
    - This collaborative exchange clarified EDC processes and their current performance, identified industry concerns, revealed consensus on key issues that could deliver substantial near-term rules improvement, and suggested additional scopes of work for future policy alignment and NJ BPU resolution, if necessary
- A public comment process, documenting, organizing, and analyzing stakeholder input, developing responses to select comments, and incorporating the information into the project
- Selective comparison of the NJ baseline to other state programs and other relevant technology/process initiatives

The results of Guidehouse's study, presented in this report, provide qualitative and quantitative assessments related to the State's **EMP Strategy 2: Accelerate Deployment of Renewable Energy and DER** and **EMP Strategy 5: Decarbonize and Modernize NJ Energy System**. This document is designed to inform policymaking and identify areas for further study.

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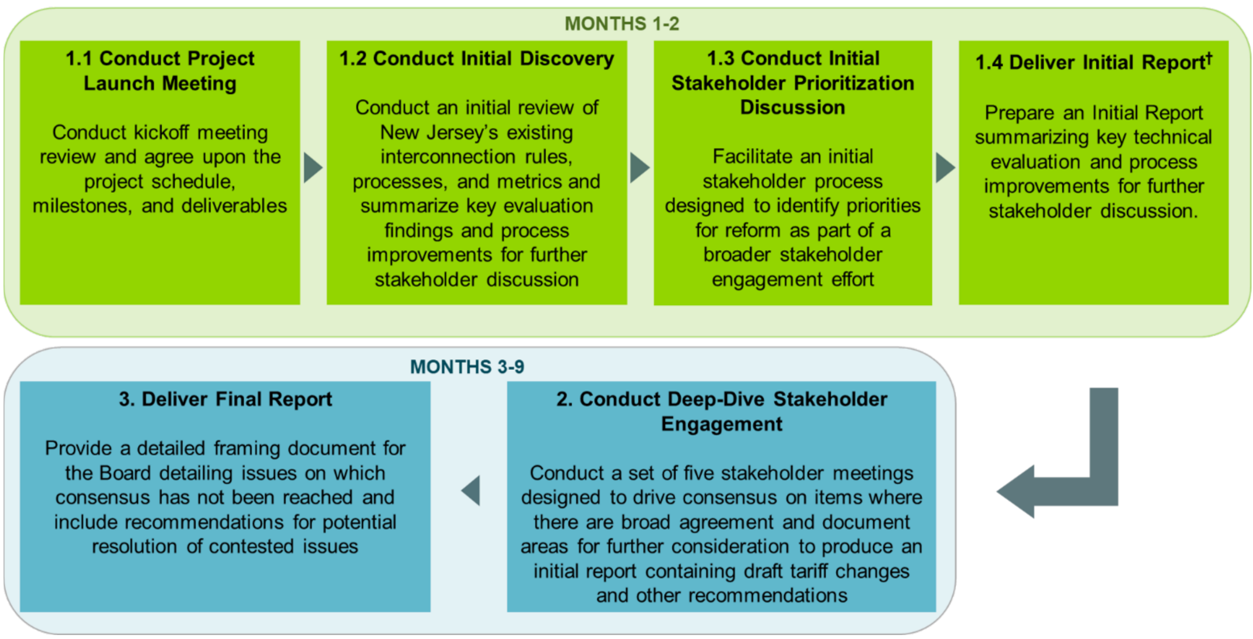
2. Study Methodology

This section describes the methodology used for data collection and analysis.

The Guidehouse study process is designed to identify NJ-specific concerns related to interconnecting renewables and DER to the distribution system. Concerns were categorized into those with relatively straightforward solutions and the more complex issues for further analysis and policy development. The overall effort involved researching the NJ interconnection environment, benchmarking and data gathering, stakeholder engagement, identifying best and common industry practices, developing recommendations for immediate implementation of straightforward solutions identified, and developing critical path scopes for additional study.

Figure 2-1. Study Timeline



† The content summarizing key technical evaluation and process improvements was presented by Guidehouse at the first two public stakeholder meetings

Source: *Guidehouse*

2.1 Soft Start Interviews

Initial interviews with the EDCs allowed Guidehouse to contextualize initial research from the different interconnection tracks and phases, milestones, and administrative steps of the interconnection process. An important benefit to this approach was establishing an early productive dialog that helped align common understandings and mitigate possible contention between stakeholders.

2.2 Data Requests

There were two primary data requests. These requests were carefully structured to begin a longer-term alignment process between EDCs in terms of data collected and presentation format. The first data request to the EDCs was populated into a standardized presentation template. The information was primarily qualitative, with some general characterization

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information for each EDC, such as quantity of customers served and MW of solar installed in 2021. Since the EDCs did not have access to all 2021 information in time for their January 2022 presentations, Guidehouse conducted a follow up data request after the EDC stakeholder presentations, with the intention of including these findings in the Final Report.

2.2.1 EDC Data Requests

Both data requests to the EDCs had the goal of documenting the 2021 baseline interconnection landscape in terms of the following:

- Application processes and fees, including current levels of automation
- Current hosting capacity interconnection tools and presentation methods
- Engineering study and circuit upgrade identification
- Related business processes, including fee collection, study process for recommended upgrades, and cost allocation
- Incremental nameplate capacity of interconnected renewables and energy storage added in 2021

The EDC stakeholder session was designed to capture DER interconnection process descriptions that are common to each EDC and make them available in a consistent comparative manner. The focus was narrow by design and served to clearly bound the relevant issues that govern all DER interconnection across the state.

2.2.2 Non-EDC Data Request

As part of the stakeholder outreach for this study, the NJ BPU solicited and coordinated a panel of non-EDC presentations to ensure representation of all stakeholders. Unlike the topically structured EDC session, this stakeholder panel session showcased formal presentations to highlight the multi-faceted dimensions and potential disruptions from emerging technologies, innovative business models, DER enabled grid reliability and power quality services, and barriers that could inhibit faster adoption.

2.3 Guidehouse and NJ BPU-Hosted Stakeholder Meeting Workshops

The project team facilitated five stakeholder workshops prior to preparing this draft report, reflected in Table 2-1.[15] The sessions were designed to form consensus among participants, leading to support for the ultimate rules revisions that will codify the interconnection reform. The conversation was initiated through a "context setting" meeting that provided basic background and research as a readout to stakeholders. The second "listening session" meeting provided time for stakeholders to share their experiences and suggest ideas for improvement. The third meeting enabled EDCs to share their current baseline interconnection methods and procedures and present their vision for future plans to help NJ achieve the EMP goals. The fourth meeting enabled non-EDC stakeholders with industry experience and technical knowledge to present on

[15] njcleanenergy.com/gridmod

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key aspects of the interconnection process as users of the process. The fifth meeting was to gain stakeholder feedback on preliminary findings and recommendations.

Table 2-1. Stakeholder Public Meetings

Date	Meeting Description
Oct 26, 2021	**Stakeholder Meeting #1** **Grid Modernization Overview** This meeting presented an overview of the project, research findings and best practices of interconnection rules by state, applicable regulations, and relevant processes governing the grid interconnection application, review, and approval workflows. Information about the process, including submittal of stakeholder comments through a dedicated link, was presented.
Nov 16, 2021	**Stakeholder Meeting #2** **Stakeholder Data/Comment Ingestion** This meeting facilitated direct feedback from a broad range of stakeholders on their experiences with interconnection processes, ideas for improvement and innovation, success stories, and other relevant input.
Jan 14, 2022	**Stakeholder Meeting #3.1** **EDC Readout - Collaborative Alignment** This meeting opened with presentations from the EDCs, summarizing their current baseline processes, historical data from preset research questions. PJM provided a progress update on their Order 2222 compliance plans. A structured conversation on priority topics included issues raised in previous stakeholder sessions, followed by facilitated discussions.
Jan 28, 2022	**Stakeholder Meeting #3.2** **Non-EDC Readout - Collaborative Alignment** This meeting provided a structured opportunity for non-EDCs to present and discuss topics that covered technical, financial, and procedural issues regarding the grid interconnection process. Non-EDC stakeholders represented a diverse portfolio of project sizes, technologies, and organization types. This was followed by a facilitated discussion across opinions, constituencies, and business models.
June 27, 2022	**Stakeholder Meeting #4** **Draft Report Review and Comments** This meeting covered the Draft Report findings and recommendations and was designed to solicit comments prior to the Final Report production.

Source: *Guidehouse*

2.3.1 Website

Guidehouse worked with NJ BPU website developers to create a webpage on the NJ Clean Energy website.[16] The page hosts stakeholder meeting presentation materials including video and presentation decks, associated public notices, and a public comments section for the formal docket.[17]

[16] NJ Clean Energy Grid Modernization website, njcleanenergy.com/gridmod
[17] Docket No. QO21010085

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2.3.2 Stakeholder Comments

All written comments on this docket (Docket No. QO21010085) were directed to be received on or before 5:00 p.m. EDT on July 19, 2022. Guidehouse prompted and gathered stakeholder comments through the following means:

- Public Comments submitted through the NJ Clean Energy proceedings website: publicaccess.bpu.state.nj.us/CaseSummary.aspx?case_id=2109704
- Emails sent to Guidehouse and NJ BPU for program development
- Webinar questions and chat during stakeholder public meetings
- Stakeholder comments during stakeholder public meetings
- Integrated polls conducted as part of the stakeholder public meetings

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3. Guidehouse Findings

This section features Guidehouse's qualitative findings through conversational interviews with EDCs and other stakeholders, and quantitative findings based on available 2021 data gathered from the EDCs. The research team received data for a varying number of the requested fields from each utility. Information from the EDCs was self-reported.

The findings include a summary of key findings, as curated by Guidehouse, based on the stakeholder engagement to date, as well as a summary of recommended areas for future study.

This section is comprised of the following key areas pertaining to resource interconnection in NJ and the future planning and research needed to realize the EMP goal of 100% clean energy by 2050:

- COVID-19 Impact Statement by EDCs
- N.J.A.C.14:8-5 Review
- Interconnection Application Process
- Circuit Capacity
- Cost and Schedule Impacts from Studies
- Distribution System Upgrade Cost Estimation and Allocation
- Interconnection Code, Standards and Certification
- PJM
- Emerging Essential Grid Modernization Topics

Section 4 of this report, Best and Common Practices, follows the same format as Section 3, Guidehouse Findings, and contains the results of best practices based on an industry scan, national experience with generator and other resource interconnection tariffs, and interconnection tariff reforms including Rule 21 in California, Hawaii Public Utilities Commission, Duke Energy, New York Public Service Commission and NY REV, Virginia Administrative code, and others.

Section 5, Targeted Findings and Recommendations for New Jersey, then provides recommendations based on the research in Guidehouse Sections 3 and 4.

The following sections provide a summary of findings consolidated by Guidehouse from our research and the stakeholder meetings.

3.1 COVID-19 Impact Statement by EDCs

During Stakeholder Meeting #3.1, the EDCs presented on the impact of COVID-19 on their operations. Key findings and reports from the EDCs include the following:

> **ACE –** ACE stated that the COVID-19 pandemic has introduced additional complexities which have had limited impact on their workplan. Due to the challenges of COVID-19, supply issues, and chip shortages, the company has seen cabinet and radio delays associated with telemetry, however these issues did not materially impact the workplan.

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In addition, ACE has had customers seek extensions and ACE has generally accommodated the requests where feasible.

JCP&L – JCP&L reported that early in the COVID-19 pandemic they experienced some minor issues with inability to access indoor meters. However, the pandemic has had little to no impact on DER application workflow as JCP&L employees directly involved with receiving, reviewing, and approving DER applications began mobile and working-from-home arrangements in March 2020. Furthermore, JCP&L has had no significant issues with overall workflow and supply chain to date.

PSE&G – Regarding supply chain, PSE&G has experienced issues with real-time metering for larger projects; however, they stated that successful mitigation actions resulted in no project delays. In addition, PSE&G reported that employee availability due to COVID-19 in 2021 caused challenges with timelines approximately 10% of the time. Remote work during the pandemic has not impacted the ability to process interconnection requests.

RECO – RECO reported that their team transitioned to remote work and has continued to meet deadlines, respond to customer inquiries, and issue permission to operate (PTO) for projects. Furthermore, RECO noted that they have not experienced supply chain issues.

3.2 N.J.A.C.14:8-5 Review

N.J.A.C.14:8-5 specifies three interconnection levels, as shown in Table 3-1. Guidehouse reviewed N.J.A.C.14:8-5 timeline and fee requirements for generator interconnection applications with key takeaways as shown in sections below.

Table 3-1. N.J.A.C.14:8-5 Interconnection Level Definitions

Request Level	
Level 1	A request to interconnect a generating facility which is inverter-based and no larger than 10 kilowatts (kW) shall be evaluated under the Level 1 process.
Level 2	A request to interconnect a generating facility no larger than 2 MW and not qualifying for the Level 1 process shall be evaluated under the Level 2 process.
Level 3	A request to interconnect a generating facility not qualifying for the Level 1 process or Level 2 process, shall be evaluated under the Level 3 process.

Source: *Guidehouse summary of content from N.J.A.C.14:8-5*

3.2.1 N.J.A.C.14:8-5 Application Timeline

Figure 3-1 and Figure 3-2 shows the key Level 1 interconnection timeline requirements in N.J.A.C.14:8-5. The timelines for key milestones for interconnection applications (e.g., obtaining construction approvals) are substantially customer-driven at all interconnection levels as described above. Level 3 timelines are not specified for any part of the Level 3 process.

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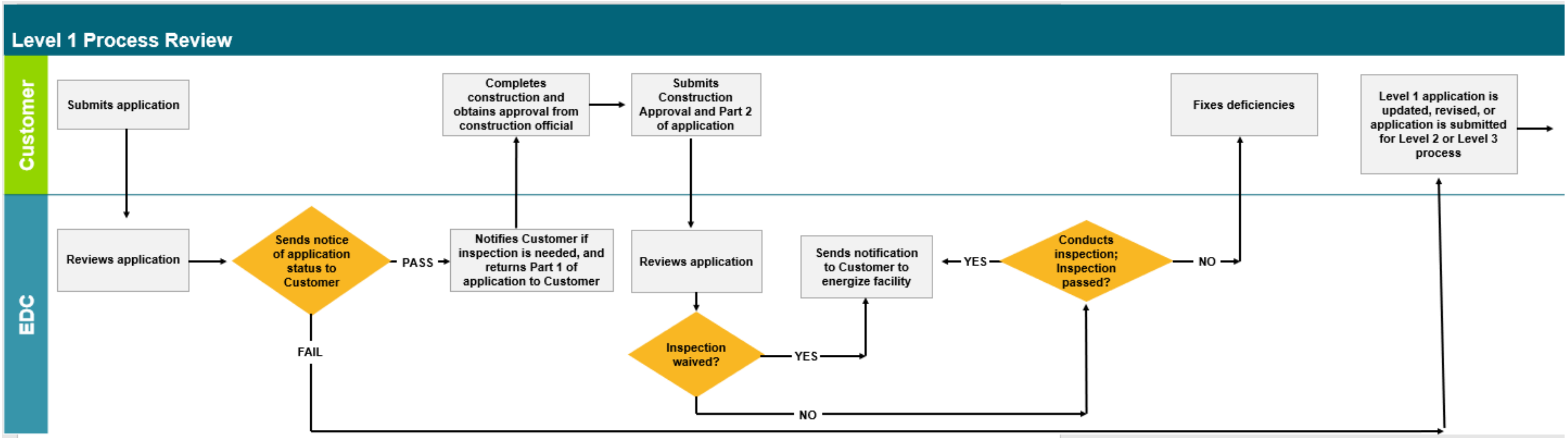
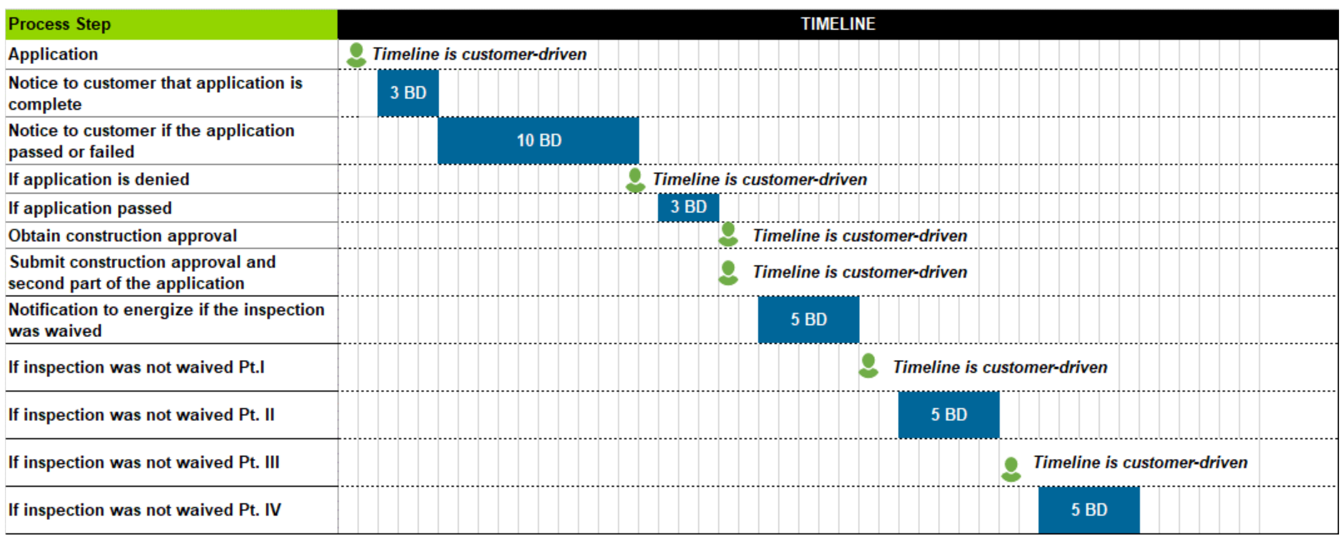
Figure 3-1. List of Key N.J.A.C.14:8-5 Requirements—Level 1 Process



***Source:** Guidehouse visualization of N.J.A.C.14:8-5 content*

Figure 3-2. List of Key N.J.A.C.14:8-5 Requirements—Level 1, Timeline View



***Source:** Guidehouse visualization of N.J.A.C.14:8-5 content*

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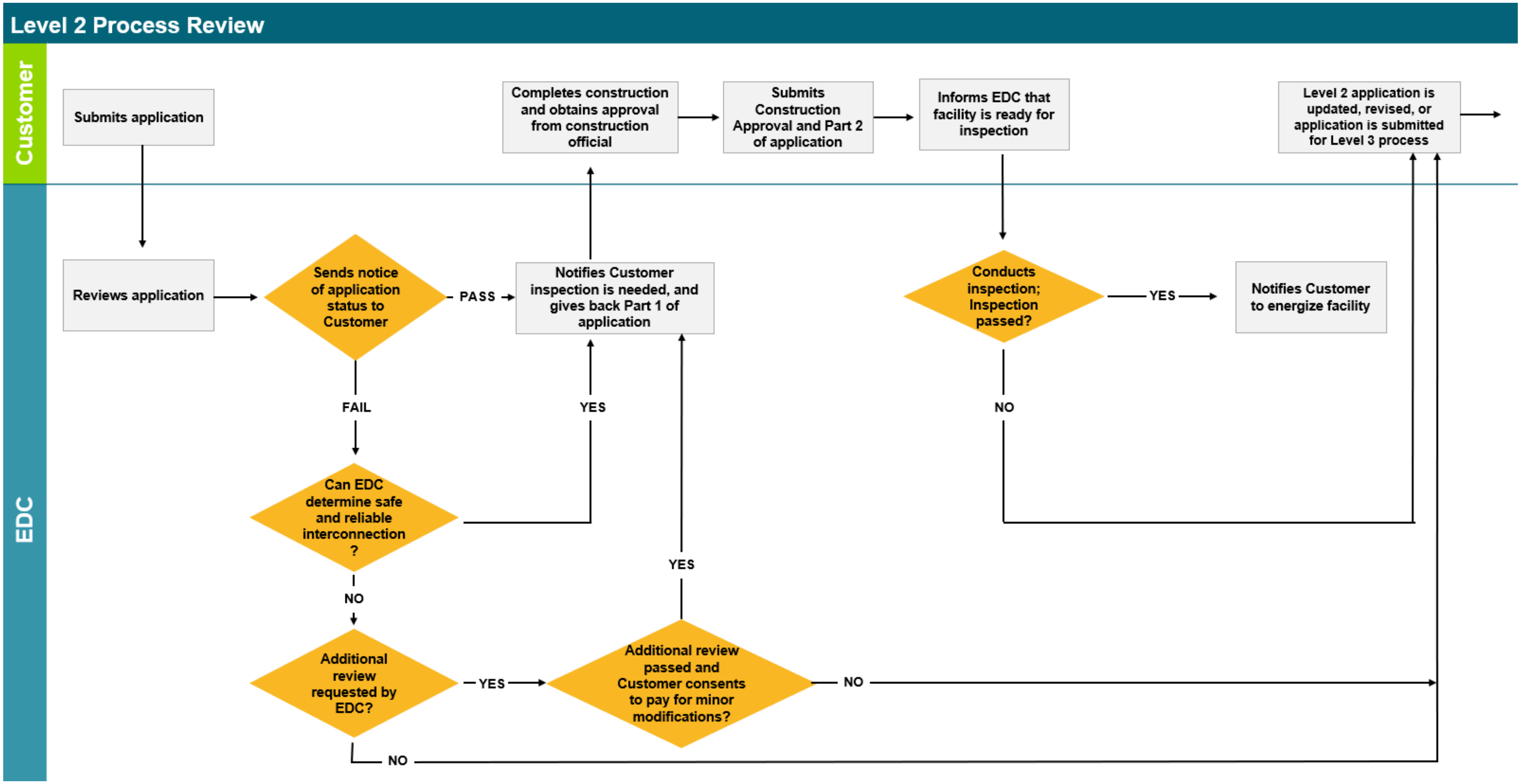
Figure 3-3. List of Key N.J.A.C.14:8-5 Requirements—Level 2 Process



Source: *Guidehouse visualization of N.J.A.C.14:8-5 content*

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Figure 3-4. List of Key N.J.A.C.14:8-5 Requirements—Level 2, Timeline View

Process Step	TIMELINE
Application	*Timeline is customer-driven*
Notice to customer that application is complete	3 BD
Notice to customer if the application passed or failed Pt. I	15 BD
Notice to customer if the application passed or failed Pt. II	3 BD
Notice to customer if the application passed or failed Pt. III	5 BD
Notice to customer if the application passed or failed Pt. IV	3 BD
Notice to customer if the application passed or failed Pt. V	3 BD
Notice to Customer that Application is Complete	*Timeline is customer-driven*
If a Generator Inspection is Needed Pt. I	*Timeline Unspecified*
If a Generator Inspection is Needed Pt. II	*Timeline is customer-driven*
If a Generator Inspection is Needed Pt. III	5 BD
If a Generator Inspection is Needed Pt. IV	*Timeline Unspecified*
If a Generator Inspection is Needed Pt. V	*Timeline is customer-driven*
If a Generator Inspection is Needed Pt. VI	*Timeline is customer-driven*
If a Generator Inspection is Needed Pt. VII	*Timeline is customer-driven*
If Application is Denied	*Timeline is customer-driven*

Source: *Guidehouse visualization of N.J.A.C.14:8-5 content*

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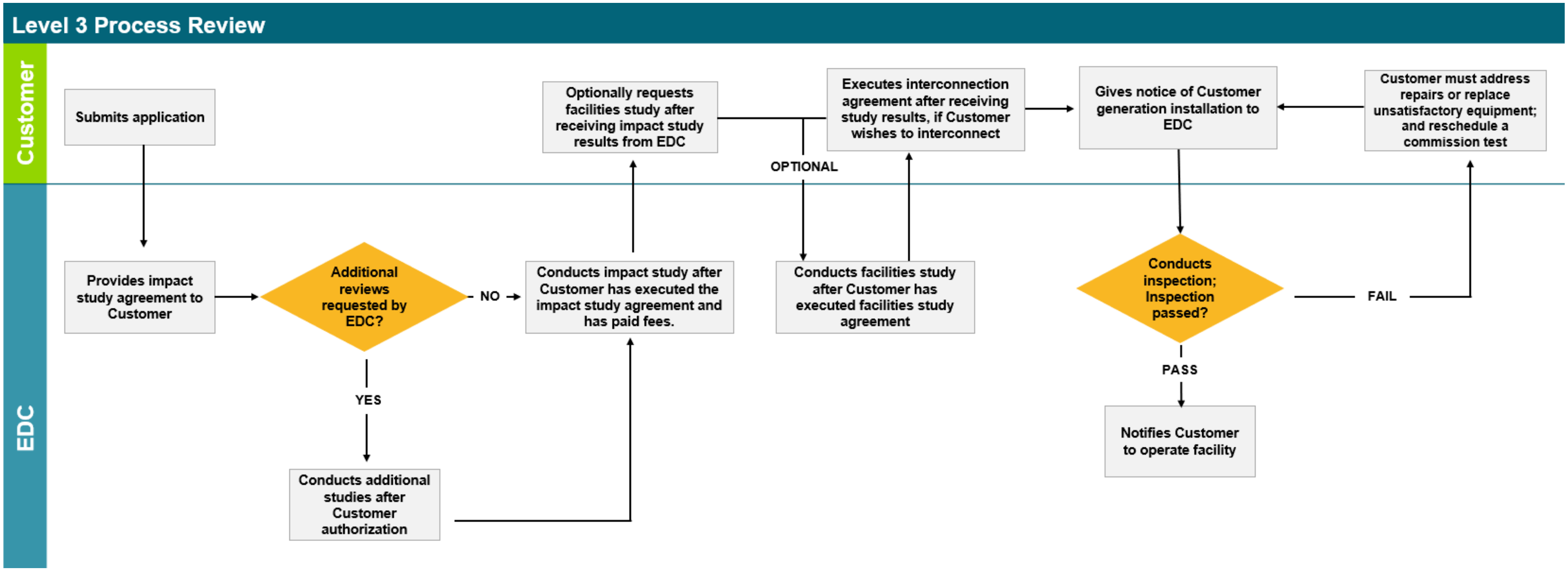
Figure 3-5. List of Key N.J.A.C.14:8-5 Requirements—Level 3 Process



Source: *Guidehouse visualization of N.J.A.C.14:8-5 content*

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3.2.2 N.J.A.C.14:8-5 Application Fee Structure

Figure 3-6 shows the interconnection fee structure per N.J.A.C.14:8-5. The Level 3 process is inclusive of all projects that do not meet Level 1 or Level 2 criteria.

Figure 3-6. N.J.A.C.14:8-5 Interconnection Fee Structure

Level 1	Level 2	Level 3
Capacity Limit: <10 kW	**Capacity Limit:** <2 MW	**Capacity Limit:** No range
Fee: No application or other fee	**Fee:** $50 + $1/kW capacity + cost of minor modifications to the electric distribution system or additional review	**Fee:** $100 + $2 / kW capacity + charges for time spent on any impact and/or facilities studies required.

Although there is no capacity range for Level 3 in N.J.A.C.14:8-5, lower capacity projects in Level 3 may not arise frequently in practice.

***Source:** Guidehouse visualization of N.J.A.C.14:8-5 content*

3.2.3 Threshold for Closed Circuits per N.J.A.C.14:8-5

The N.J.A.C.14:8-5 screening criteria for Level 1, Level 2, and Level 3 applications are used by the EDCs to escalate interconnection requests through the study process and determine whether infrastructure upgrades are required to accommodate a project being studied.

The decision tree used to determine threshold parameters to “close” a circuit for Level 1 and 2 applications that do not pass screening criteria varies by EDC. Project size and location relative to the conductor size and automated protection relays near the project are key reasons for limiting hosting capacity unless a developer agrees to pay for required upgrades.

3.3 EDC Generator Interconnection Application Business Process

Guidehouse found the generator interconnection request application process was consistent across the EDCs relative to items explicitly addressed in N.J.A.C.14:8-5 and varied between EDCs for other items such as the format of the application and how the EDCs tracked application progress.

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The following sections detail EDC interconnection application business processes as reported by the EDCs in their Stakeholder Meeting #3.1 presentations. In general, the EDCs self-reported compliance with N.J.A.C.14:8-5 guidance a majority of the time.[18]

3.3.1 Application Process Including Fees

For Stakeholder Meeting #3.1, EDCs were asked to provide information on their Level 1 – Level 3 interconnection application approach. The responses from the EDCs are captured in Table 3-2, outlining intake, management tools, and fees.

Table 3-2. Application Process for ACE

atlantic city electric – AN EXELON COMPANY
Application Process Flow:
Customer completes application via online portal & submits payment:
Level 1: no fee
Level 2: $50 + $1 per kW AC Inverter Rating
Level 3: $100 + $2 per kW AC Inverter Rating
ACE reviews application for administrative completeness & technical attributes; Levels 2 & 3 subject to deeper technical study
ACE notifies customer application is approved and notifies customer of next steps
Customer executes construction, local inspections & submits Certificate of electrical completion to ACE
ACE installs net meter and provides PTO
Platform & Customer Tools:
Online portal launched in 2020, "Connect The Grid" or "CTG"†
Hosting capacity maps provided to guide interconnection location
Typical Milestone Delays:
Incomplete customer applications require corrections or ACE application is updated & customer has to re-submit
Good faith negotiations with developer regarding upgrades and execution of said upgrades

† As of January 31, 2022, ACE processes all applications through the online portal and no longer accepts email and hardcopy applications

Source: *Stakeholder Meeting #3.1 presentation, January 14, 2022*

[18] E.g., from Stakeholder Presentation #3: (1) PSE&G: "~90% of Level 1 and Level 2 applications have been completed within the N.J.A.C. timeline requirements" and (2) ACE: "The average processing times from the part 2/B application through Permission To Operate is approximately 8-9 days."

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Table 3-3. Application Process for JCP&L

Jersey Central Power & Light — A FirstEnergy Company
Application Process Flow: Customer submits application to JCP&L via email & pays fees Level 1: no fee Level 2: $50 +$1/kW AC device rating Level 3 $100 + $2/kW AC device rating; $15K Special Study Fee JCP&L reviews application for administrative & technical completeness JCP&L uses Graphical Information System Mapping tools to verify distribuiton equipment can accommodate customer request; dicuss options with customer based on exsiting equipment, customer historical billing & estimated upgrade costs Level 2 >50 or 100 kW goes to a Distribution Planning Engineer for in-depth technical evaluation Level 3 applications have an outsourced circuit analysis JCP&L issues Part 1 approval to install Customer submits Part 2 application seeking PTO JCP&L reviews Part 2 application for changes, issues PTO & directs Meter Department to upgrade to bi-direcetional meter Level 2 (> 1000 kW) & Level 3 projects require customer Remote Terminal Unit tie in to the JCP&L system, on site commissioning testing, & telemetry verification **Platform & Customer Tools:** 99% of applications received from customer via email Online Solar Accomodation Map provided to guide interconnection location† **Typical Milestone Delays:** Errors regarding account number; cleared up through customer conversations Majority of projects experience little to no delay, issues typically resolved through downsizing, operation mode changes or circuit modifications Some Level 2 & 3 projects have withdrawn due to infrastrcuture upgrade costs

Source: *Stakeholder Meeting #3.1 presentation, January 14, 2022*

Table 3-4. Application Process for PSE&G

PSEG
Application Process Flow: 1. Customer submits application to PSE&G via email 2. PSE&G reviews application for completeness; compliant applications sent to Engineering for review Level 2 & 3 applications are sent to Local Planning & System Protection Depts. for additional review 3. If approved by Engineering, Customer is informed of status and pays fee **Level 1:** no fee **Level 2:** Application Technical Review fee of $50 plus $1 per kW system size and $10,000 Load Study **Level 3:** Application Technical Review fee of $100 plus $2 per kW system size and $10,000 Load Study 4. Customer completes construction & provides PSE&G township approval & Certification of Completion 5. PSE&G Meter Change Service Order is created, Meter Department inspects Customer installation and either approves or notifies Customer of corrections required. 6. PSE&G Meter Department installs new meter on approved projects & provides PTO **Platform & Customer Tools:** Solar Power Suitability maps available online, indicate amount of solar a circuit can accommodate **Typical Milestone Delays:** Application issues responsible for 33% of project delays Project access & inspection issues drove 10% of delays Lack of township inspection documentation attributed to 2% of delayed projects

† As of February 2022, PSE&G revised their hosting capacity limit by approximately 2 MW per feeder to the values shown in Section 3.4 below by updating their engineering assumptions.

Source: *Stakeholder Meeting #3.1 presentation, January 14, 2022*

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Table 3-5. Application Process for RECO

Rockland Electric Company
Application Process Flow: Customer files application via online portal and pays fee Level 1 (up to 50kW AC): no fee Level 2 (50kW+ AC): $50 + $1/kW; supplemental $2.5K-$5K load study fees & possible $6K-$16K Coordinated Electric System Interconnection Review (CESIR) fee if consultants required for studies Level 3 (50kW+ AC): $100 + $2/kW; $6K-$16K CESIR fee if consultants required for studies RECO reviews application and approves Customer to install or request application corrections prior to approval Level 2 & 3 applications receive preliminary engineering study Results of study discussed with Customer, supplemental engineering review follows In some cases, CESIR study required, once complete Customer and Utility construction proceeds Customer completes construction and RECO installs meter Verification test data sent to RECO RECO provides final review and acceptance Level 2 and 3 projects received facility verification testing prior to PTO **Platform & Customer Tools:** • RECO provides an Interconnection Online Application Portal (IOAP) • Orange & Rockland projects Hosting Capacity and System Data maps online **Typical Milestone Delays:** Level 1: incomplete or inaccurate application documents Level 2 & 3: Same as Level 1 + missing application fees Delays in PTO typically driven by incomplete inspection paperwork or weather delays for verification tests.

Source: *Stakeholder Meeting #3.1 presentation, January 14, 2022*

Guidehouse additionally reviewed the customer-facing online applications as shown below and found that the interconnection applications, submission instructions, and hosting capacity maps for each of the EDCs were accessible through their company websites. Furthermore, ACE, PSE&G, and JCP&L currently provide a FAQ section on their company websites specifically for issues with interconnection requests. RECO's company website has FAQ about billing and crediting; they plan to supplement with additional FAQ about interconnection requests.

Stakeholders, such as ANB Systems and Sunnova,[19] recommend that the EDCs utilize advanced automation to improve the speed, review turnover, flexibility, management, and interoperability of customer-facing interconnection application systems and overall process. Sunnova also recommends standardization across the state to increase cohesiveness and reduce redundant data requests.

[19] Stakeholder Meeting #3.2

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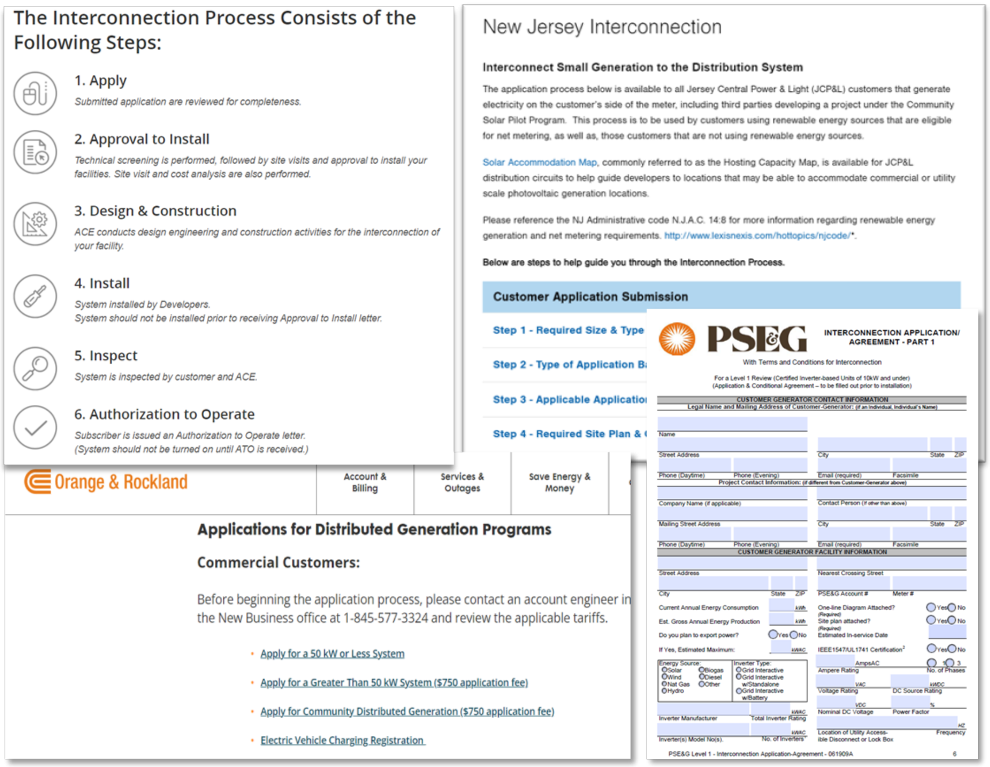
Figure 3-7. Illustrative Screenshots of EDC Interconnection Website Pages



Source: *Screenshots from EDCs interconnection website pages; ACE's Interconnection Process, (upper left), interconnection applications available on RECO's company website (lower left), JCP&Ls New Jersey Interconnection landing page (upper right), PSEG Level 1 Interconnection Application PDF (lower right)*

3.3.2 EDC Application Timelines

Guidehouse issued a supplemental data request to the EDCs in February 2022. As a part of the request, Guidehouse asked EDCs for information regarding Application Part A and Part B timelines observed in 2021. Part A of the application is the initial generator interconnection application submitted by the customer to the EDC and covers the timeline from submission to approval to install being granted by the EDC. Part B of the application is submitted by the customer after the project is built and ready for inspection by the EDC and covers the timeline between completion of the project build including commissioning, and PTO being granted by the EDC. EDC responses are summarized in Table 3-6 and Table 3-7.

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Table 3-6. Average Application Part A Review Timeline Windows in 2021 by Level

	Level 1	Level 2	Level 3
ACE	Within 25 days	Within 30 days	N/A[20]
JCP&L	Within 15 days	Within 30 days if less than 300 kW 30-60 days if larger[21]	N/A[22]
PSEG†	Within 15 days	Within 15 days	
RECO	Within 15 days	Within 30 days	N/A

Source: *Guidehouse summary of EDC responses to the supplemental data request*

Table 3-7. Average Application Part B Review Timelines in 2021 by Level

	Level 1	Level 2	Level 3
ACE	Within 15 days	Within 15 days	N/A
JCP&L	N/A[23]		Within 10 days
PSEG†	Within 20 days	Within 20 days	
RECO	Within 10 days	Within 10 days	N/A[24]

Source: *Guidehouse summary of EDC responses to the supplemental data request*

3.3.3 Generator Interconnection Fees

Guidehouse asked the EDCs to provide additional information regarding fees collected by the EDC in 2021. The summary of the EDCs' responses related to the generator fees are shown in Table 3-8.

Table 3-8. Generator Interconnection Application Fees Collected by the EDCs in 2021†

	Level 1	Level 2	Level 3	Other
ACE	$0	$149,500	$157,000	N/A
JCP&L	$0	$86,500	$10,500	Community Solar: $38,500
PSEG	$0	$189,000	$39,000	N/A
RECO	$0	Level 2 and 3 Generator Application fees are within the $10,000s		N/A

† Rounded to the nearest $500

Source: *Guidehouse-rounded EDC responses to the supplemental data request*

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[20] "N/A" corresponds to categories where data is unavailable from the EDC

[21] According to JCP&L, timeline highly dependent on the quality of the application and the outcome of the circuit study

[22] According to JCP&L, the company does not track this data

[23] According to JCP&L, the company does not track this data

[24] According to the RECO, there were no Application Part A's for approval to construct

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3.3.4 Stakeholder Request for a Pre-Application Process

Stakeholders expressed a desire for the NJ application process to include a pre-application study option, a common approach highlighted by both IREC and FERC.

The Pre-Application Report is a relatively low-cost method of informing applicants of grid conditions for their specific project location and nameplate capacity and potential interconnection limitations early in the interconnection process. Whereas the existing hosting capacity maps provide feeder-level information, even the most detailed hosting capacity maps cannot be updated in real time. Additionally, power flows are not available for the proposed generation at specific locations without a project-specific pre-application report. Thus, a pre-application process may encourage faster interconnection in locations with little to no detrimental impact to the grid. Increasing transparency of these grid conditions may also enable applicants to better plan for interconnection costs and requirements, such as system modifications and complex engineering studies. By providing these benefits, pre-application reports are expected to reduce the number of canceled interconnection applications.[25]

3.3.5 Recordkeeping Mechanisms and Data Access

Most EDCs do not have an auditable database that tracks key data from their generator interconnection applications.[26] Some EDCs have implemented an online portal or online application process; however most do not have a standardized system for exporting data. This interconnection application data is valuable for identifying process improvements, financial tracking, and analyzing investment and asset management. The capability to easily export interconnection application data in a standardized, automated manner is essential to continuous improvement of the interconnection process. Generator interconnection application data of interest to stakeholders and NJ BPU include:

- Generation type (e.g., solar, wind)
- Dates for key milestones (e.g., dates for Part A and Part B sign-off by responsible parties)
- Nameplate kW installed
- Processing fees and upgrade costs paid
- Designation of DER aggregation participation

Stakeholders also expressed a need for improved customer-facing systems for the interconnection application process. Digitally-based customer-facing systems provide high potential for improved recordkeeping, data accessibility, and data management. Suggestions include integrating automation processes for application submissions, standardization, application tracking, and pre-applications. Sunnova provided SolarAPP+ as an example that was developed by NREL to assist with the application process for residential photovoltaic (PV) systems.

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[25] NREL, *Evaluating the Role of Pre-Application Reports in Improving Distributed Generation Interconnection Processes*, November 2018. nrel.gov/docs/fy19osti/71765.pdf

[26] Such application databases are common for utility-run energy efficiency programs, for example. ACE did provide their interconnection data in an auditable database format.

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The subject of data access was also raised by non-EDC stakeholders during the stakeholder process. The Solar Energy Industries Association (SEIA) emphasized the need for customer data rights within the interconnection process. The organization states that data access is the key toward customer focused innovation, flexible interconnection, and grid modernization. Tesla also recommends data access as a means to enhance existing repositories of data and to streamline access to data such as pre-application reports and distribution system maps.

3.3.6 EDC Self-Reported Customer Satisfaction Surveys

For Stakeholder Meeting #3.1, EDCs shared results of customer satisfaction feedback. The responses from the EDCs are captured in Table 3-9.

Table 3-9. EDC Self-reported Customer Satisfaction Surveys

atlantic city electric An Exelon Company	Jersey Central Power & Light A FirstEnergy Company	PSEG	Rockland Electric Company
Customers are satisfied overall with the interconnection experience–86% Customers are also satisfied with the ease of completing the interconnection process - 84%	Very few Most inquiries in 2020/2021 have been related to billing/meter reading and not application review/processing.	PSE&G does not have a formal process to solicit feedback but meets with a sampling of customers to solicit feedback throughout the process. PSE&G is working to develop a more standard process for receipt of feedback. Additionally, PSE&G has staff readily available by phone and email to provide updates on applications and projects.	RECO does not offer a customer satisfaction survey. The Company is currently evaluating a customer satisfaction survey process.

Source: *Stakeholder Meeting #3.1 presentation, January 14, 2022*

One participant from Stakeholder Meeting #2 emphasized the need for EDCs to have a better system of filing complaints.[27] States such as California (Rule 21, Section K) are required to identify an ombudsman for each utility to handle complaints. Additionally, the California Public Utilities Commission (CPUC) has a complaint process.[28] NJ EDCs currently do not have embedded ombudsmen to handle broad complaints for all stakeholders. The NJ BPU does have an ombudsman to facilitate and mediate questions and complaints arising for municipal, private, and public entities.

[27] U.S. Department of Energy (DOE) April 2022 issue brief "Interconnection Standards for Combined Heat and Power (CHP): State Standards that Impact Interconnection to the Electric Distribution Grid" states on p. 9: "Differences between customers and utilities occur, and effective interconnection standards spell out the steps for resolving disputes and the timeline for resolving the disagreement."

[28] California Public Utilities Commission, Utility Compliant website: cpuc.ca.gov/consumer-support/file-a-complaint/utility-complaint

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3.3.7 Total 2021 Nameplate Solar Approved to Operate

EDCs provided information about their total nameplate clean energy MW approved to operate in 2021. Based on this data, solar PV accounts for most of the 2021 nameplate clean energy approved to operate.

In the February 2022 Supplementary Data Request, the EDCs provided information regarding PTO MW for 2021, which is summarized by Guidehouse in Table 3-10. While a majority of the connections are Level 1, the total interconnected capacities (MW) for Level 2 and Level 3 are, together, significantly larger than the total Level 1 interconnected capacity (MW). Therefore, the Level 2 and Level 3 interconnection process are of equal importance to Level 1 relative to interconnected renewable MW and meeting NJ EMP goals.

Table 3-10. PTO MW Issued in 2021 by Level

	Level 1	Level 2	Level 3	Other
ACE	21 MW	22 MW	Not applicable	Not applicable
JCP&L	15 MW	35 MW	5 MW	Community Solar: totaling < 1 MW PJM/Grid Supply: 27 MW
PSEG	31MW	74 MW	37 MW	Not applicable
RECO	< 1 MW	1 MW		Not applicable

Source: *Guidehouse-rounded EDC responses to the supplemental data request*

3.4 Circuit Capacity

For Stakeholder Meeting #3.1, the EDCs provided information regarding closed circuits on their system. Of the four EDCs, only two reported closed circuits.[29] While the definition of a closed circuit is case-specific, generally project size, location relative to the conductor size, and protection relaying for the local grid are factors considered. Reopening a closed circuit depends on the viability of the project relative to the upgrade costs. PSE&G and ACE reported having 150 and 49 circuits respectively closed to new capacity additions. The presence of closed circuits for the two EDCs indicates barriers to integration of new clean energy resources. Stakeholders, including the Mid-Atlantic Solar and Storage Industry Association (MSSIA), emphasize the action of upgrading substations and circuits as a necessary step toward adding capacity for moving more power “uphill.”

[29] Procedures for screening circuits are addressed in the FERC interconnection procedures. The meaning of a closed circuit is that an upgrade to infrastructure, including wires and transformers, would be required to accommodate the requested interconnected generation based on a study of the location that includes relevant electrical safety and reliability standards, and that the required upgrades are not economically feasible for the application at hand. Options to accommodate more renewable interconnection on the distribution grid could include (1) more detailed studies of individual interconnection requests to identify whether criteria may be relaxed without affecting safety, deliverability, and reliability, (2) investments in infrastructure by the state, outside of the generator interconnection queue process, (3) investigating new and advanced technologies such as controllable devices or System Control and Data Acquisition (SCADA).

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Table 3-11. New Circuit Capacity Summary

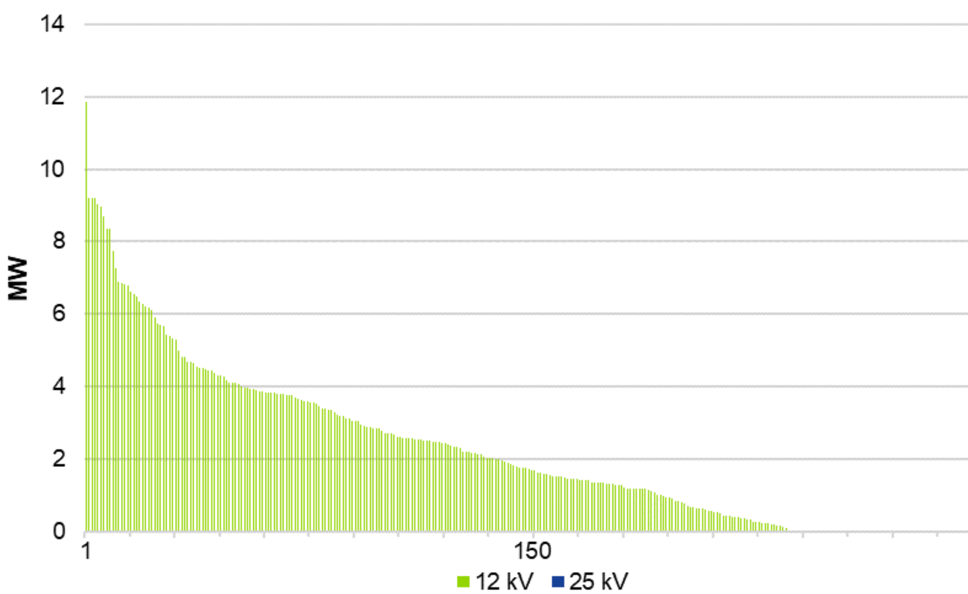
EDC	Closed circuits	Total EDC circuits	Total EDC customers served
ACE	49	327	565,482
JCP&L	0*	1153	1,134,891
PSE&G	150	1936	2,300,000
RECO	0*	79	73,948

Source: *EDC Stakeholder Meeting #3.1 presentations, January 14, 2022 (closed circuits, total EDC customers) and EDC supplemental data request (total EDC circuits)*

* JCP&L and RECO reported that they have zero closed circuits

The following hosting capacity plots for ACE, JCP&L, PSEG, and RECO show the maximum nominal generator interconnection margins on each feeder, sorted from highest to lowest. The hosting capacity limits shown in Figure 3-8, Figure 3-9, Figure 3-10, and Figure 3-11, are nominal limits for guidance only, arrived at using general engineering criteria such as conductor size and assumed nearby electric load. The actual outcome of an interconnection study for a given interconnection customer application is expected to differ from these nominal values based on a variety of factors such as project location along the feeder and substation interconnection limits.

Figure 3-8. ACE Reported Hosting Capacity †



† Per ACE: "The strict PV Hosting Capacity (kW) is calculated using power flow software and a stochastic methodology to estimate capacity of small new DER can be added to the feeder in random arrangements before a violation is encountered (thermal equipment limits, excessive voltage rise, equipment operating outside of bandwidth, etc.). This is represented on the hosting capacity map in an estimated range of available hosting capacity by color code."

Source: *ACE Supplemental Data Request*

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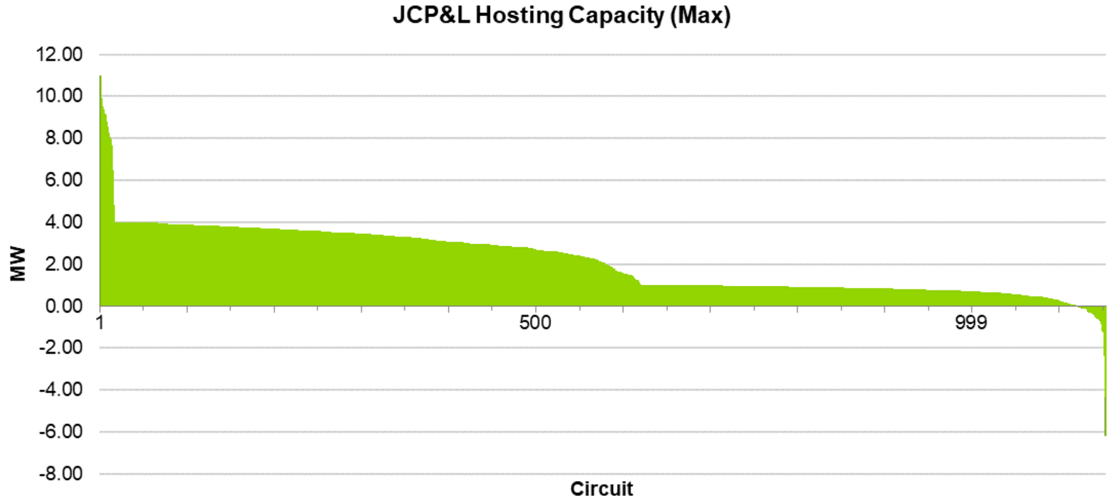
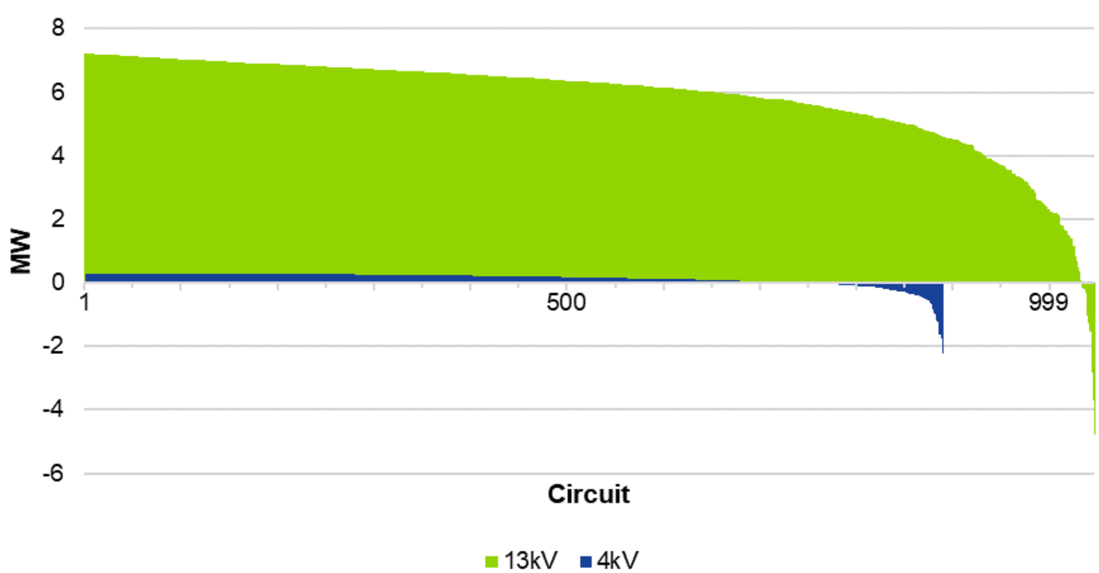
Figure 3-9. JCP&L Reported Hosting Capacity†, ‡



† Sorted from highest to lowest MW including all circuit voltages (35 kV, 12.47 kV, 4 kV)
‡ Negative hosting capacity indicates the circuit hosting capacity is above the nominal maximum for those circuits
Source: *JCP&L Supplemental Data Request*

Figure 3-10. PSEG Reported Hosting Capacity†



† Negative hosting capacity indicates the circuit hosting capacity is above the nominal maximum for those circuits
Source: *PSEG Supplemental Data Request*

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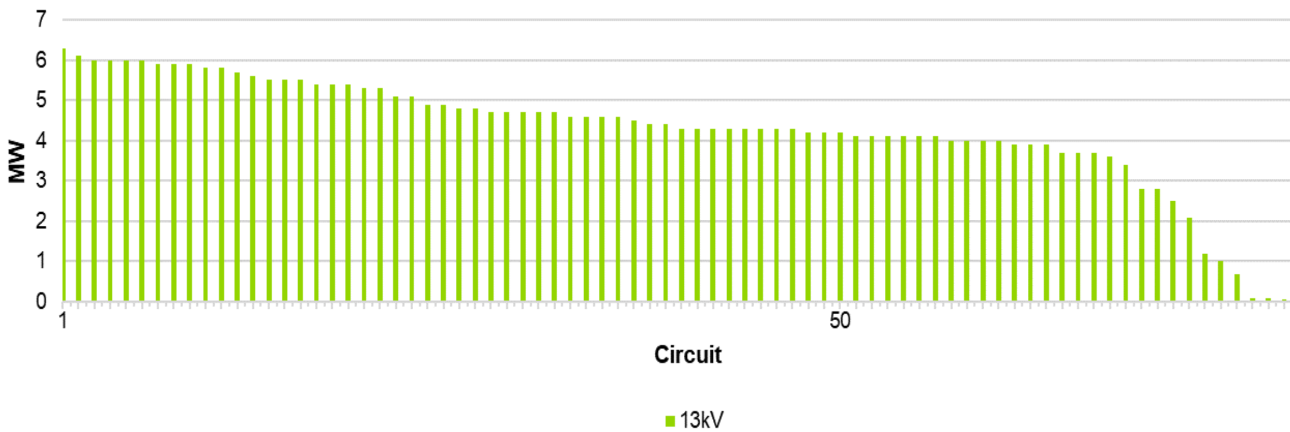
Figure 3-11. RECO Max Hosting Capacity



Source: *RECO Supplemental Data Request*

During Stakeholder Meeting #3.2, stakeholders recommended that the existing hosting capacity thresholds be updated as they currently impact the customer experience negatively. For instance, Sunrun recommends that the Level 1 system size threshold be increased; states such as Rhode Island, Connecticut, and New York have considered a threshold of 25 kW within their interconnection processes. Tesla also recommended that EDCs increase the threshold for Level 1 systems to 15 - 20 kW.

In addition, each EDC has hosting capacity maps available online through their company website for informational purposes (Figure 3-12). During Stakeholder Meeting #3.1, all EDCs stated that hosting capacity maps were available in their jurisdiction in 2021. The targeted update frequency for JCP&L and RECO is six months, and for ACE and PSEG, quarterly. The maps allow interconnection customers to search for the address of their prospective renewable generator interconnection project and see a feeder-level view of key information such as available hosting capacity on the feeder. This allows developers and other stakeholders to assess the suitability of the electric circuits for their project prior to submitting an interconnection request application. Although interconnection applications still require a full review by the EDC to confirm project viability and associated costs, the hosting capacity maps can provide stakeholders with early insight into the feasibility of their project.

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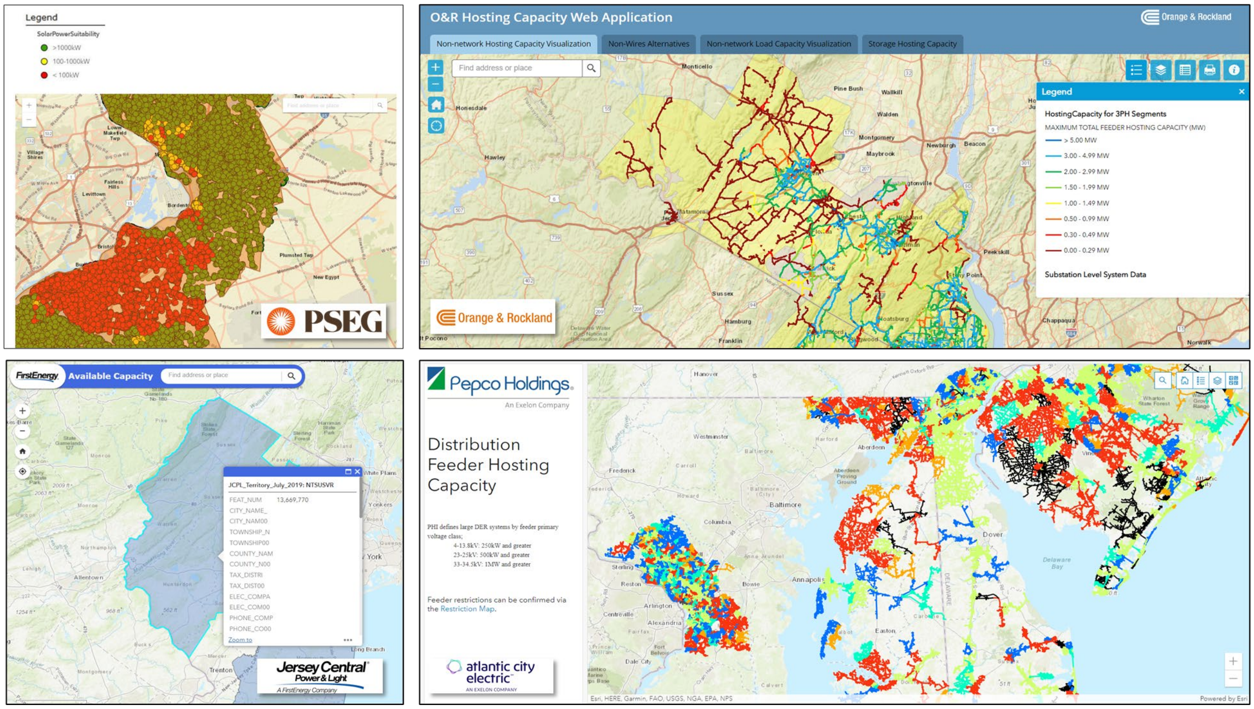
Figure 3-12: Illustrative Screenshots of Online EDC Hosting Capacity Maps



Source: *Screenshots from EDCs interconnection website pages; PSEG Solar Power Suitability Map (upper left), JCP&L Solar Accommodation Map (lower left), RECO O&R Hosting Capacity Map (upper right), ACE Hosting Capacity Map for Radial Distribution Feeders (lower right)*

Guidehouse found that the existing hosting capacity maps online representation and underlying approach to calculating capacity headroom appears inconsistent across EDCs. Some EDCs calculate a theoretical maximum available capacity based on assumed feeder loading whereas others calculate a range of capacities based on actual loads and point of interconnection. Furthermore, following Stakeholder Meeting #3.2 JCP&L clarified that the quantity of closed circuits in their service area was less than appeared to be the case in slides presented by other stakeholders. Guidehouse found this was due to inconsistent labeling of hosting capacity and differing underlying assumptions across EDCs in how hosting capacity information is prepared and presented in the online maps.

3.5 Cost and Schedule Impacts from Generator Interconnection Studies

EDCs did not report systematic schedule delays or cost overruns due to generator interconnection studies performed in response to customer requests for generator interconnection. Some non-EDC stakeholders reported long schedule delays due to a range of factors leading to difficulty meeting NJ BPU timelines for projects with required upgrades, however according to the EDCs, the delays were not specifically due to delays in performing the interconnection studies. According to the EDCs, delays are primarily due to (1) the submission of inaccurate or incomplete applications submissions, and customer misunderstandings about whether an application was complete, (2) lack of access to meters for testing, (3) the

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identification of additional required upgrades that can be extensive and costly, and (4) processes pertaining to invoicing and cost estimation.[30]

3.5.1 Cost-Related Findings from Quantitative Data

EDCs provided information regarding fees collected to perform interconnection studies in 2021. The fees are based on the N.J.A.C. fee structure and are consistent with the number of projects. The EDCs summarized responses on the generator and interconnection fees collected for the performance of interconnection studies. The values as reported by the EDCs are shown in Table 3-12.

Table 3-12. Interconnection Study Fees in Dollars Collected by the EDC in 2021†

	Level 1	Level 2	Level 3	Other
ACE	$0	$280,000	$230,000	N/A[31]
JCP&L	$0	$180,000 (total for Level 2, Level 3, and Community Solar)		
PSEG	N/A[32]			
RECO	$0	Level 2 and 3 Interconnection Study fees are in the $10,000s		N/A

† Rounded to the nearest $500

Source: *Guidehouse-rounded EDC responses to the supplemental data request*

Table 3-13. Interconnection Average Study Fees Per Interconnection in 2021†, ††

	Level 1	Level 2	Level 3	Other
ACE	$0	$10,000/application	$10,000/ application	N/A
JCP&L	$0	$100/application	$15,000/application	N/A
PSEG	N/A[33]			
RECO	Not Tracked	$500/application	N/A	N/A

† All quantities are rounded

† For some EDCs the study fees per application metric includes applications that may not have reached approval to operate (ATO) status yet

Source: *Guidehouse-rounded EDC responses to the supplemental data request*

3.6 Distribution System Upgrade Cost Estimation and Allocation

Guidehouse found that EDCs typically use a serial study process and a cost-causer allocation approach.

In the February 2022 Supplementary Data Request, EDCs provided information on EDC-recommended upgrade costs by Level for 2021 interconnection projects. EDC-recommended costs required for generator interconnection upgrades in 2021 were in the

30 Based on EDC presentations from Stakeholder Meeting #3.1

31 "N/A" corresponds to categories where data is unavailable from the EDC

32 According to PSEG the company does not track this data

33 Ibid.

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range of millions of dollars for each EDC. The EDCs recommended upgrades for projects at all interconnection levels, including community solar projects.

During Stakeholder Meeting #3.2, several stakeholders shared ideas on reducing cost barriers for developers and customers. Bloom Energy's recommendations included re-approaching cost allocation for system upgrades in ways beneficial to EDCs and developers and developing mechanisms that will allow customers to have both NEM and non-NEM DERs behind the same meter.

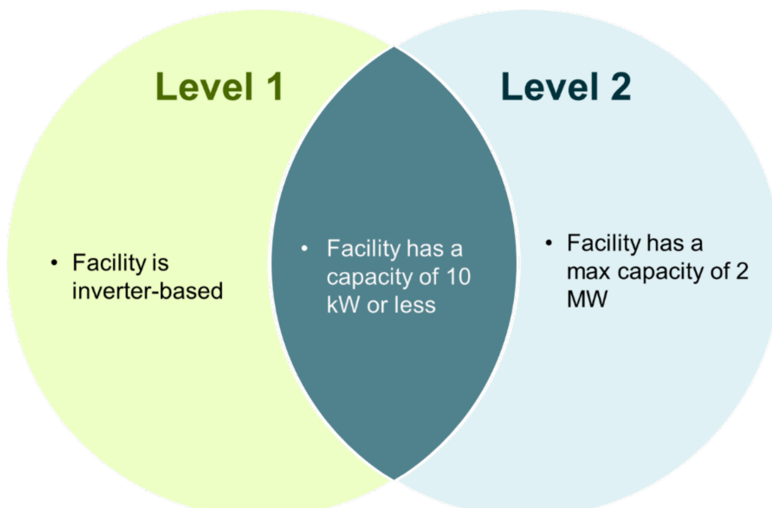
Con Edison also raised the need for EDCs to provide firm and flexible upgrade cost options. This is due to their observation on how cost allocation costs are all shouldered by the generating facility.

3.7 Interconnection Code, Standards and Certification

3.7.1 High Level Guidehouse N.J.A.C.14:8-5 Observations

N.J.A.C.14:8-5 generally follows FERC's SGIP.[34] An overview includes the following points, and Figure 3-13 shows the capacity overlap for Level 1 and Level 2 in NJ.

Figure 3-13. Level 1 and Level 2 N.J.A.C.14:8-5 Capacity Criteria Overlap



***Source:** Diagram is based on criteria provided in N.J.A.C.14:8-5.4 and N.J.A.C.14:8-5.5*

Guidehouse found that N.J.A.C.14:8-5 contains an out-of-date reference. The following Codes and Standards are out of date:

IEEE 1547 has released a 2018 version with a 2020A (Amendment) (2003 is currently referenced instead of 2018)

[34] FERC SGIP, ferc.gov/industries-data/electric/electric-transmission/generator-interconnection/standard-interconnection, referenced 2/12/2022

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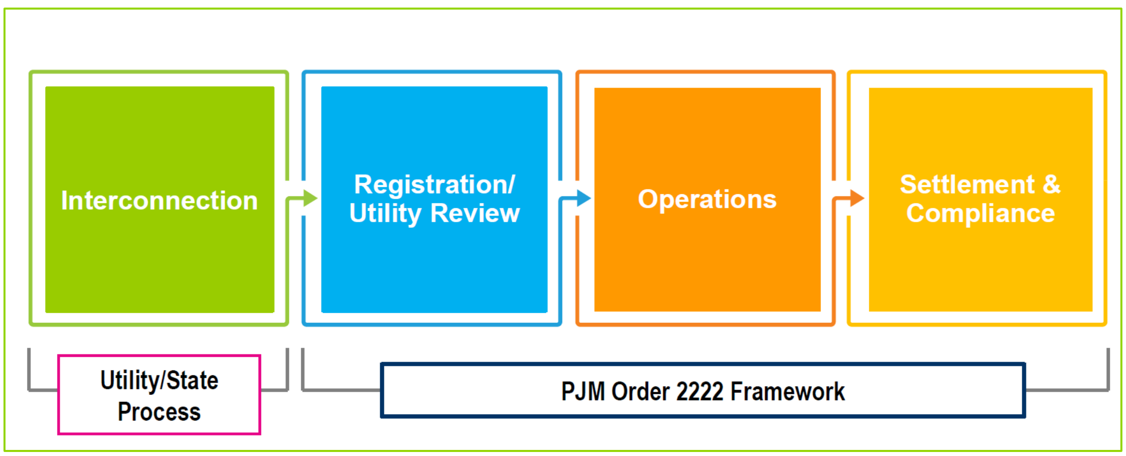
Guidehouse additionally found that N.J.A.C.14:8-5 does not contain specified timelines within the Level 3 study process (i.e., does not state when an impact study needs to be delivered to a customer).

3.8 PJM

As of January 2022, PJM has almost 16,000 MW (please refer to Figure 3-15) of proposed resources under study for interconnection in NJ, and approximately 11,000 MW are dedicated to on- and offshore wind generation.[35] Approximately 3,200 MW (or 20%) are comprised of storage projects which may provide power or other resource services to the system. The proposed resources represent about 10% of the entire PJM load of 160,000 MW, although it is expected that a fraction of this amount will ultimately connect to the system.

PJM provided a high-level view of its guiding principles at Stakeholder Meeting #3.1. PJM aims to conclude most project connections within two years of filing. As such, there is some urgency to develop and implement procedures to secure new projects and interconnect them in a systematic and orderly manner aligned with best practices and based on a process integrated with the relevant agencies per Figure 3-14.

Figure 3-14. PJM Process Flow for PJM Participation Under Order 2222



Source: *PJM presentation, Public Stakeholder Meeting #3.1*

To accommodate the increased volume of interconnection activity, PJM has organized its processes into a NSR (New Service Request) format. These processes are outlined in PJM Manual 14A. The NSR establishes a baseline for the connection of new resources with a goal of study completion within two years. The format includes a request for new service, study phases, completed agreements, and commercial and operational readiness prior to market operations.

The PJM web portal is organized to track and update relevant information with the goal of showing levels of completion. The new format intends to provide customers with more actionable information earlier in the process. PJM has developed a checklist for organizing information to achieve a queue position. Interconnection process data is based on resource size

[35] NJ BPU Grid Modernization Stakeholder Meeting #3.1.

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and includes study results, location of merchant facilities, expected network upgrades, cost estimates and in-service dates.

PJM is also reviewing application issues during submission to increase efficiency. By reviewing the application process on an ongoing basis, customers can receive more actionable information earlier to assist in decision-making. Finally, the application process has off ramps to assist both PJM and the customer by providing orderly exit points during the decision process.

3.8.1 Interconnection Process

In concert with the transmission planning process, PJM studies the effect that a proposed resource may have on the transmission system. Moreover, to address the integrity of the overall system, PJM studies resource projects connecting directly to the transmission system and projects connecting to the distribution system that participate in PJM markets in coordination with the owner of the delivery infrastructure.

To manage the addition of resources to the transmission and distribution system, PJM has developed a list of principles to help guide the connection of resources to the system.

To expedite the overall process, a company should be able to file and complete a connection within two years. By providing customers with better information, robust processes, and by managing cycle times, backlog can be reduced. Further, off ramps can be added at strategic decision points in the process.

Interconnection costs for both PJM and the developer can be managed in several ways. By using a cluster and cycle based format, costs can be effectively shared by various developers. The addition of financial milestone deposits and a move from first-in/first-out processing to first ready/first through processing can reduce costs and improve overall connection processing.

Finally, aligning and automating project changes provides more certainty for customers. Recommended changes include adding relevant interconnection agreement milestones for state jurisdictional projects from the transmission owner/distribution provider in support of receiving a Wholesale Market Participation Agreement.

PJM has expressed an intent to seek stakeholder approval and draft tariff changes through Q1 2022 to implement FERC Order 2222.

3.8.2 DER Participation and Market Registration in PJM Under FERC Order 2222

PJM has developed a stakeholder process to balance the needs of resource aggregators, including DER, with regulatory authorities and distribution utilities to achieve safe and reliable operations. Aggregators may be delayed in connecting resources until standards are agreed-upon and met. There is a need for additional coordination between the delivery infrastructure owners and PJM to connect distribution-level resources.

Under PJM’s current FERC Order 2222 proposal, DER at or above 100 kW and up to a capacity of 5 MW will have the option to register for PJM market participation after interconnecting. DER will continue to have the ability to be processed through the queue. It should be noted, PJM does not yet have projections for project aggregator application growth in NJ.

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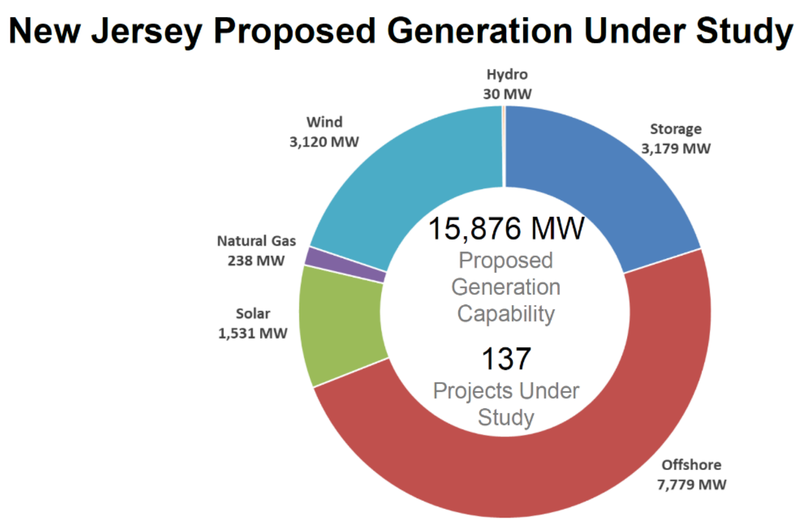
The process PJM ultimately uses for Order 2222 will depend on FERC's final ruling. Significant milestones include PJM's February 1, 2022, compliance filing to FERC. From February 2022 to early 2023 FERC will be considering its final ruling. Implementation will follow. PJM has requested that FERC grant an effective date of February 2, 2026, for the Tariff and Operating Agreement.

For PJM Market Registration under Order 2222, the EDCs and developers are expected to follow the interconnection process requirements of the respective states. The developers will register for market participation with PJM prior to commencing market operations. Absent an EDC objection, PJM will issue final approval. The market registration, operations, settlements, and compliance are guided by the PJM Order 2222 framework.

PJM continues to work with the stakeholders including EDCs, regulatory authorities, and aggregators to develop implementation details, address issues such as metering and telemetry, reliability driven dispatch overrides, etc. and incorporate into the PJM Operating Manuals.

Figure 3-15. PJM in NJ



Source: *Stakeholder Meeting #3.1*

3.9 Emerging Grid Modernization Essentials

Stakeholders provided early feedback that establishing a path for a cost-effective grid modernization process must include more than limited review and update of the interconnection process in its current form within N.J.A.C.14:8-5. During the data collection process Guidehouse and NJ BPU identified areas outside of interconnection reforms that would add to NJ meeting the EMP goal of 100% clean energy by 2050.

Broadly, essential grid modernization topics beyond the scope of this report include:

EMP requirement for Integrated Distribution Plans (DER Roadmaps)

Hybrid DER system interconnection, including microgrids, energy storage, and EV service equipment

Regulatory Sandbox and Rapid Pilots for limited deployment of innovative technologies and methods that are not permitted under current rules.

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Each of these areas for additional exploration must consider a unique combination of the impacts to people, processes, technologies, policies, information, and data. Some changes will be more obvious, e.g., quick wins such as improvements to the application process through software solutions that could be implemented uniformly across the state, and others will require further investigation to align on a path forward. Emerging technologies such as power quality (Volt/VAR optimization, control schemes using smart inverters, power quality), DERMS, EV charging infrastructure, and more timely access to information will require additional study. Activities and initiatives required to prove innovative solutions essential to fulfilling the EMP mandate while ensuring safety, deliverability, and reliability of the electric grid include: (1) demonstration and pilot projects, (2) electrification policies and tariffs, (3) qualification and approval of vendors, and (4) UL certifications. Likewise, implementation of recommendations identified in this report to improve interconnection and integration capability for the four EDCs requires further study beyond the scope of this report.

During Stakeholder Meeting #3.2 on 1/28/2022, non-EDC stakeholders presented potential pathways to enable renewable generation in NJ and that could provide cost savings to customers. Technologies encouraged for consideration include hydrogen and carbon capture technologies through FuelCell Energy, the Backup Switch by Tesla, and Net Energy Metering Multiple Technology (NEMMT) for operating NEM and non-NEM technologies behind the same meter. Furthermore, MSSIA raised that the pathway toward grid modernization should include the use of technologies such as ramp-up and ramp-down controls, reverse flow through substations; and aforementioned, Volt-VAR control.

Additional grid modernization enabling technologies shared by non-EDC stakeholders also include electric vehicles, energy storage, load shaping, and demand management. Stakeholders also recommended that a multi-stakeholder process should be developed to study optimal pathways for solar development. Regarding standardization of interconnection and other grid modernization technologies, IREC recommended the implementation of IEEE 1547-2018 and other standards to enable smart grid development.

3.9.1 EMP Requirement for Integrated Distribution Plans (DER Roadmaps)

Executive Order 28, signed by Governor Murphy on May 23, 2018, directed the Energy Master Plan Committee, chaired by NJ BPU, to complete an EMP that would provide a comprehensive blueprint to achieve 100% clean energy by 2050. This grid modernization proceeding is a direct outgrowth of that initiative.

The resulting 2019 EMP identifies seven key strategies to achieve the NJ Clean Energy and greenhouse gas emissions reduction goals. Chief among them is the accelerated procurement of renewable energy and DER and the electrification of the transportation sector.

To enable clean energy to be generated at an accelerated pace and utilized as effectively and efficiently as possible, the NJ interconnection rules and processes require updating. The 2019 EMP Strategy 5: Decarbonize and Modernize New Jersey's Energy System outlines specific strategies to modernize the state's grid including requiring utilities to establish Integrated Distribution Plans and the modernization of interconnection standards.

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From IREC regarding integrated distribution planning:[36]

> *However, cost allocation challenges are symptomatic of a larger issue at play on the distribution system. The process to review and interconnect DER to the grid is still reactive, instead of proactive. Absent more comprehensive and transparent distribution grid planning and DER forecasting, costly queue backlogs and system upgrades will likely be a constant reality as penetrations of DER on the grid continue to increase.*
>
> *Hawaii's approach contributed to the very similar concept known as integrated distribution planning, which is under consideration in a number of states today and represents an innovative shift for the planning of the distribution grid and interconnections of DER. In addition to cost allocation, integrated distribution planning puts issues of hosting capacity analysis and DER forecasting front and center. It brings us to the cutting edge of interconnection, and its intersection with distribution planning and broader grid modernization efforts.*

3.9.2 Hybrid DER System Interconnection, Microgrid, Battery Energy Storage, EV Supply Equipment

Emerging technologies and processes such as hybrid DER interconnection, microgrids, battery energy storage, and EV supply equipment will require additional tariff provisions (e.g., standby purchased electric power tariffs for qualifying facilities and cogeneration), particularly where part of the hybrid resource involves a technology eligible for net metering and part of the hybrid resource does not. Additionally, NJ may need to incorporate flexible interconnection/integration mechanisms for including storage as a grid asset.

For example, if battery energy storage is limited in operations during periods of grid stress, a lower cost option for interconnection is achievable. In the case of a site that is charging both an EV and a battery, if the site is willing to stipulate in their interconnection agreement that they will not charge them at the same time, then the interconnection approval does not need to assume a 'worst case' coincident peak, even if protection devices may be designed to account for this.

Similarly, if metering rules are changed to allow multiple meters, then limitations need not be placed on a hydrogen system for a site that also has solar generation.

Currently NJ only allows renewable sources to participate in net metering. If a customer has renewable and non-renewable resources behind the same meter, the EDCs do not have standard policies for how such projects should be interconnected to the grid, or how net metering credits should be calculated to prevent de facto net metering of technologies that do not qualify for net metering credits.

Additionally, no formalized process currently exists to interconnect energy storage. Energy storage can provide multiple benefits to the grid, but it does provide a very difficult study

[36] IREC, Interstate Renewable Energy Council, Inc., Model Interconnection Procedures (2019), available at irecusa.org/resources/irec-model-interconnection-procedures-2019/#:~:text=IREC's%202019%20Model%20Interconnection%20Procedures,maintaining%20grid%20safety%20and%20reliability.

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process to the EDCs since it can act as both generation and load. Examples where states have formalized an approach appear in Section 4.

3.9.3 Rapid Pilots and Regulatory Sandbox

Stakeholder feedback noted[37] that certain technologies and processes have been vetted and are considered best practices outside of NJ (e.g., smart inverters, interconnection application automation software and application tracking platforms) and extensive pilots may not be needed to prove technology readiness. However, more complex, and less developed areas such as DERMS may benefit from a regulatory sandbox[38] to accelerate technology development when compared to a traditional rulemaking or legislative process.

3.10 Ideas for Further Analysis

As part of the Stakeholder Meetings #3.1 and #3.2, EDC and non-EDC stakeholders provided suggestions to advance toward EMP goals, covering a range of topics relevant to accelerating renewables interconnection and grid modernization including technical, financial, and procedural issues for a range of project sizes, lending insights into the status and challenges of their respective grids and business processes. A summary of key points for further analysis pertaining to the interconnection processes in NJ is presented in this section.

3.10.1 Suggestions From non-EDC Stakeholders on Topics for Further Analysis

Additional recommendations from non-EDC stakeholders include amending residential solar interconnection rules to allow for future loads with lower costs for residential solar and updating the hosting capacity thresholds in NJ interconnection rules to appropriately allocate calculated gross feeder load for proper assessment and validation. Other recommendations included proactive grid planning and system upgrades to maximize the value of DERs on the grid.

3.10.2 Suggestions From EDCs on Topics for Further Analysis

3.10.2.1 Common Suggestions Across EDCs

This section discusses findings and recommendations pertaining to administrative and operational practices suggested by the EDCs to streamline the generator interconnection process.

Overall:

- EDCs uniformly reported having enough staff and believe they can maintain adequate staffing as applications continue to arrive.

- The EDCs recommended streamlining the application process via a consistent (unified) application approach and using the cost-causer approach for infrastructure upgrades.

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[37] Stakeholder Meeting #3.2, stakeholder comments.

[38] Guidehouse Insights, *Blockchain Applications for Remote and Grid-Connected Microgrids*, 2019.

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- Drivers of costs tend to occur when DER connection requests exceed distribution transformer capacity. If transformer capacities are being exceeded, some distribution lines may also be approaching thermal limits.
- All EDCs utilized inverter-based controls as a renewable resource integration strategy in 2021. Full compliance with IEEE 1547-2018 should enable utility control signals to effectuate grid reliability and power quality management services.
- None of the EDCs reported restrictions in 2021 based on the circuit fault protection or peak load checks in N.J.A.C.14:8-5.4 (ACE stated they did not track any).
- JCP&L and RECO apply a targeted clustering approach to interconnection processing in limited circumstances.

EDC Recommendation for Streamlined Application Process

Overall feedback from the EDCs was that the lack of a consistent framework for managing interconnection applications is introducing confusion and delay, and that a standardized remedy be explored for NJ.[39]

EDCs reported having sufficient staff and recommended streamlining of the application process via a consistent (unified) statewide approach for consistency. There is uniform interest across all EDCs modernizing distribution system operation and controls platforms such as advanced distribution management system (ADMS) and DERMS to improve the integration of DER. Additionally, all EDCs expressed a preference for a structured approach to storing, managing, and reporting data related to the generator interconnection application process. Common suggestions from EDCs fall into three distinct categories:

State Level Process Uniformity:

NJ BPU should determine the cost and benefits of a unified interconnection application and platform that could be leveraged by all EDCs to manage customer requests, invoicing, field information management, and system upgrade costs and timelines. A standardized approach could automate various tasks across EDCs and support future scaling as interconnection requests increase.

Advanced Distribution Operations Platforms (ADMS, DERMS, AMI, Etc.):

- NJ BPU should implement new capabilities, enhancing or replacing existing utility tools and platforms to facilitate deployment and safe operation of DER on the distribution system.
- NJ BPU should implement advanced control, monitoring, and communications infrastructure and customer-facing technologies to manage two-way energy delivery.
- NJ BPU should leverage advanced analytics to improve planning and technical analysis.

Data Management and Reporting:

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[39] See EDC presentations for Stakeholder Meeting #3.1

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NJ BPU should modernize data access and availability, data privacy standards, and cybersecurity protections, including those under consideration in the NJ BPU's advanced metering infrastructure (AMI) Data Access proceeding, which directly relate to more efficient interconnection methods.

3.10.2.2 Additional Suggestions from Individual EDCs

ACE

- Consider process efficiencies through deployment of AMI.
- Develop enhanced capacity maps.
- FERC Order 2222 may impact existing EDC customer and reliability focused processes and business operations. DER aggregations may require additional metering and telemetry granularity for wholesale market products and services performance and reliability awareness.

RECO

- Develop standard Data Security Agreements and other agreements where necessary to protect both customer data and utility systems.
- Continue to transform how utilities engage with customers to meet changing customers' energy use expectations.
- Implement advanced applications for fault location, isolation, and service restoration, Volt/VAR optimization, state estimation (digital twin modeling), and DERMS in future phases.

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4. Best and Common Practices

The Guidehouse team conducted research to identify best and common practices for generator interconnection process in other states relative to the following key topics from Section 3:

- COVID-19 Impact Statement by EDCs
- N.J.A.C.14:8-5 Review
- Application Process
- Circuit Capacity
- Cost and Schedule Impacts from Studies
- Distribution System Upgrade Cost Estimation and Allocation
- Interconnection Code, Standards and Certification
- PJM
- Emerging Grid Modernization Topics Essentials

4.1 COVID-19 Impact

Guidehouse has not found any overarching trends of delays to upgrades or interconnection requests nationally as a result of the COVID-19 pandemic.

4.2 N.J.A.C.14:8-5 Review

The Guidehouse team conducted research to identify best and common practices for the generator interconnection process in other states relative to the key topics in N.J.A.C.14:8-5 such as required timelines and fee structures. The following sections summarize these research findings.

4.2.1 Level 1 Interconnection Review <10kW (N.J.A.C. 14:8-5.4)

Other utilities are doing the following to streamline the application process:

- Reducing screening criteria
- Simplifying language for screening criteria, e.g., "The utility shall verify that the Generating Facility can be interconnected safely and reliably"
- Screening criteria from other sources are based on combining Level 1 and Level 2, such as:
    - California Public Utility Commission Rule 21
    - IREC[40]

[40] IREC, Connecting to the Grid website: irecusa.org/our-work/connecting-to-the-grid/

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- Electric Power Research Institute (EPRI)[41]

Additionally, other states charge a Level 1 Application fee, whereas NJ does not. IREC states, in part:

"Most states apply a Level 1 Application fee in the $100 to $200 range, though a number of states have chosen to waive the fee for net-metered facilities. In general, the appropriate fee should ensure that the utility is compensated, on average, for conducting a reasonably efficient process. This can be achieved by requiring a utility to provide data regarding its actual costs for processing Level 1 applications and how many Level 1 applications it processes. This same approach should be used for setting any fee in these Interconnection Procedures."

4.2.2 Level 2 Interconnection Review

N.J.A.C.14:8-5 Level 2 currently has a limit of 2 MW or less that applies to all resources whereas FERC MW limits for fast-track are based on voltage level as shown in Table 4-1.

Table 4-1. FERC Fast-Track Eligibility for Inverter-Based Systems

Line Voltage	Fast Track Eligibility Regardless of Location	Fast Track Eligibility on a Mainline and < 2.5 Electrical Circuit Miles from Substation
< 5 kV	< 500 kW	< 500 kW
> kV and 15 >kV	< 2 MW	< 3 MW
>15 kV and < 30 kV	< 3 MW	< 4 MW
> 30 kV and < 69 kV	< 4 MW	< 5 MW

Source: *Guidehouse visualization of FERC SGIP, Section 2.1*

Screening criteria vary for Level 2 for the following industry sources:

- FERC
- California Public Utility Commission Rule 21
- IREC / EPRI

4.2.3 Level 3 Interconnection Review

The NJ EDCs currently uses a serial study process, whereas some other states utilize milestones and a cluster process to help spread cost among similar projects and avoid clogging

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[41] EPRI website: epri.com/

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the queue. Alternatives to a serial process require initial review and scoping meetings to create interconnection study groupings. These can accelerate processing for generator interconnection.

4.3 Utility Generator Interconnection Application Business Process Benchmarking

The following tables compare key features between NJ and other states for interconnection application timelines, additional items such as hosting capacity maps and metering requirements, and fees for various interconnection levels.

4.3.1 Timelines

Table 4-2. Interconnection Timelines State Benchmark

	Level 1	Level 2	Level 3	Level 4
New Jersey	Screening: 10 Business Days (BDs)	Screening: 15 BDs Additional Review: 30 BDs	Not defined for studies	
Virginia	Not defined in Virginia Administrative Code	Not defined in Virginia Administrative Code	Feasibility: 30 BDs System Impact: 45 BDs Affects Systems: 20 BDs Facilities Studies: 45 BDs	
New York	Systems 50 kW or Less Screenings: 10 BDs		Systems above 50 kW up to 5 MW Preliminary Screening Analysis : 15 BDs Supplemental Screening Analysis: 20 BDs Coordinated Electric System Interconnection Review: 60 BDs	
Washington DC	Screenings: 10 BDs Additional Reviews: 15 BDs (if applicable & at EDCs expense)	Screening: 20 BDs Additional Review: Not defined	Area network impact study: 25 BDs Additional Review: Not defined	Feasibility: Not defined System Impact: Not defined Facilities Studies: Not defined
Maryland	Connect Safely & Reliably: 15 BDs	Screening: 20 BDs Additional Review: 30 BDs	Area network impact study: 25 BDs Additional Review: 30 BDs	Feasibility: 30 BDs System Impact: 45 BDs Facilities Studies: 45 BDs
California	Pre-Application: 10 BDs Fast Track Screening: 15 BDs Modifications: 15 BDs Supplemental Review: 20 BDs Non-invert: 6 months		Detailed Study: Independent System Impact Study: 60 BDs Facilities Studies: 60 BDs (45 BDs if no upgrades are identified) Distribution Group Study Process DGS Phase I: 60 BDs DGS Phase II : 60 CDs to start, 60 BDs for report	

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Table 4-3. Interconnection Capacity Maps State Benchmark

	Fast Track Process	Hosting Capacity Maps	Pre-application	Application Process
 **New Jersey**	Levels 1 and 2	14:8-9.9 (f) The EDCs shall make available and update, in a commercially reasonable fashion, capacity hosting maps.	Not in the New Jersey Administrative Code	Not specified – currently allow paper, email, and software / online tools. Application is standardized for different Levels and posted to EDC's website
 **Virginia**	Levels 1 and 2	Not in Virginia Administrative Code – Dominion: Plan to refresh the data at least quarterly.	Yes – **20VAC5-314-35** Proposed project for a specific site: generating facility project, including site address, grid coordinates, project size, and proposed point of interconnection	Not standardized in Virginia Administrative Code
 **New York**	Yes, for ≤ 50 kW > 50 kW & ≤ 5 MW	Not in NYS Standardized Interconnection Requirements	Pre-Application Report (see Appendix D herein) be provided by the utility	Standard application in Appendix's. Electronic submission of all documents via the Interconnection Online Application Portal ("IOAP") is required.
 **Washington DC**	Levels 1, 2, and 3	Not in D.C. Municipal Regulations PEPCO has hosting capacity map	Not in D.C. Municipal Regulations	Interconnection customers seeking to interconnect a small generator facility shall submit an interconnection request using a standard form approved by the Commission to the electric distribution company ("EDC") that owns the electric distribution system to which interconnection is sought. The EDC shall establish processes for accepting interconnection requests electronically.
 **Maryland**	Levels 1, 2, and 3	**Sec. 20.50.04.01. Information for Customers** A. System Maps or Records. Each utility shall maintain up-to-date maps, plans, or records of its entire transmission and distribution system, with such other information as may be necessary to enable the utility to advise prospective customers, and others entitled to the information, as to the facilities available for serving a locality.	**Sec. 20.50.09.06. General Requirements** (3) For projects with a nameplate capacity over 20kW, the utility shall: (a) Provide the applicant an opportunity to request a pre-application report	Each utility shall establish a process that allows an applicant and an applicant's authorized designee to: (1) Sign and submit an interconnection request electronically on the utility's website; (2) Track the status of the interconnection request electronically; and (3) Conduct electronically any other process that can reasonably occur in that manner.
 **California**	Fast Track Process or detailed studied	Rulemaking 14-08-013 Integration Capacity Analysis -The ICA map is designed to help contractors and developers find potential project sites for distributed energy resources (DERs).	Yes - Pre-Application Report Request	Rule 21 - Standardize Application Online applications

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Table 4-4. Interconnection Metering Requirements State Benchmark

	Consolidated Levels	Hosting Capacity Maps
New Jersey	No	**N.J.A.C 14:8-4 NET METERING FOR CLASS I RENEWABLE ENERGY SYSTEMS** **Net Metering**: If applicable, customer is responsible for ensuring they meet the requirements of code. Utility will install the net meter.
Virginia	No	**20VAC5-314-80. Interconnection metering**. Any metering, including telemetering, necessitated by the use of the SGF and any additional utility metering requested by the IC and agreed to in writing by the utility shall be provided by the utility at the IC's expense in accordance with commission requirements or the utility's specifications. The IC shall be responsible for the utility's reasonable and necessary cost for the purchase, installation, operation, maintenance, testing, repair, and replacement of metering and telemetering equipment.
New York	No	Metering requirements shall be determined by the configuration of the DER system. New metering or modifications to existing metering will be reviewed on a case-by-case basis and shall be consistent with metering requirements adopted by the Commission.
Washington DC	No	**D.C. Regulations 15-40 & Chapter 15-9. NET ENERGY METERING** Any metering necessitated by a small generator interconnection shall be installed, operated and maintained in accordance with applicable tariffs. Any such metering requirements shall be clearly identified as part of the small generator interconnection agreement executed by the interconnection customer and the EDC.
Maryland	No	**Chapter 20.50.05. Meter Requirements** PEPCO: Telemetry is required on all DER systems over 2MWs. On radial circuits that have or can incorporate Distribution Automation, telemetry is required on all systems 250kW and greater. Telemetry requirements for the secondary network are delineated under that section. BGE: If EDC reasonably determines the need to install additional metering and telemetry and/or the capability of remote disconnect, Interconnection Customer shall allow this to be installed as expeditiously as possible.
California	Yes – screening criteria exits out of the additional screenings	**Net Metering**: Generating Facility customers may be required to install Net Generation Output Metering for evaluation, monitoring, and verification purposes and to determine applicable standby and non-bypassable charges **Telemetry**: If the nameplate rating of the Generating Facility is 1 MW or greater, Telemetering equipment at the Net Generation Output Metering location may be required at Producer's expense. If the Generating Facility is Interconnected to a portion of Distribution Provider's Distribution System operating at a voltage below 10 kV, then Telemetering equipment may be required on Generating Facilities 250 kW or greater Producer will bear all costs of the Metering required by this Rule, including the incremental costs of operating and maintaining the Metering Equipment.

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4.3.2 Interconnection Fees

Table 4-5. Interconnection Fees State Benchmark

State	Request Level	Capacity Level	Fee/Deposit
 **New Jersey**	Level 1	≤ 10 kW	No application or other fee.
	Level 2	≤ 2 MW	$50 + $1/kW capacity + cost of minor modifications to the electric distribution system or additional review Fee min: $51 max: $2,050 (additional review shall not exceed $100 per hour)
	Level 3	No range	$100 + $2 / kW capacity + charges for time spent on any impact and/or facilities studies required. Fee min: $102 max: $4,100 (engineering work shall not exceed $100 per hour)
 **Virginia**	Level 1	≤ 500 kW	$100 Processing fee
	Level 2	≤ 2 MW	$1,000 processing fee
	Level 3	> 2 MW	$1,000 processing fee and $10,000 plus $1.00 per kW_{AC} interconnection request study deposit
 **New York**		≤ 50kW	No application fee is required
		> 50 kW and ≤ 5 MW	Non-refundable fee of $750 . $2,500 nonrefundable fee for the supplemental screening
 **Washington DC**	Level 1	≤ 10 kW	Application fee of $100 payable to the EDC
	Level 2	≤ 2 MW	Application fee amount is $500
	Level 3	≤ 50 kW connected to area network OR ≤ 10 MW connected to a radial distribution	Application fee amount is $500
	Level 4	≤ 10 MW	Application fee amount is $1,000
 **Maryland**	Level 1	≤ 10 kW	None
	Level 2	≤ 2 MW	$50 plus $1 per kW
	Level 3	≤ 50 kW connected to area network OR ≤ 10 MW connected to a radial distribution	$100 plus $2 per kW
	Level 4	≤ 10 MW	$100 plus $2 per kW, to be applied toward any subsequent studies related to this application
 **California**	Non-NEM and > 1 MW NEM-2	Schedules NEM2, NEM2V, NEM2VMSH, and NEM2VSOM	Request fee: $800; Supplemental Review: $2,500; Detailed Study: Up to $250,000;
	<= 1 MW NEM-2		Request fee: $145; Supplemental Review: $0; Detailed Study: $0;
	NEM-1	Schedules NEM, NEMV, and NEMVMASH	Request fee: $0; Supplemental Review: $0; Detailed Study: $0;
	Non-NEM Solar ≤ 1MW		Request Fee + Supplemental Fee + Detailed Study: First $5,000 of study fees waived

Source: *Guidehouse*

4.3.3 Pre-Application Process

Pre-applications are a widely used, low-cost method of providing information to interconnection customers for decision-making purposes on grid conditions and potential interconnection limitations. The pre-application reduces the amount of canceled applications.[42] The method can also reduce the sunk costs and number of projects requiring a complex review.

Despite the significant value created by hosting capacity maps, pre-application informational studies provide interconnection customers more comprehensive and current set of data points upon which to make better informed interconnection decisions especially for Level 2 and Level 3 projects. In interconnection tariffs under Rule 21, the following table provides a sample of information typically provided under pre-application studies. Please note this is not an

[42] NREL, Evaluating the Role of Pre-Application Reports in Improving Distributed Generation Interconnection Processes, November 2018. nrel.gov/docs/fy19osti/71765.pdf

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exhaustive list of data points but illustrates the information most valuable to interconnection customers.[43] [44]

Table 4-6. Summary of Pre-Application Data Points

Standard Pre-Application	Enhanced Pre-Application: Primary Service Package	Enhanced Pre-Application Report: Behind the Meter Interconnection Package
Available capacity (MW) of substation/area bus or bank and circuit most likely to serve proposed site. Allocated capacity (MW) of substation/area bus or bank and circuit likely to serve proposed site. Queued capacity (MW) of substation/area bus or bank and circuit likely to serve proposed site. Relevant line Section(s) peak load estimate, and minimum load, when available. Limiting conductor rating from proposed Point of Interconnection to distribution substation.	Relevant line section(s) absolute minimum load, and minimum load during the 10 A.M. – 4 P.M. period Existing upstream protection including device type, device controller, phase settings, ground settings, rated continuous current, short Circuit interrupting capability, confirm if the device is capable of bidirectional operation Provide the Available Fault Current at the proposed point of interconnection including any existing distributed generation fault contribution.	Relevant line section(s) absolute minimum load, and minimum load during the 10 A.M. – 4 P.M. period Transformer data including kVA rating primary voltage, secondary voltage rating, configuration on both primary and secondary side, impedance (%Z) Primary and Secondary Service Characteristics: Conductor type (AL or CU) and size (AWG), Conductor insulation type, Number of parallel runs, confirm if the existing primary service is 3-wire or 4-wire.

Source: *PG&E and SCE Pre-Application Report Request documents (Rule 21 governed)*

States such as California provide an option for a pre-application informational study process with fees as shown in Table 4-7.

[43] PG&E Pre-Application Report Request. https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/interconnection-renewables/pre-app-request-guide.pdf

[44] SCE Rule 21 – Optional Pre-Application Report Request. https://edisonintl.sharepoint.com/:b:/t/Public/Misc/ERLq8u5V_y9DiL4hX8Yd-5oBxoDNFRFomtprvLfVq4MueA?e=aCKWXw

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Table 4-7. Summary of Rule 21 Interconnection Fees

Fee Description or Project Type	Amount
Pre-Application Report Fee	
Standard Pre-Application Report	$300
Enhanced Pre-Application Report: Primary Service Package	$225*
Enhanced Pre-Application Report: Behind the Meter Interconnection Package	$800*
Combined Primary Service Package and Behind the Meter Interconnection Package	$1,025*

Source: *From the Guidehouse Rule 21 evaluation report*

* Fees for enhanced pre-application report requests are $100 greater if they exclude a standard pre-application report request.

New York also uses a pre-application process, with the pre-application fee applicable toward the full application fee if the formal application is received by the utility within 15 business days of receipt of the pre-application report, as follows:[45]

> *"…the applicant may also request that a Pre-Application Report…be provided by the utility. The applicant shall provide a non-refundable fee of $750 with its request for completion of the Pre-Application Report. The Pre-Application Report shall be provided to the applicant within ten (10) Business Days of receipt of the form and payment of the fee. The Pre-Application Report will be non-binding and shall only provide the electrical system data and information requested that is readily available to the utility. Should the applicant formally apply to interconnect their proposed DG project within fifteen (15) Business Days of receipt of the utility's Pre-Application Report, the $750 will be applied toward the application fee in Step 3."*

4.3.4 Streamlined Application Process

Some states use utility-focused software platforms[46] to create a streamlined, auditable application framework. Functionalities of such software include the ability to take electronic payments, provide notifications to and from the customer, and update projected timelines. Through such implementation, the time required to address inconsistencies and errors would be reduced and the overall application process, including automating notifications of missing information, would be unified across EDCs.

For instance, states including California, New York, Arizona, Texas, Nevada have tested or implemented the SolarAPP+ to improve and streamline the application process. Turnkey software solutions, similar to the online portal used by ACE[47], are valued by developers and customers because they provide a common process across service areas, accelerating the

[45] New York State Public Service Commission, 2017. *New York State Standardized Interconnection Requirements and Application Process For New Distributed Generators 5 MW or Less Connected in Parallel with Utility Distribution Systems*. nationalgridus.com/niagaramohawk/non_html/ADDESIR.pdf

[46] Examples include PowerClerk, SolarApp+, and ANB Systems

[47] ACE online application portal: https://www.atlanticcityelectric.com/SmartEnergy/MyGreenPowerConnection/Pages/ApplyOnline.aspx

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interconnection process. Such software would improve the efficiency and tracking of interconnection connection throughout all levels. Interconnection application software provides structured data intake and notifications, enforcing clearly defined tariff timelines. Furthermore, increased streamlining would help in unifying the overall application process, including automating notifications of missing information, across EDCs.

4.3.5 Recordkeeping Mechanisms and Data Access

Utilities in states such as California are moving toward managing generator interconnection requests in a database.

NY has an online system per their tariff: "electronic submission of all documents via the Interconnection Online Application Portal (IOAP)."[48] Likewise ACE has an online portal system[49] with similar functionality.[50]

4.3.6 Customer Satisfaction Surveys

Some states use interconnection customer feedback satisfaction surveys as a best practice.

4.4 Circuit Capacity

Hosting capacity maps are indicative of which portions of the grid can accommodate more generation without costly circuit upgrades and are required to enable renewables interconnection and grid modernization. In combination with prequalifying studies, hosting capacity maps are a valuable guide to connection viability.

There are multiple use cases for capacity maps, which are typically implemented in a phased approach and evolve over time. Per IREC,[51] the four steps involved in a hosting capacity analysis (HCA) are: (1) Model Preparation, (2) Simulation, (3) Post-Data Processing, and (4) Visualization, and the use cases include:[52]

- Interconnection
- Site selection
- Fast-track screens
- Distribution Upgrade Planning
- Locational Value

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[48] National Grid nCAP Portal: ngus.force.com/s/

[49] ACE interconnection application portal: atlanticcityelectric.com/SmartEnergy/MyGreenPowerConnection/Pages/HowToApply.aspx

[50] The ACE portal was recently updated on February 14, 2022: atlanticcityelectric.com/SmartEnergy/MyGreenPowerConnection/Documents/ConnectTheGrid%20Refresh%20Information.pdf

[51] IREC, NREL, April 2022. Nagarajan, A., Zakai, Y. Data Validation for Hosting Capacity Analyses irecusa.org/wp-content/uploads/2022/04/Data-Validation-for-Hosting-Capacity-Analysis-Final.pdf

[52] IREC, Key Decisions for Hosting Capacity Analyses, September 2021, p.8: irecusa.org/wp-content/uploads/2021/10/IREC-Key-Decisions-for-HCA.pdf

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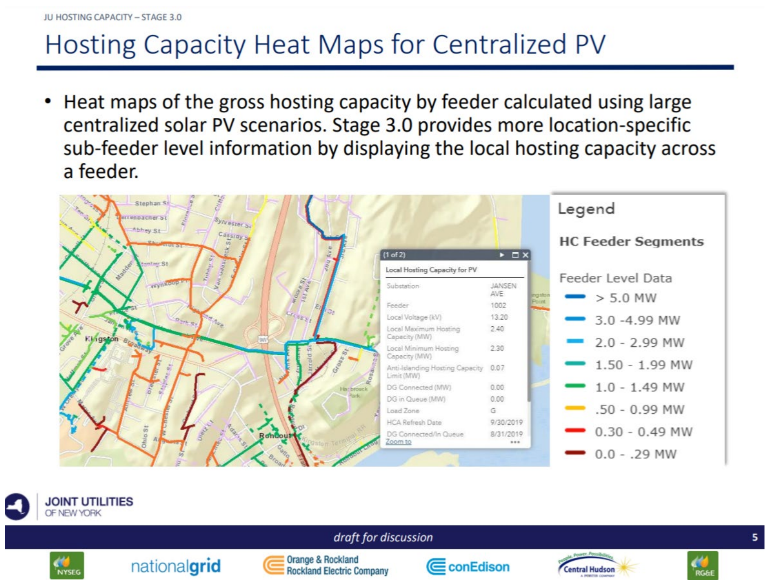
Hosting capacity data must be correct and up to date, easy to find, and easy to understand and interpret, and integration capability improved and managed using intelligent devices. Existing online hosting capacity maps available in NJ are described in Section 3.4 above and can be compared with the following best-in-class maps.

California and New York (Reforming the Energy Vision, REV) use controllable intelligent devices to manage hosting capacity.

Figure 4-1. Illustrative Hosting Capacity Heat Map for Centralized PV



Source: *Joint Utilities of New York*

4.4.1 California

4.4.1.1 Southern California Edison (SCE)

Since 2019, the three large Investor-Owned Utilities in California[53] have utilized their own Integration Capacity Analysis (ICA)[54] mapping tool to provide information about each utility's distribution grid. SCE's online tool provides a best-in-class example of ICA maps currently available in regard to transparency and usability. The following screenshots demonstrate key capabilities for the SCE ICA maps.

[53] Called EDCs in New Jersey

[54] Also called hosting capacity

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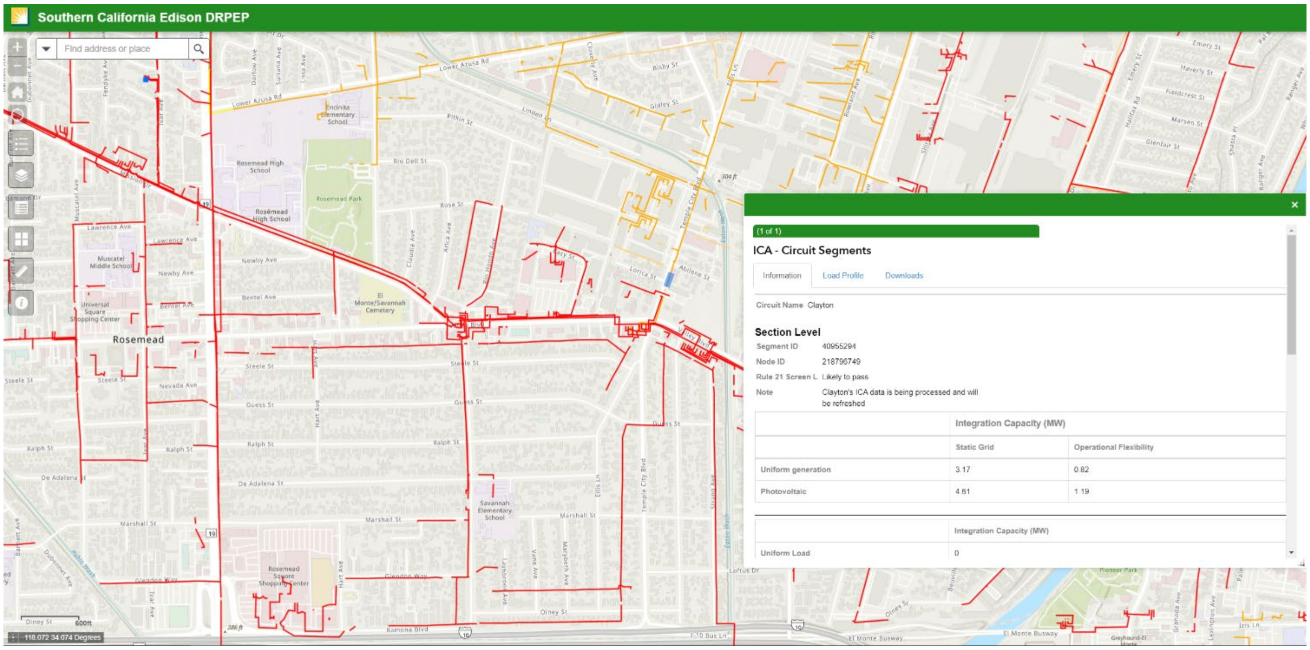
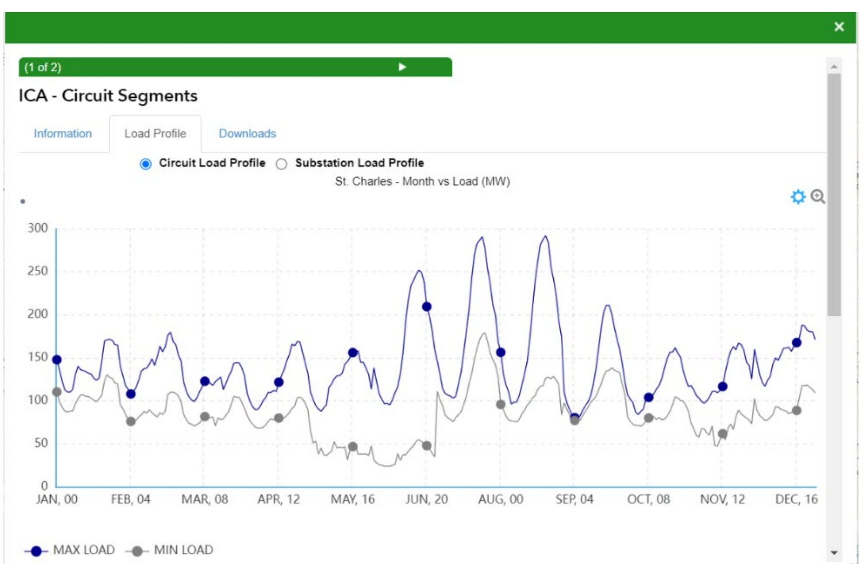
Figure 4-2. SCE's Integration Capacity Analysis (ICA) Map



Source: *Southern California Edison*

The line segments of the circuits for SCE indicate the available capacity with red indicating limited capacity and green ample capacity. Load profile graphs are also available within the ICA map. This data is presented at both the circuit and substation level and includes the maximum and minimum daily values throughout the last measured year. Sample graphs are shown in the figures below.

Figure 4-3. Circuit Load Profile



Source: *Southern California Edison*

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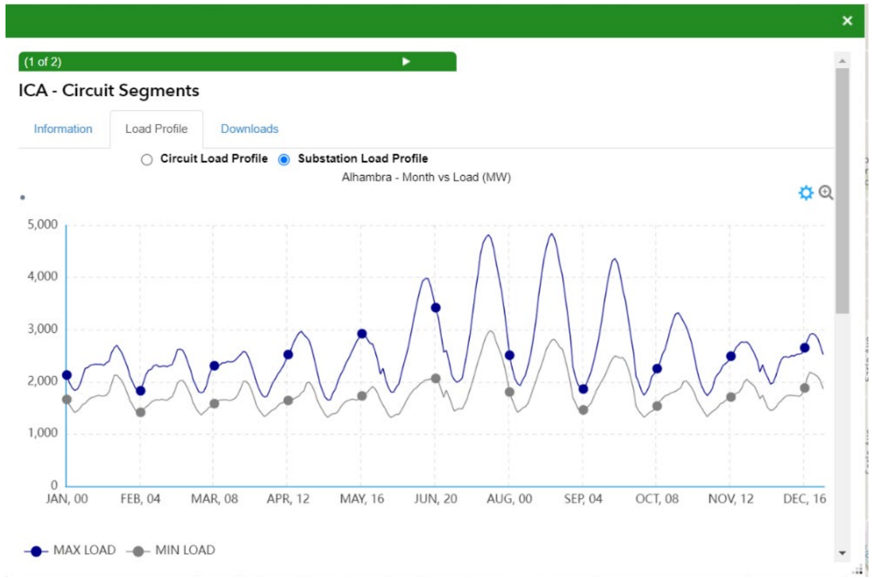
Figure 4-4. Substation Load Profile



Source: *Southern California Edison*

Other detail available to developers from the SCE tool includes the following:

- Generation capacity is specified as Static Grid or Operational Flexibility (OpFlex)
  - Static Grid: the amount of generation that can be integrated without violating one of the four criteria in thermal, steady-state voltage, voltage fluctuation, and protection
  - OpFlex: includes an additional criterion intended as a proxy for evaluating whether the construction of a DER project would limit the utility's ability to reconfigure circuits in the case of an emergency fault or other event
- Uniform load on a circuit segment
- Preliminary information on the circuit segment and its likelihood to pass Rule 21 Screen L, which checks if an interconnection area has known transient/dynamic stability limitation, if a transmission ground fault overvoltage is possible, if a proposed facility has any transmission interdependencies, and if all islanding conditions are met based on the utility's screening policies
- Hosting maps contain a built-in function enabling users to filter sites based on available capacity above a certain threshold
- Circuit information that includes the voltage, existing generation, queued generation, and the customer type at a selected circuit as seen in Figure 4-5 below

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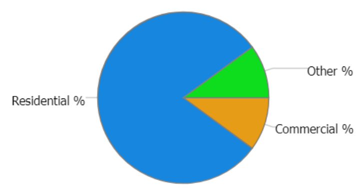
Figure 4-5. Circuit Information

Circuit Level

Circuit Name	Edmond
Circuit Voltage (KV)	4
Substation Name	Ivar
System Name	Mesa 220/66 System
Existing Generation (MW)	0.16
Queued Generation (MW)	0
Total Generation (MW)	0.16

Generation data under review

Customer Type Breakdown

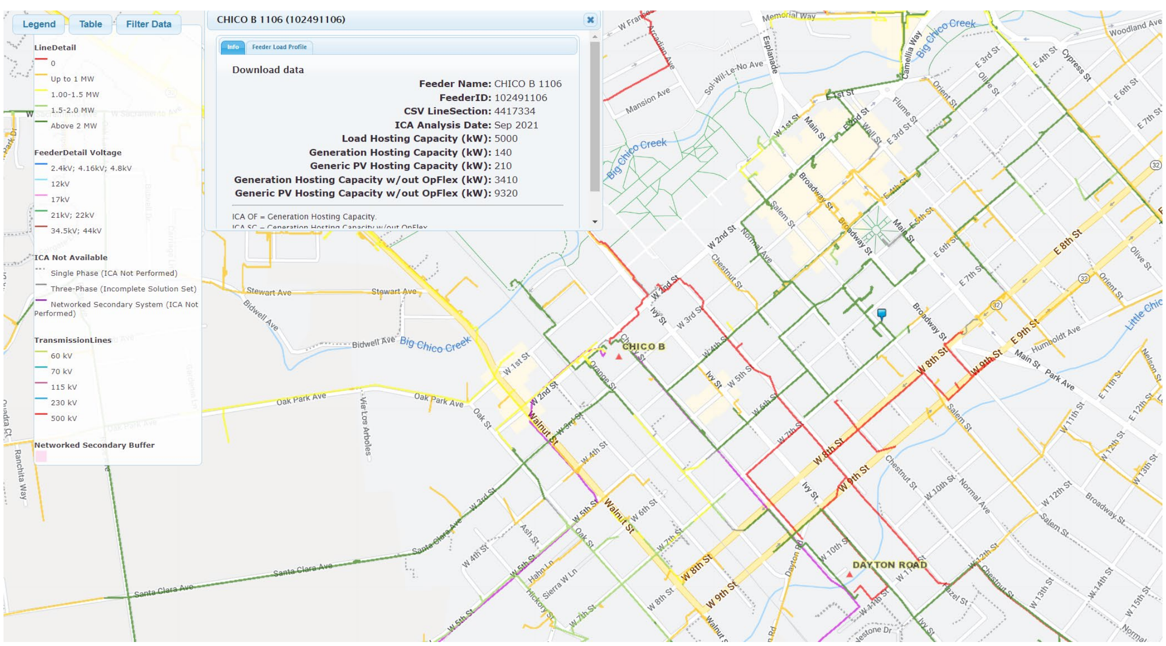


Source: *Southern California Edison*

4.4.1.2 Pacific Gas & Electric Company (PG&E)

PG&E also provides similar data to SCE. For each feeder, the load hosting capacity and both the normal generation and PV generation are labeled individually. Both types of generation are outlined with and without OpFlex as shown in the figure below. The feeder graphic can also be filtered by load capacity up to 5 kW.

Figure 4-6. PG&E's ICA Map



Source: *PG&E*

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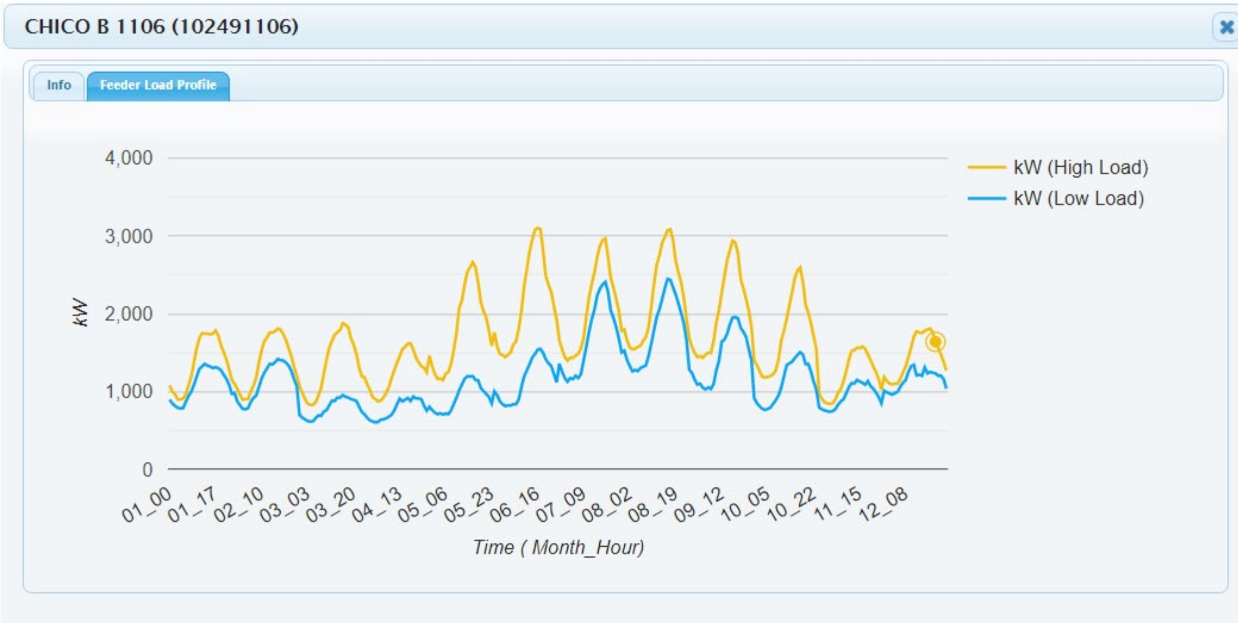
Feeder Load profile in Figure 4-7 is also another similarity compared to the SCE data. Substation load profile is not included in the PG&E's data.

Figure 4-7. Feeder Load Profile



Source: *PG&E*

PG&E also provides a table for their feeder information that can be filtered by the measured load and generation data. As seen in Figure 4-8, the data can also be downloaded in an excel file to provide an easier way to view data.

Figure 4-8. Feeder Table

Export to CSV | Export to Excel | Close

FeederId	FeederName	CSV_LineSection	ICA_Analysis_Date	LoadCapacity_kW	GenCapacity_kW	GenericPVCapacity_kW	GenCapacity_no_OpFlex_kW	GenericCapacity_no_OpFlex_kW
102050401	CHICO A 0401	3482012	Aug 2021	570	90	120	690	1330
102050401	CHICO A 0401	4974787	Aug 2021	570	90	120	790	1330
102050401	CHICO A 0401	4626297	Aug 2021	910	90	120	1040	2490
102050401	CHICO A 0401	4128339	Aug 2021	400	90	120	350	730
102050401	CHICO A 0401	4632045	Aug 2021	750	90	120	890	2020
102050401	CHICO A 0401	4550494	Aug 2021	640	90	120	730	1300
102050401	CHICO A 0401	3812466	Aug 2021	470	90	120	440	930
102050401	CHICO A 0401	3790721	Aug 2021	580	90	120	640	1300
102050402	CHICO A 0402	5017625	Feb 2022	310	270	380	850	1430
102050402	CHICO A 0402	4008208	Feb 2022	290	270	380	790	1170

Showing 1 to 10 of 1,000 entries visible on the map. Previous 1 2 3 4 5 … 100 Next

Source: *PG&E*

4.5 Cost and Schedule Impacts Due to Interconnection Studies

Interconnection studies required for safe and reliable interconnection to the grid have associated cost and interconnection timeline impacts. Utilities perform studies once the project data is made available and fees have been paid. Opportunities exist to increase the efficiency of

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the interconnection process by streamlining the study process. There are two primary interconnection study approaches: (1) a serial study process, and (2) a cluster study process.

4.5.1 Serial Process

The serial interconnection study process is the traditional approach in which projects are studied individually and sequentially based on the time of the request, i.e., their queue position. While this provides simplicity, some adverse effects can be:

- Projects can clog the queue since higher queued projects must be completed before studying the next queued project.
- Typically, there is no timeline for applicants to pay upgrade costs which adds to this problem.
- Higher-queued projects may have to bear all the costs of system upgrades that will benefit lower-queued projects, e.g., $500,000 worth of upgrades attributed to a single higher-queued project may also benefit subsequent lower-queued projects. In a serial study process the lower-queued projects are not required to pay any of the upgrade costs even though they benefit from the upgrades.

4.5.2 Cluster Process

The cluster study process uses a grouped study where projects are generally submitted during a specified request window by project developers. The clustering approach, historically used for transmission system interconnection based on FERC transmission ISO/RTO standards, is one that many electric utilities are moving toward to improve renewables interconnection to the distribution system since it allows for the following benefits:

- Multiple projects are studied at the same time, typically grouped by nearby electrical location
- Costs of upgrades are shared among all applicants in the cluster, e.g., $500,000 worth of upgrades are allocated across five applicants, for example, $100,000 per applicant[55] so that the cost burden of the upgrades does not fall on a single “cost-causer” applicant.
- Additionally, re-studies due to applicants dropping out of a cluster can also be mitigated through withdrawal penalties for projects exiting out of the normal study cycle. These withdrawal penalties can support restudy costs for those projects remaining in the process.

While the clustering process has aided queue reform by reducing queue length and mitigating speculative project withdrawals through larger financial deposits, queue backlogs continue to grow. Some states have pre-built transmission interconnections to renewable resource areas to lower entry costs for generators, such as FERC’s Location Constrained Resource Interconnection policy.

[55] The cost allocation in a cluster study process is not necessarily evenly split among interconnection customers in a cluster.

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The current process has some outdated legacy processes and thresholds from the FERC small generator pro forma which could be modified to better fit the NJ grid and its customers. The South Carolina Public Service Commission in 2019 directed their state regulated utilities, Dominion & Duke, to work together and carry out a stakeholder process to accomplish a requested list of items from the Commission.[56]

In 2021, the State of New York Public Service Commission approved a petition for changing the "first mover" rule for DER interconnection cost sharing. In the prior cost sharing approach, the first interconnection project that triggers a substation upgrade requirement would be responsible for the cost of the upgrade and could be reimbursed with other future interconnection projects. In the new cost sharing approach, the first project that triggers an upgrade need and projects with later interconnection queue positions on the same substation would share the cost using a pro-rata approach.

Furthermore, in Massachusetts, the Department of Public Utilities started the process of a straw proposal that allows the utilities to file capital investment projects in which the cost of DER-related upgrades could be recovered from customers using a new reconciling charge over a period of time.

For jurisdictions who advance-build infrastructure based on prospective need, a regulatory body is responsible for determining substantiation of need to support DER integration and other criteria. For example, if there is obsolete equipment on the grid that should be replaced for system reliability and resiliency, then a grid modernization program, paid for by the utility customers across the system, not just at DER locations, is appropriate. Examples of such equipment are protective relays, installation of SCADA monitoring, communications systems, small wire replacement.[57]

4.6 Distribution System Upgrade Cost Estimation and Allocation

Many jurisdictions use a grouping or clustering approach to studying interconnection requests when considering required upgrades, upgrade cost estimation and allocation.

4.6.1 Interconnection Study Options Other than Serial Studies

Table 4-8. Serial and Cluster Interconnection Study Process Descriptions

	Serial	Cluster
Entry	Generally done on a 'first-come, first served' approach where once a valid application has been submitted, the customer is given a queue position. The queue positions define the order in which each project will be studied.	A cluster request window is usually open for a limited amount of time (e.g., 60, 150 calendar days) which allows any interconnection customer to submit a formal request to be considered in the upcoming cluster process.

[56] South Carolina Public Service Commission Act 62: link
[57] Massachusetts uses this approach

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	Serial	Cluster
During	Projects are studied one at a time depending on queue position Any upgrade costs are designated only to the first project in the queue that triggers an upgrade need EDCs use higher-queued project studies and upgrades to see if any lower-queued projects studied may require further upgrades to be connected Process can include milestones (example below).	Projects are studied in a group The grouping of projects usually happens by nearby electrical location Cost of upgrades is shared among group project participants, using a cost sharing approach Some processes have milestones (example below) to show first-ready, first-through status If a project drops out a restudy and a reallocation of cost may be conducted Withdrawal penalties may be applied to fund the re-studies for applicants still in the process Set timeline for EDCs and applicants for each action
Exit	Lower-queued projects need to wait in line as higher-queued projects either pay or wait for upgrades Usually, no timeline for applicants to pay upgrade cost Ex of cost - $500,000 upgrade cost to one applicant.	All applicants still in the process will pay their part of the upgrade cost Example of cost sharing: - $500,000 upgrade cost shared among five applicants can be $100,000 per applicant.
Pros	Provides simplicity for EDCs as there is only one interconnection being studied at a time Easy to track cost of study and cost of upgrade for EDCs Applicants with a lower queue status can end up paying nothing.	Multiple interconnection requests are studied concurrently Network upgrade costs can be split among all applicants in a cluster (pro-rata and per capita) Can hold other customers accountable through withdrawal penalties which can be allocated toward restudy costs.
Cons	Stalled projects can clog queue (Example: customers waiting in the queue have to wait a long time for customers ahead of them to pay, since there may not be a set timeline required for customer payments). Most of the backlog tends to be for renewable resources with increased interest in meeting carbon free goals for different regions. Interconnecting customers may have to bear upgrade costs individually that will also benefit lower-queued projects.	If an interconnection customer drops out of a queue, it can cause a restudy of all remaining requests in the cluster Larger than anticipated cluster sizes can be troublesome for EDCs to plan and manage.

Source: *Guidehouse*

Milestones can provide an extra project viability assurance for an EDC, such as by offering the option of paying a smaller application deposit if a customer meets certain milestone

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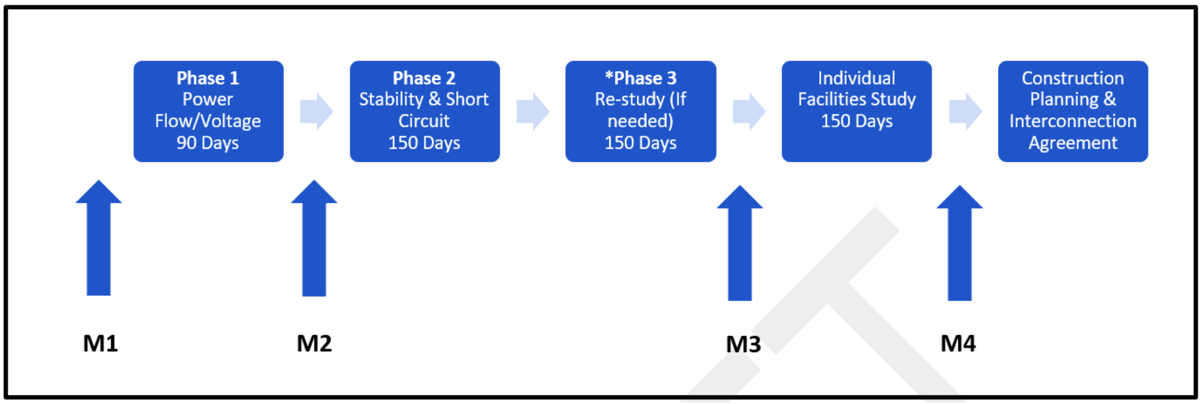
requirements. Although more typical on the transmission grid, Duke Energy is piloting milestone checks for the distribution-side interconnection process to improve interconnection queue efficiency (see Figure 4-9 from Duke Energy). Meeting the milestones can consider the project "ready." Additionally, stage gate milestones must be met before commencing a new stage of an interconnection process. Milestones can include various goals such as:

- An executed term sheet binding the customer to a contractual obligation for the sale of the generation facility's energy (e.g., a purchase power agreement)
- Reasonable evidence the project has been selected by the EDC in a resource plan or offering to sell its output through a resource solicitation process

Figure 4-9. Example of Milestones Implemented During Interconnection Process



Source: *Duke*

Additionally, increased withdrawal penalties can be applied to a "non-ready" interconnection customer if they withdraw and haven't met certain milestones throughout the process.

A "non-ready" project will be one that has not met the milestone criteria to be considered a "ready" project, they would need to pay higher deposits and withdrawal penalties if they choose to withdraw.

The following figures illustrate the impacts of "ready" and "non-ready" status on study deposit and withdrawal penalties outlined by Duke's interconnection process respectively.

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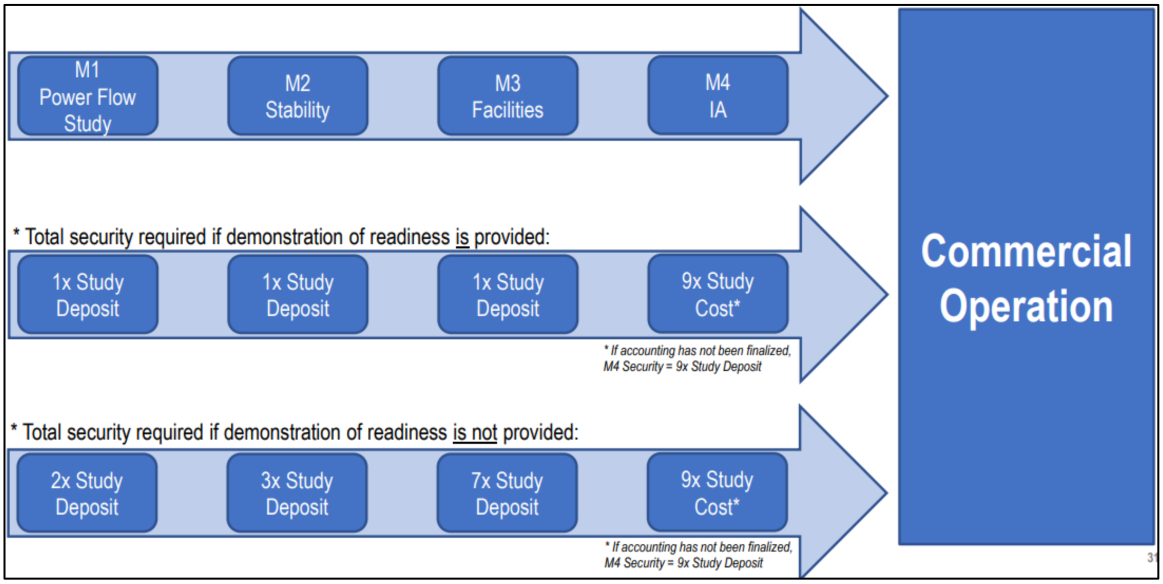
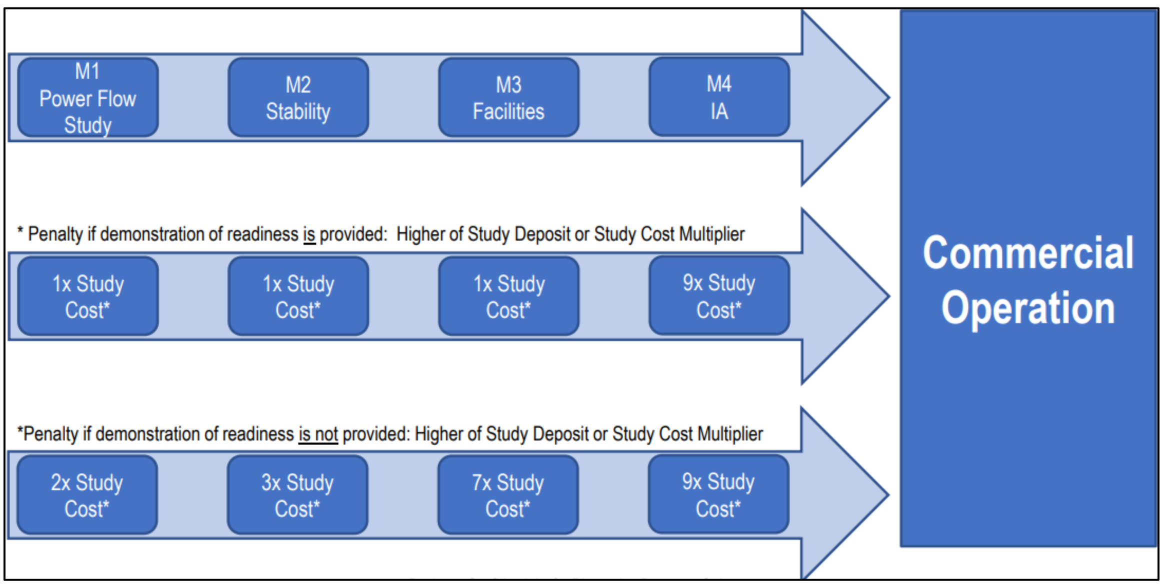
Figure 4-10. Study Deposit Process for Ready and Non-Ready Projects



Source: *Duke*

Figure 4-11. Withdrawal Penalties Process for Ready and Non-Ready Projects



Source: *Duke*

Table 4-9 shows the status of clustering approaches across states.

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Table 4-9. Clustering Approach State Benchmark

	Request Level	Capacity Level	Fee/Deposit
 **New Jersey**	Level 1	<= 10 kW	No Options for clustering (Potentially clustering similarly located projects with the same Interconnection Customer)
	Level 2	<= 2 MW	
	Level 3	No range	
 **Virginia**	Level 1	<= 500 kW	**20VAC5-314-50. Levels 2 and 3 interconnection request general** C. The utility shall prioritize interdependent projects pursuant to 20VAC5-314-38. If applicable, the interconnection request study deposit specified in the Interconnection Request Form will be required pursuant to 20VAC5-314-38. **At the utility's option, interconnection requests may be studied serially or in clusters for the purpose of the system impact study**.
	Level 2	<= 2 MW	
	Level 3	> 2 MW	
 **New York**		<= 50kW	No- A completed application shall be placed in the utility's interconnection queue. The utilities will manage the queue of interconnection applications in their inventories in the order in which they are received and according to the timelines set forth in SIR document. To ensure applications are addressed in a timely manner and monitor the overall interconnection activities, utilities shall submit an SIR inventory of projects monthly to the Public Service Commission by the 15th day of the following month. Therefore, 12 interconnection inventory submissions shall be provided each year by each of the electric utilities. Utilities shall provide DPS Staff with redacted and unredacted versions of its interconnection inventory, including the current queue, for the associated time period in Excel format
		> 50 kW and <= 5 MW	
 **Washington DC**	Level 1	<= 10 kW	No – it is not in the D.C. Regulations.
	Level 2	<= 2 MW	
	Level 3	<= 50 kW connected to area network OR <= 10 MW connected to a radial distribution	
	Level 4	<= 10 MW	
 **Maryland**	Level 1	<= 10 kW	No - The EDC shall assign a queue position. The queue position of an interconnection request shall be used to determine the cost responsibility necessary for the facilities to accommodate the interconnection. The EDC shall notify the applicant about other higher-queued applicants. Any required interconnection studies shall not begin until the EDC has completed its review of all other interconnection requests that have a higher queue position.
	Level 2	≤ 2 MW	
	Level 3	<= 50 kW connected to area network OR <= 10 MW connected to a radial distribution	
	Level 4	<= 10 MW	
 **California**	Non-NEM and > 1 MW NEM-2	Schedules NEM2, NEM2V, NEM2VMSH, and NEM2VSOM (Not a NEM-1 Schedule)	**Detailed Study Screens:** **Screen Q: Is the Interconnection Request electrically Independent of the Transmission System?** If Applicant's Interconnection Request fails Screen Q or elects to be studied under the Wholesale Distribution Tariff (WDT) Transmission Cluster Study Process, Applicant shall have the option of applying for Interconnection under the WDT Transmission Cluster Study Process of the Wholesale Distribution Tariff in accordance with its provisions. If Applicant fails Screen Q, Applicant's Interconnection Request shall be deemed withdrawn under this Rule regardless of whether Applicant applies for Interconnection under the WDT. Distribution Provider shall inform Applicant of the Detailed Study start date.
	<= 1 MW NEM-2		
	NEM-1	Schedules NEM, NEMV, and NEMVMASH <= 1 MW	
	Non-NEM Solar ≤ 1MW		

Source: *Guidehouse*

4.7 Interconnection Codes, Standards and Certification

4.7.1 Detailed Electric Interconnection Rules

Many utilities and state commissions use FERC SGIP as the basis for their interconnection procedures, including codes, standards, and certifications used. However, recently many utilities and utility commissions have started to develop their own version of a generation interconnection process, some examples are:

- California rule 21 which was a combination of CPUC, CAISO and IOUs effort that took 10 years
- Duke North/South Carolina process which follows their FERC process so both transmission and distribution project studies could be run side by side, and New York

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which recently updated the standard interconnection procedures process to include energy storage

- Duke was directed to revise their current interconnection process to "include energy storage and ensure efficient and timely processing of interconnection request."[58] This supports regulatory interconnection reforms that standardized basic requirements while still allowing the electric distribution utility to define grid-specific processes as needed.

In addition to specifying generation processes, states such as California and New York, have directed their own electric utilities to create detailed interconnection procedures including fast-track processes, structured timelines for serial and cluster processes, milestones, withdrawal penalties, and deposits. These detailed interconnection frameworks provide a clear path for viable projects from application to construction, accelerating interconnection of renewable generators onto the grid. Figure 4-12 shows and example of a detailed decision tree for San Diego Gas and Electric (SDG&E) used to screen and accelerate the interconnection process, produced under Rule 21 guidance.

[58] South Carolina Office of Regulatory Staff, South Carolina Energy Freedom Act website: ors.sc.gov/consumers/electric-natural-gas/solar/south-carolina-energy-freedom-act

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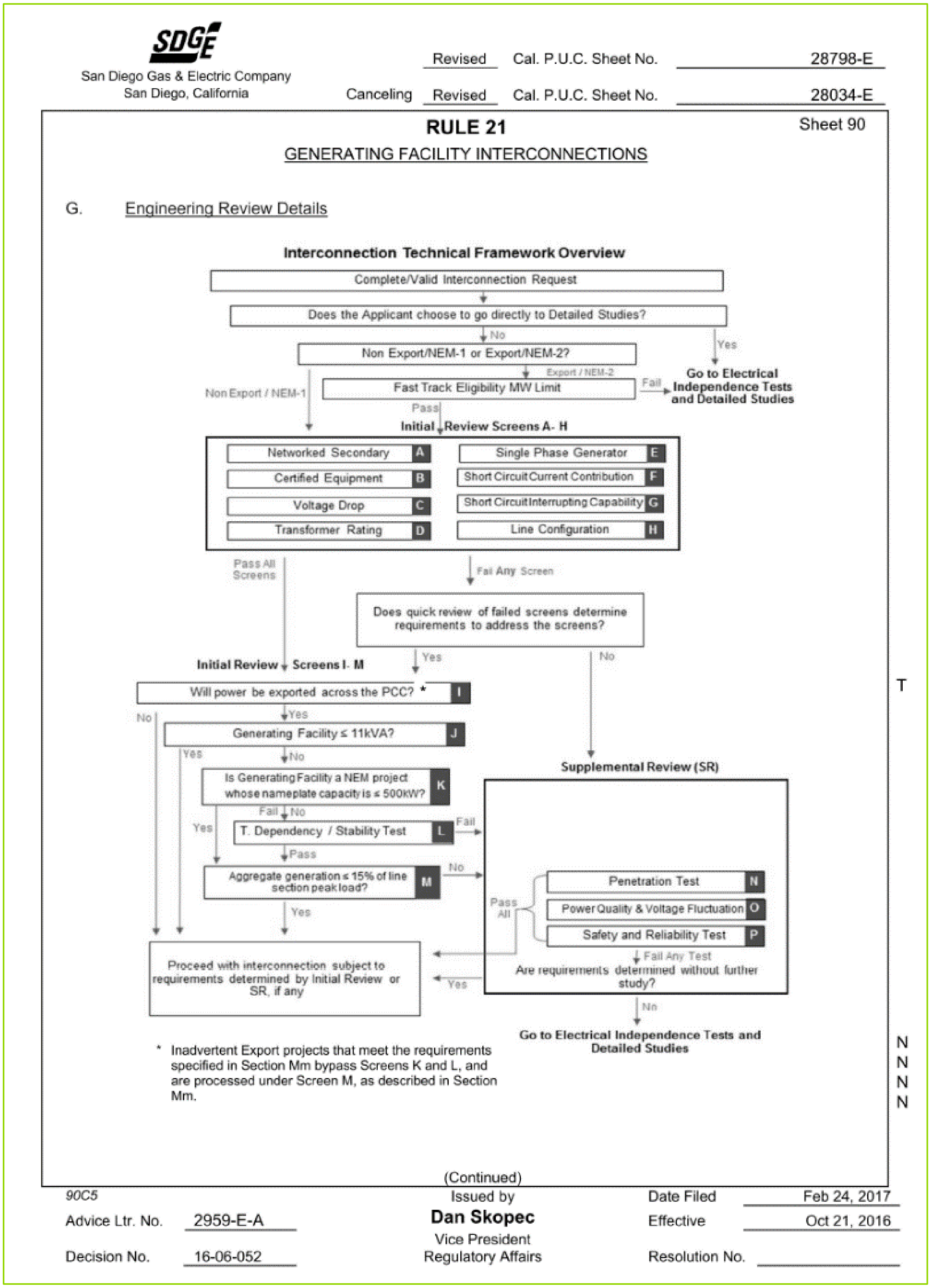
Figure 4-12. California Rule 21 Generating Facility Interconnection Review Details



SDGE
San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 28798-E
Canceling Revised Cal. P.U.C. Sheet No. 28034-E

RULE 21 Sheet 90

GENERATING FACILITY INTERCONNECTIONS

G. Engineering Review Details

* Inadvertent Export projects that meet the requirements specified in Section Mm bypass Screens K and L, and are processed under Screen M, as described in Section Mm.

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N
N
N
N

(Continued)

90C5	Issued by	Date Filed	Feb 24, 2017
Advice Ltr. No. 2959-E-A	**Dan Skopec**	Effective	Oct 21, 2016
Decision No. 16-06-052	Vice President Regulatory Affairs	Resolution No.	

Source: *SDG&E*

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Additionally, other states use definitions for interconnection levels other than the FERC SGIP, which was developed primarily for transmission rather than distribution use cases.

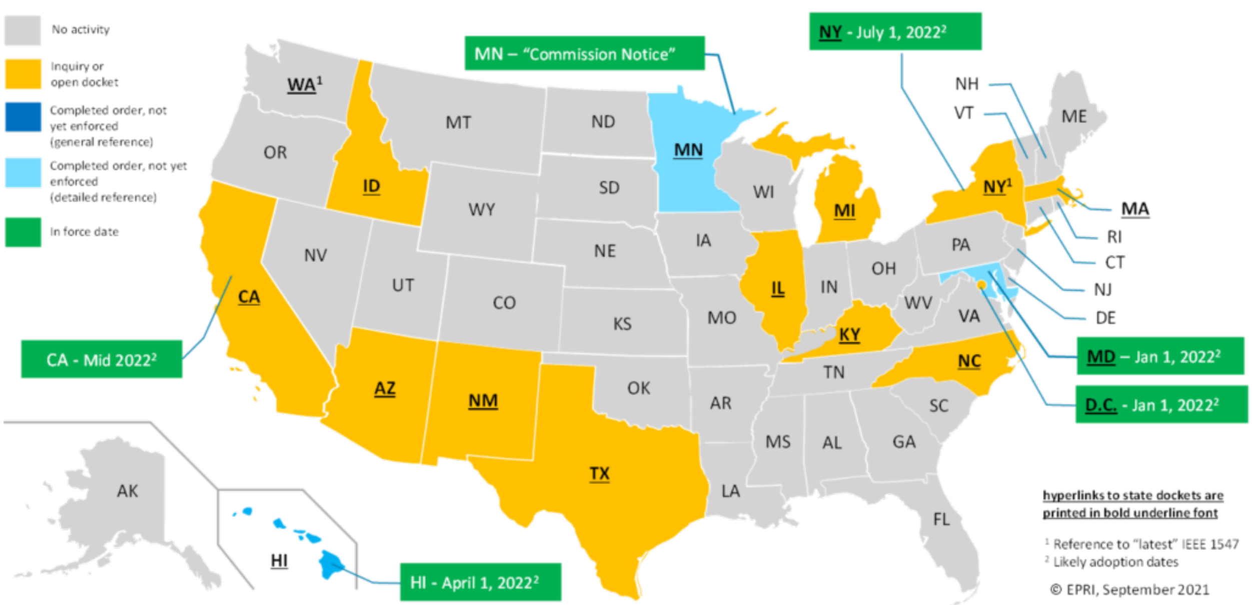
To enable technologies that are languishing under outdated policies, some states, such as North Carolina, direct electric utilities to prove in emerging technologies. Some best and common practices which have begun to emerge under these initiatives are:

- Load forecasts take into account load growth and netting the effects of the addition of new resources
- Operational practices address the issue of resource backflow into the distribution system in a safe and reliable manner
- Studies address the issues of energy storage including planning and operational considerations pertaining to energy storage charging and discharging practices
- DER integration practices more closely align planning and interconnection activities
- Operational considerations include enhanced communication and control of the system to complement the addition of new technology and resources

4.7.2 Implementation of IEEE 1547-2018

IEEE 1547 is a standard that provides interconnection and interoperability requirements for DERs. An updated version of this standard was approved in 2020. As of September 2021, IEEE 1547-2018 has been adopted in 13 states.[59] [60]

Figure 4-13. Status of IEEE 1547-2018 Adoption by State



Source: *IEEE Std 1547-2018 (Revision of IEEE Std 1547-2003), IEEE*

59 IEEE SAA, IEEE Std 1547-2018 (Revision of IEEE Std 1547-2003)
60 This includes states that either have an inquiry/open docket or that have completed an order for IEEE 1547-2018

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The 2018 updated version of IEEE 1547 provides an expansion on interconnection capability requirements. The standard elaborates and sets definitive criteria on frequency and voltage support, tripping and reclose coordination, and voltage support.

These changes will help address NJ stakeholder concerns about enabling existing inverter functions and controls. Furthermore, the revised standard introduces and elaborates on performance categories for normal (with voltage regulation) and abnormal conditions (using voltage ride-through).

IEEE 1547-2018 also provides approaches for information exchange within local DER communications interfaces to enable interoperability between DERs and the distribution grid. This is essential to interconnecting, integrating, and operationalizing increasing amounts of renewable generation capacity on the distribution grid. The 2020 amendment for IEEE 1547-2018 provides more flexibility for adoption of abnormal operating performance Category III.

As standards such as IEEE 1547 are updated, they are generally brought up to the most up to date codes in the industry. A transition period is implemented wherein any projects after a set date shall meet the new version of the code and any legacy projects prior to the date will follow the old codes. In support of keeping standards up to date, NREL has developed a framework[61] for utilities and jurisdictions that are planning to update and incorporate the latest version of IEEE 1547. The process includes:

- **Determine the context** – understand the broader context around interconnection in relation to stakeholders involved, transmission and distribution planning, and other relevant regulatory and policy procedures
- **Develop the interconnection rule** – put the IEEE 1547-2018/2020A standard into context with other technical requirements needed by the EDCs and NJ
- **Maintain and revise the interconnection rule** – monitor and evaluate both the process and technical components of the rule using goals and drivers assessed by stakeholders

4.8 PJM

PJM has received a large number of requests for interconnection and its new processes are similar to the common practice of other ISOs/RTOs. PJM is moving to “first ready/first through” processing to improve project readiness reduce delays and is moving toward interconnection study and cost allocation processes which are cluster and cycle based. Cluster studies have the advantage of decreasing costs for participants due to the sharing of facility development in cluster regions. Multiple projects in the queue can be addressed quickly and efficiently by providing an off-ramp for projects that would clog the queue under a traditional serial interconnection study process.

[61] NREL, A Guide to Updating Interconnection Rules and Incorporating IEEE Standard 1547, October 2021, https://www.nrel.gov/docs/fy22osti/75290.pdf

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4.9 Emerging Essential Grid Modernization Essentials

4.9.1 EDC Integrated DER Roadmap Plans

Integrated DER roadmap plans are called for in the EMP. California, several Mid-Atlantic states, and Hawaii have developed integrated DER roadmaps in response to requirements of their state commissions.[62] Even as they have had some challenges, an integrated DER plan sits at the center of the industry's complex transition toward a clean and modernized grid.

For instance, California State Assembly Bill 327 required electrical corporations to file distribution resource planning (DRP) proposals by July 1, 2015.[63] The bill provides a regulatory framework for distribution planning that recognizes the needs and limitations for DER growth within the energy system and California's climate goals. With AB 327 in place, electric companies abided by the following requirements:[64]

- Evaluate locational benefits and costs of distributed resources located in the distribution system.
- Propose or identify standard tariffs, contracts, or other mechanisms for the deployment of cost-effective distributed resources that satisfy distribution planning objectives.
- Propose cost-effective methods of effectively coordinating existing commission-approved programs, incentives, and tariffs to maximize the locational benefits and minimize the incremental costs of distributed resources.
- Identify any additional utility spending necessary to integrate cost-effective distributed resources into distribution planning consistent with the goal of yielding net benefits to ratepayers.
- Identify barriers to the deployment of DER including methodologies related to technology or operation of the distribution circuit that unduly exceed what is required to maintain safety and reliable service as set forth in applicable industry standards.

The implementation of a regulatory framework improves the traditional approach to resource planning by structuring the integration of DERs in grid planning. With regulatory administration, DRP enhances the development of pathways towards meeting customer and grid needs addressing state climate goals. DRP also provides additional visibility to areas such as the grid constraints of increased deployment of DERs for the grid and infrastructure investment needs (e.g., investments in upgrades, enabling technologies, etc.). As interconnection is a critical aspect of integrating DERs to the grid, DRP allows regulators and other stakeholders to better identify limitations and challenges within the interconnection process to further the development of effective solutions.

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[62] Doyle, Patrick; Santiago Enriquez; Eric Hyman; Loretta Bauer; and Pablo Torres. 2020. Recommendations for Preparation of a Distributed Energy Resources Plan or Roadmap. Washington, DC: Crown Agents USA and Abt Associates, Prepared for USAID, pdf.usaid.gov/pdf_docs/PA00X3M1.pdf

[63] AB-327 Electricity: natural gas: rates: net energy metering: California Renewables Portfolio Standard Program

[64] Public Utilities Code – § PUC 769. leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=769.&lawCode=PUC

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4.9.2 Multiple Generators Behind the Same Meter, Hybrid DER System Interconnection

Hybrid interconnection scenarios with multiple generation sources behind the meter, such as solar-plus-hydrogen, are emerging in many utility jurisdictions. States have been assessing mechanisms to allow non-renewable fuel sources to take part in the NEM program. In particular:

- Georgia power (a Southern Company subsidiary) allows for non-renewable fuel sources to take part of the net metering program.[65]
- The Public Service Commission of Wisconsin allows non-renewable resources to get an energy credit rate for the utility's avoided cost.[66]
- Connecticut, New York, and Rhode Island have adopted policies to allow fuel cells to be included in the net metering program.[67]
- California and New York are explicitly including an energy storage interconnection process in their code for Hybrid Project, standalone storage, or the addition of energy storage to an existing generating facility.

Additionally, The Department of Energy (DOE) Office of Energy Efficiency & Renewable Energy issued a report for Combined Heat and Power (CHP), which includes a pathway for CHP to qualify as a clean distributed generation source through the use of renewable biomass or clean energy-like natural gas. This allows CHP systems to be net-metered, improving the economics for the CHP system and other generators that are interconnected to the grid.[68]

The intersection of NEM-participating resources and KPIs pertaining to New Jersey's clean energy future[69] [70] such as greenhouse gas reduction offsets should be considered. To be able to accomplish their de-carbonation goals some states are allowing green hydrogen (hydrogen created from renewables), fuel cells, etc. Many fuel sources are considered clean fuel sources, even if they are not considered renewable sources.

4.9.3 Regulatory Sandbox and Rapid Pilots

Research strategies intended to accelerate policy development and adoption, such as regulatory sandboxes and rapid pilots, are already in use by regulators in the context of blockchain for micro-grid applications[71] and could include integrated DER planning as a preferred mechanism to reduce timeframes usually associated with regulatory reform and legislative rulemaking.

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65 Georgia Power, Behind-the-Meter Solar Installation Options website: https://www.georgiapower.com/company/energy-industry/energy-sources/solar-energy/solar/solar-buy-back.html

66 Institute for Local Self-Reliance, Net Metering – Wisconsin website: https://ilsr.org/rule/net-metering/2556-2/

67 Fuel Cell & Hydrogen Energy Association, Net Metering website: fchea.org/net-metering

68 U.S. Department of Energy, Interconnection Standards for Combined Heat and Power (CHP): betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Issue_Brief_Interconnection_May2020.pdf

69 nj.gov/governor/news/news/562021/20211110a.shtml

70 nj.gov/dep/aqes/rggi.html

71 Guidehouse Insights Report, *Blockchain Applications for Remote and Grid-Connected Microgrids*, 2019, p. 31, "One of the most successful implementations of this model is Ofgem's regulatory sandbox in the UK, which grants selected vendors exemption from specific regulations for a set amount of time to determine the potential benefits and costs of enacting a policy change."

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Electric utilities understand the capabilities and technical limitations of their systems and territory best. By directing the EDCs to plan and execute pilot programs when applying smart inverters, DERMS, or other new technology to monitor and increase capacity, regulators can more effectively and efficiently enable and approve strategic grid investments.

Pilot program and regulatory sandboxes in which EDCs are free to test new procedures and policies, can support power quality, aid in understanding performance outcomes, deliverability, and reliability of the contiguous system when connecting new facilities like renewable generators. Strategic initiatives like these also provide a solid platform to add new and more innovative facilities into a rapidly evolving future state of the NJ electric grid.

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5. Targeted Findings and Recommendations for New Jersey

This chapter precipitates the findings in sections 3 and 4 into targeted findings. The findings and recommendations in Table 5-1 are ranked in priority from one to nine based on three considerations: (1) implementation urgency relative to meeting the NJ EMP goals,[72] (2) the potential for immediate implementation,[73] and (3) minimum interconnection rule requirements for a safe and reliable electric grid in light of increasing penetration of DERs.

Table 5-1 includes four sections for each finding/recommendation (F&R): (1) detailed findings, (2) "what" should be done (Actions), (3) "how" it should be done (Implementation Plan), and (4) "why" it should be done (Rationale).[74] Organizing the recommendations in this manner will support subsequent NJ BPU rulemakings pertaining to interconnection process and grid modernization.

[72] Guidehouse assessed implementation urgency based on best and common practice, and existing barriers to increased renewable energy interconnection as communicated by NJ stakeholders during the public stakeholder process.

[73] The potential for immediate implementation depends on the maturity of each recommendation along two axes (1) strength of supporting evidence, and (2) readiness relative to stakeholder debate

[74] This approach is based on the DOE Grid Modernization Consortium framework in which the first two categories of the framework, L0 (Principles) and L1 (Objectives), cover what should be done, and are less specific. The last three categories, L2 (Capabilities), L3 (Functionality), and L4 (System Requirements), cover how the principles and objectives should be implemented, and are more specific.

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Table 5-1. Targeted Findings and Recommendations

<table>
<tr><th></th><th></th></tr>
<tr><td rowspan="6">F&R #1</td><td>Finding #1: N.J.A.C.14:8-5 IEEE 1547 reference is out of date</td></tr>
<tr><td>N.J.A.C.14:8-5 currently references IEEE 1547-2003 however IEEE has released a 2018 version IEEE 1547-2018 and an amendment IEEE 1547a-2020.

There is no process in place to assure that NJ will remain aligned with the most recent standards on an ongoing basis, including IEEE 1547.</td></tr>
<tr><td>Recommended Actions</td></tr>
<tr><td>a) NJ should adopt the latest version of IEEE 1547 as amended and supplemented for NJ (IEEE 1547-2018 / IEEE 1547a-2020) and establish a process to refresh the standards in alignment with industry practices.
b) NJ BPU should promptly update N.J.A.C.14:8-5 to indicate the latest version adopted in NJ is IEEE 1547-2018 / IEEE1547a-2020 as amended and supplemented.
c) NJ BPU should establish an annual review process to assure NJ will remain aligned with the most recent standards, including IEEE 1547, on an ongoing basis.</td></tr>
<tr><td>Recommended Implementation Plan</td></tr>
</table>

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	a) Due to the complexity of implementing, and remaining aligned with, IEEE 1547 as amended and supplemented, NJ BPU should establish a working group as detailed in F&R #5[75] composed of the EDCs, the NJ BPU, and other expert stakeholders to annually review which sections of IEEE 1547 should be implemented in NJ. The working group should develop a definitive and achievable implementation plan and timeline for each section/clause the working group recommends should be implemented, such as within six months from the time revisions to IEEE 1547 have been approved by IEEE. The timeline for implementation of IEEE 1547 should be one of the ongoing focus areas of the working group. b) EDCs to implement a conformity assessment process for Level 2 and Level 3 to ensure smooth implementation of the revised IEEE 1547 standard. c) NJ BPU and EDC staff, and the grid modernization working group recommended in F&R #5, shall consult NREL report NREL/TP-5D00-75290[76] annually and other industry documents and industry groups to ensure N.J.A.C.14:8-5 is kept up to date relative to new and emerging technologies, standards, and trends.
	Rationale

[75] In lieu of a unified working group responsible for monitoring and implementing grid modernization policies in NJ in light of new and emerging technologies, FERC orders, and other matters potentially impacting interconnection policies and procedures, NJ BPU and the EDCs may wish to assign staff in house to monitor quarterly findings and recommendations put forward by other organizations such as those listed below.

- California Energy Commission (CEC), especially the Electric Program Investment Charge (EPIC)
- Massachusetts department of Energy resources (DOER)
- Rule 21 group in California, cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/rule-21-interconnection
- Department of Energy, energy.gov/oe/articles/doe-study-shows-maximizing-capabilities-existing-transmission-lines-through-grid
- New York Public Service Commission "Power Grid Study", dps.ny.gov/pscweb/WebFileRoom.nsf/Web/297C3A89CF2B334C852587D000694B37/$File/pr22004.pdf?OpenElement
- CIGRE Grid of the Future, cigre-usnc.org/grid-of-the-future-2022/
- NEETRAC, neetrac.gatech.edu/

[76] NREL, A Guide to Updating Interconnection Rules and Incorporating IEEE Standard 1547, October 2021, nrel.gov/docs/fy22osti/75290.pdf

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	In comparison to IEEE 1547- 2003, IEEE 1547-2018 provides an expansion on interconnection capability requirements such as by leveraging advanced technologies and existing equipment and grid capabilities, e.g., implementing smart inverters and Volt/VAR optimization. The standard elaborates and sets definitive criteria on, for example, frequency and voltage support, tripping and reclose coordination. These changes will help address NJ stakeholder concerns about fully realizing the benefits of existing inverter functions and controls. IEEE 1547-2018 introduces and elaborates on performance categories for normal and abnormal conditions, ensuring grid safety and reliability. IEEE 1547-2018 also provides approaches for information exchange within local DER communications interfaces to enable interoperability between DERs and the distribution grid. This is essential to interconnecting, integrating, and operationalizing increasing amounts of renewable resource capacity on the distribution grid.
F&R #2	**Finding #2: There are opportunities to streamline the interconnection process**
	There are opportunities to streamline and automate the interconnection process. Applications are sent back to customers by EDCs due to missing or incorrect information,[77] which can cause delays. Interconnection application status and key information is tracked using a different process and different software for each EDC, particularly for Level 2 and Level 3 interconnection requests, including key milestones such as timelines, schedule and budget for upgrade commitments, and construction timelines. This makes it difficult for the NJ BPU to monitor interconnection process KPIs across EDCs. Additionally N.J.A.C.14:8-5.6 (Level 3) does not state required timelines for key milestones. The EDCs do not collect fees for Level 1, yet a large percentage of applications are presently Level 1, with a projected increase of Level 1 applications in the future. For example, an increase in smaller (Level 1 <= 10 kW) interconnection applications is expected due to a projected increase in DER aggregation projects enabled by the adoption of FERC Order 2222.
	Recommended Actions

[77] Public Stakeholder Meeting #3.1

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Interconnection Application Software

a) EDCs that do not have an auditable electronic application tracking process shall set in place interconnection application software that will provide a structured approach for data intake and notifications for all interconnection Levels.

b) EDCs shall install or upgrade to a portal-based software application platform capable of tracking key information throughout the interconnection application process. Such a platform would, at a minimum, be easily customizable and capable of tracking and automating the permitting process, documenting generation type and capacity, timelines, schedule and budget for upgrade commitments, and construction timelines, as well as reporting out this information in an easily auditable format. In addition, the platform would be designed to share files and information securely and efficiently between the EDC and the customer, with effective audit capability for the NJ BPU.

c) The software shall be capable of generating automatic email and online notifications to the customer with the goal of enforcing clearly defined tariff timelines, reducing the turnaround time for missing data. The software should be designed to improve the accuracy and consistency of data entry and facilitate cross-department intake of application information. The NJ BPU should establish a working group to balance the need for transparency and access by a broad set of stakeholders while maintaining the privacy of customer data, and security of other sensitive data pertaining to the electric grid.

d) NJ BPU to require EDCs to collect and store electronically KPIs such as number of applications with missing data, applications with complete information, and achieved timelines for all interconnection applications at all interconnection Levels. This information already exists within interconnection applications, however, it is not easily accessible in a usable format to stakeholders or NJ BPU.

e) NJ BPU to compare KPIs relative to N.J.A.C. 14:8-5 timelines and require EDCs to implement application process improvements within a specified timeframe as necessary to reduce discrepancies between N.J.A.C. 14:8-5 and EDC actual interconnection application timelines.

f) NJ BPU to direct the working group to consider specifying milestones and associated maximum timelines for Level 3 projects.

g) EDCs to make an FAQ webpage to provide guidance useful to interconnection customers engaging in the interconnection process.

h) The EDCs shall develop an interconnection dispute resolution process for NJ BPU review and approval, to be included on the EDC FAQ webpages. As part of a dispute resolution process the EDCs should identify an ombudsman to handle customer interconnection complaints.

Application Fees

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	i) The NJ BPU should set a range for Level 1 application fees for utilities that use Level 1 fees informed by the state comparisons in Section 4of this report. NJ BPU should consider adopting the Level 1 application fees as recommended in IREC's Model Interconnection Procedures.[78]
	Recommended Implementation Plan
	a) The NJ BPU should develop milestones for the EDCs to meet as they research and implement any new software packages and platforms needed to implement this recommendation. Milestones should be realistic and flexible, yet time-bound, with clear target start and end dates. Milestones should allow time to integrate new software with existing EDC IT platforms and business processes, and should include an assessment of the safety, security, and privacy of the electric grid and customer sensitive information. b) As part of their research, EDCs will need to consider ongoing investment in and maintenance of these new systems. EDCs to define how existing software platforms can be leveraged to manage customer interconnection requests and invoicing. NJ BPU should consider how costs for such investments will be recovered. c) After a software-based application process is implemented, each EDC shall review the application forms for usability and clarity based on remaining areas where the most examples of missing or incorrect information occur. d) NJ BPU to periodically review a random sample of customer applications found incomplete by EDCs to develop suitable metrics to better understand trends in application deficiencies. e) NJ BPU update the N.J.A.C.14:8-5 to provide the fee or range of fees for Level 1 interconnection applications.
	Rationale

[78] IREC, https://irecusa.org/resources/irec-model-interconnection-procedures-2019/

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<table>
<tr><td></td><td>
Interconnection Application Software
Digitally-based customer-facing systems provide high potential for improved recordkeeping, data accessibility, and data management.

Interconnection application processing and automation pilots have been built in states including California, New York, Arizona, Texas, Nevada and more.[79]

Uniform KPIs across EDCs will enable the NJ BPU to monitor compliance with N.J.A.C.14:8-5 and future interconnection rules, and target future enhancement measures.

Application Fees
Consistent with best practices in other jurisdictions and IREC recommendations, Level 1 fees are justified to recover costs and provide a financial basis for increasing IT functionality and fund staff augmentation. This will ensure resource sufficiency to accelerate the interconnection process and meet the renewable energy goals in the EMP. For example, revenue from Level 1 fees could be used to automate parts of the permitting process by investing in software and related computer hardware infrastructure and hiring additional staff to manage the automated system. Stakeholder input also mentions current legislation in process which recommends grid modernization fees.
</td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="3">F&R #3</td><td>Finding #3: Existing online EDC hosting capacity maps are inconsistent across EDCs</td></tr>
<tr><td>Existing online EDC hosting capacity maps, including data update schedule and underlying approach to calculating interconnection and integration capacity headroom, reveals inconsistencies across EDCs.[80]

Hosting capacity information is inconsistently labeled across EDCs resulting in the quantity of closed circuits potentially being overestimated by stakeholders[81]</td></tr>
<tr><td>Recommended Actions</td></tr>
</table>

[79] Stakeholder Meeting #3.1 and #3.2

[80] Some EDCs calculate a theoretical maximum available capacity based on assumed feeder loading whereas others calculate a range of capacities based on actual loads and point of interconnection

[81] Public Stakeholder Meeting #3.2

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	a) The NJ BPU should convene a working group, including the EDCs, to determine and enhancing hosting capacity methodology, consistency, and hosting capacity map data granularity and update schedule. The first task of the working group should be to identify inconsistencies across EDC hosting capacity methodologies and subsequently direct the EDCs to implement consistent approaches. The working group shall consider items such as the following in identifying improvements to the methodology:[82] [83] a. Update EDC business process manuals to require uniform data content, granularity, and refresh frequency for capacity map tools according to industry standard methods b. Assess potential security issues associated with posting sensitive information, and consider implementing a sign-in procedure to access the capacity maps c. Update capacity maps at least yearly, or when change in generation on a feeder exceeds an EDC-specified amount, or when the aggregate change in load exceeds an EDC-specified amount d. EDCs to clearly label their maps with detailed legends explaining what the data means, and consider developing a shared lexicon to label their maps e. Require identification of potentially limiting equipment requiring a system upgrade on the hosting capacity maps (e.g., voltage controllers, protective relays, communication systems, conductor ampacity, etc.) f. NJ BPU to specify, and EDCs to provide, a uniform unit cost guide for system upgrades that includes a range of costs based on current pricing information. The information would be clearly labeled with the limitations of use and non-binding nature of the cost guides which are high-level estimates for information only. As the range of cost would be based on high-level estimates (e.g., +/- 25%), developers/customers would still need to consult with the EDCs regarding more precise cost estimates for system upgrades based on detailed engineering studies. g. If project applications are abandoned based on system upgrade cost, cause data should be captured at the time the customer exits the application
	Recommended Implementation Plan

[82] IREC, NREL, April 2022. Nagarajan, A., Zakai, Y. Data Validation for Hosting Capacity Analyses irecusa.org/wp-content/uploads/2022/04/Data-Validation-for-Hosting-Capacity-Analysis-Final.pdf

[83] IREC, Key Decisions for Hosting Capacity Analyses, September 2021, p.8: irecusa.org/wp-content/uploads/2021/10/IREC-Key-Decisions-for-HCA.pdf

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	a) EDCs shall annually present their hosting capacity methodologies to the NJ BPU for evaluating cross-EDC consistency. b) Working group to outline a process, timeline, and the proposed hosting capacity methodology recommendations into EDC business process manuals and, where so determined by related working groups, into N.J.A.C.14:8-5. c) EDCs to develop a uniform unit cost guide for system upgrades, including necessary disclaimers about the use and limitations of the costing guidelines.
	Rationale
	Stakeholder support for capacity hosting maps is strong in NJ and throughout the country, but the capacity hosting maps provide value only when updated with current data and relevant information regarding system upgrade equipment costs. CAISO currently provides unit costs guides for transmission level interconnections for developers to estimate potential upgrades before formally engaging the utilities, reducing cost and effort on both parties to the application. Early information could equally benefit developers working at the distribution level.
F&R #4	**Finding #4: There is no way to accelerate interconnection projects within the NJ interconnection rules**
	Other than the Level 1 interconnection process, which provides an expedited installation track for projects that qualify (e.g., inverter-based projects 10 kW or less), there is currently no *pre-application process* in NJ. Industry advocates[84] suggested that a pre-application process will provide valuable information about available grid capacity and likely upgrade costs without waiting for a full interconnection review as specified in N.J.A.C.14:8-5. Utilities in California offer multiple options for interconnection pre-applications with varying levels of detail available to developers, and a corresponding variable fee structure. Additionally, when an impact study is being conducted there is no screening mechanism to *streamline the impact study* where it may be feasible to complete on a faster timeline than the normal study process.
	Recommended Actions

[84] Public Stakeholder Meeting #2

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	Pre-Application Process a) NJ BPU should design and implement a pre-application process which will provide the opportunity to expedite renewables interconnection. The process should enable key information affecting project viability (e.g., available capacity (MW) of substation/area bus/bank and circuit most likely to serve proposed site; relevant line section absolute minimum load) to be exchanged between the EDC and the customer prior to initiating a standard interconnection review. b) EDCs should make an FAQ webpage to provide guidance useful to the pre-application process once the pre-application process is established by the NJ BPU. **Streamlined Impact Study Process** c) Projects with limited electrical or cost allocation impacts on other projects should be assessed for eligibility for an expedited impact study which is expected to be completed on a faster timeline than the normal study due to fewer complexities. d) The NJ BPU should establish a working group to ratify a streamlined study process for “ready” projects that do not impact any other projects. See *Figure 4-12. California Rule 21 Generating Facility Interconnection Review Details* of this report for an example of an interconnection study workflow that includes a ‘fast-track’ process.
	Recommended Implementation Plan

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a) NJ BPU should undertake a pre-application stakeholder engagement process informed by a working group to inform the NJ BPU pre-application design. The scope of the working group, reporting to the NJ BPU and a NJ BPU-established Steering Committee, should include the following:

   a. Assess the merit, eligibility requirements, and required timeframes in which to implement a pre-application process for Level 2 and Level 3 interconnection projects. The working group should present their plan to the NJ BPU within six months.

   b. In collaboration with the EDCs, review the current screening process for Level 2 projects below 25 kW to standardize a process for determining potential for relief from the 10 kW Level 1 restriction (e.g., through review of the limiting equipment such as the size of the local transformer limits, and other critical factors in N.J.A.C.14:8-5). Standardizing such a review process will potentially allow more projects to proceed under a Level 1 review, which would accelerate renewable project installation and relieve the Level 2 backlog.

   c. The working group mandate should additionally include the following to inform the NJ BPU in parallel to their development of the pre-application process:

   d. Develop definitions, purpose, and tier structure for a pre-application process. See, for example, *Table 4-6 Summary of Pre-Application Data Points* in this report showing the multiple California pre-application tiers (e.g., multiple levels of grid information available to the developer).

   e. Design a fee structure aligned with the pre-application tiers which can be annually reviewed and adjusted as necessary. The fee structure should be aligned across EDCs. See, for example, *Table 4-7 Summary of Rule 21 Interconnection Fees* in this report showing the multiple California pre-application tier fees.

   f. Due consideration of how EDC safety and reliability requirements can be satisfied under accelerated interconnection business processes as defined by the working group. New interconnection processes shall remain supportive of the EDCs' requirements to conduct technical studies needed to preserve safety and reliability of the grid, while also maintaining the EDCs' discretion to streamline the necessary reviews where possible.

   g. Consider how FERC Order 2222 agreement timelines may intersect with the state/EDC timelines.[85]

b) A pre-application should be required for Level 2 and Level 3 projects 500 kW and above,[86] and optional for other projects.

c) For projects less than 500 kW, EDCs should develop detailed example applications and provide to interconnection applicants via their interconnection FAQ webpages.

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	d) Methods and processes to accelerate the interconnection process may be EDC-specific within the broader guidance developed by the working group and approved and adopted by the NJ BPU. For EDCs where a pre-application already exists (e.g., ACE) the EDC should implement a fee structure as directed by the NJ BPU. e) Pre-application will be modeled on the existing application process so the information filed in the pre-application can be seamlessly moved into the application form to reduce resubmission inefficiencies. EDCs should have the option to use staff augmentation to implement the pre-application process to ensure the pre-application report is available more quickly than a normal N.J.A.C. 14:8-5 study. f) The NJ BPU and the EDCs should periodically review customer applications returned by EDCs and document frequent application deficiencies; the pre-application process should be designed to proactively mitigate deficient applications by requiring prescreening of common issues.
	Rationale
	Pre-application results enable interconnection customers assess viability of their projects and avoid sunk study costs incurred for economically unfeasible projects. Developers can leverage favorable pre-application results to secure funding and capacity offtake agreements, increasing overall success rate of projects. An NREL study[87] indicates once pre-application reports were required for projects 500kW+ in MA, the approval rate of applications increased by 24%. FAQs for all interconnection application Levels will reduce confusion without introducing an ongoing EDC burden. Once an accelerated process is defined, projects identified as eligible for accelerated study may be used to help prioritize feeders and beneficiaries relative to cost recovery, as well as distributed energy resource planning and grid modernization budget development.
F&R #5	**Finding #5: New Jersey does not have an interconnection tariff, and EDCs do not have EDC-specific business process manuals or handbooks to enact the existing rules**

[85] Although FERC Order 2222 defers to state interconnection requirements, it is worth considering how the timelines for PJM agreements coincide with the NJ interconnection process timelines, and the role pre-applications could play in helping interconnection customers meet PJM agreement deadlines.

[86] NREL, Evaluating the Role of Pre-Application Reports in Improving Distributed Generation Interconnection Processes, November 2018. nrel.gov/docs/fy19osti/71765.pdf

[87] NREL, Evaluating the Role of Pre-Application Reports in Improving Distributed Generation Interconnection Processes, November 2018. nrel.gov/docs/fy19osti/71765.pdf

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	NJ EDCs have adopted N.J.A.C.14:8-5. However, N.J.A.C.14:8-5 does not address EDC-specific interconnection issues in detail. Communication, telemetry, and backflow protection criteria in N.J.A.C.14:8-5 do not allow for utilization of modern interconnection technology. Interconnection rules which leverage commonly deployed equipment capabilities, such as DERMS monitoring and control, and IEEE 1547 smart inverter functionality, lower barriers to interconnecting renewable energy projects.[88] Volt/VAR capability is not acknowledged in the DER application process or compensated for in grid operation. There are barriers for the installation of storage products and DER installations such as meter collars that are approved in other states[89] but have not been approved in NJ. NJ does not currently have a mechanism for rapid evaluation of new technologies or its impact on business models.
	Recommended Actions

[88] Public Stakeholder Meeting #3.2
[89] Public Stakeholder Meeting #3.2

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a) The NJ BPU should develop a steering committee and convene working groups and task forces to further reform the interconnection and grid modernization process. The steering committee should recommend tools and approach for a "regulatory sandbox" for the NJ BPU to test for "fail or scale" of new technologies and processes. Working groups and task forces should have narrowly defined, time-bound scopes rapidly converge around new equipment capabilities, procedures, thresholds for technical studies (e.g., increasing Level 1 from 10 kW), and funding and cost recovery mechanisms to recommend to the NJ BPU for consideration. Working groups will represent the diversity of stakeholders participating in the grid modernization proceeding.

b) The regulatory sandbox will allow stakeholders such as the EDCs the flexibility to align operational practices within the diverse market sectors in each EDC service area, while allowing the EDCs to maintain grid safety and reliability with the usual oversight of NJ BPU.

c) To address issues such as new equipment capabilities (e.g., DERMS) which may require infrastructure investments to implement, working groups define specific implementation criteria and cost trade-offs before presenting to the steering committee and NJ BPU.

d) This report identifies practice guidelines and requirements that can serve as tools and resources for the working groups (e.g., IREC, California Rule 21, IEEE 1547).[90] Using these and other sources, the working group should research issues such as how to right-size equipment (e.g., sensor networks and other platforms, metering, and telemetry) for each interconnection Level and type of interconnection customer (e.g., NEM, export, non-export customers). The working group should recommend to the steering committee and NJ BPU how to cost effectively advance enabling technologies, such as DERMS, communications (fiber/RF/cellular communications), and Volt/VAR control.

e) Create a structured process for documenting the interconnection rules in NJ: e.g. use multiple documents including, (1) a tariff, (2) EDC business practice manuals, and (3) EDC handbooks, where the handbook and business practice manuals are updated periodically (e.g. annually) by a working group reporting to the steering committee, with the tariff being updated less frequently (e.g., on a three-year cycle).

f) It is recommended that each EDC have at least one representative attend and participate in the working groups to assure they align practices with the latest recommendations of industry experts. The EDCs should use their business practice manuals and handbooks to clarify technical criteria in N.J.A.C.14:8-5 and future tariffs to assure best practices are incorporated to minimize interconnection cost and installation timelines (e.g., for IEEE 1547 specific configurations) in each of their services areas.

g) Guidehouse recommends that a neutral third-party expert facilitator be retained at the discretion of NJ BPU to ensure grid modernization is incorporated into the agenda of the steering committee and working groups and timely moves forward. EDCs shall enable, on a continuous basis, the implementation of new equipment and technology capabilities in a manner which will support and improve safety and reliability with advice from the steering committee and expert advisors. The role of the steering committee and

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	expert facilitator is advisory and does not supersede the usual relationship between NJ BPU and the EDCs.
	Recommended Implementation Plan
	a) New capabilities recommended from the advisory process should include matters such as DERMS control/monitoring, the adoption of revised IEEE 1547 smart inverter functionality (e.g., including Volt/VAR and Volt/Watt control), cost recovery mechanisms, and integrated DER plans. b) Working groups with narrow focus, working under short timelines, should be mandated to minimize costs while improving distribution system performance and reliability in an evolving grid paradigm. To this end, representatives from the EDCs and the developer community are to meet regularly (quarterly or semi-annually) to develop an inventory of legacy practices and future technology advancements which affect major operational issues of the electric distribution system. c) Under a regulatory sandbox process, the EDCs will evaluate and report interconnection field data and “lessons learned” to NJ BPU, the steering committee, and relevant working groups related to reliability and safety standards, performance targets, and shall identify a process to continuously improve interconnection processes and documentation. d) The EDCs shall undertake regular reviews of their interconnection rules documentation (e.g., the tariff, the business process manual, and the handbook) and participate in working groups with the intent of meaningfully reducing barriers to adopting new equipment and technology such as smart inverters. Appendix B contains an illustrative interconnection rules outline based on Rule 21 for use by the working group and EDCs in expanding the scope of N.J.A.C.14:8-5 and related interconnection documents.

[90] In lieu of a unified working group responsible for monitoring and implementing grid modernization policies in NJ in light of new and emerging technologies, FERC orders, and other matters potentially impacting interconnection policies and procedures, NJ BPU and the EDCs may wish to assign staff in house to monitor quarterly findings and recommendations put forward by other organizations such as those listed below.

- California Energy Commission (CEC), especially the Electric Program Investment Charge (EPIC)
- Massachusetts department of Energy resources (DOER)
- Rule 21 group in California, cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/rule-21-interconnection
- Department of Energy, energy.gov/oe/articles/doe-study-shows-maximizing-capabilities-existing-transmission-lines-through-grid
- New York Public Service Commission "Power Grid Study", dps.ny.gov/pscweb/WebFileRoom.nsf/Web/297C3A89CF2B334C852587D000694B37/$File/pr22004.pdf?OpenElement
- CIGRE Grid of the Future, cigre-usnc.org/grid-of-the-future-2022/
- NEETRAC, neetrac.gatech.edu/

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	Rationale
	NJ can leverage ideas from existing interconnection rules such as California Rule 21 to achieve the goals in the EMP within the required timeframe, avoiding a long stakeholder process. However, Guidehouse recommends an advisory group structure, led by a steering committee with a "fast-scale or fail" mandate, consider how rules from other jurisdictions might best be implemented in NJ to ensure safety and reliability of the grid and benefit to NJ stakeholders. The energy transition initiative relates to numerous and complex changes to the operation of the power system. New equipment, technology, and the application of technology is being developed rapidly. The transition of the power system will take a tangible amount of time. Moving too quickly will invite changes to which there are no simple or cost-effective solutions and operations may suffer. Moving too slow will result in delays to effective DER integration, maintaining legacy operations which could affect performance, reliability, and safety. Stakeholder-utility partnerships must quickly and accurately assess, adjust to, and implement numerous activities to ensure a cost-effective, reliable, and safe power system. A standing steering committee of utility and stakeholder advisory representatives with a strong mandate to identify improvements (under regulatory oversight) would pursue an ongoing and refined balance on the speed of transition. By seeking to work strategically together on real projects with known barriers, renewable resource interconnection projects can be delivered more effectively.
F&R #6	**Finding #6: The application queueing and cost allocation process in NJ is serial**
	The application queueing and cost allocation process in NJ is, for the most part, a serial process for Level 1, Level 2, and Level 3 resources. The current process also follows the FERC (transmission) small generator pro forma document which may not be sufficient for distribution interconnections in all cases. For Level 2 and Level 3 projects, stakeholders reported that project timelines and upgrade costs under the current process create barriers to some projects to move forward in a timely manner. However, the root cause reason for the perceived deficiencies was not clearly defined by the stakeholders.
	Recommended Actions

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	a) Informed by a stakeholder process, initiated by the NJ BPU, NJ EDCs should implement a streamlined flexible queue process across EDCs which would include a mechanism to prioritize a “first ready, first through” approach. This would support more viable projects and avoid clogging the queue for Level 1, Level 2, and Level 3 projects, while ensuring equity and fairness in the queue. b) Prior to initiating a stakeholder process, NJ BPU should consider a deep-dive evaluation of the queueing and cost allocation process used by the EDCs to identify specific areas of the interconnection processes that result in Level 2 and Level 3 customer complaints. c) NJ BPU should establish a stakeholder process to assess queue reform options. Examples of items to be considered by stakeholders are: (1) criteria and eligibility for a cluster process, (2) a streamlined impact study process, (3) a milestone process, (4) penalties for withdrawing or maximum queue ‘parking time,’ (4) ensuring that final upgrade costs are within a reasonable range (e.g. +/- 25%) of the initial estimate, and (5) identifying a target date by which the new interconnection queue options will be included in the interconnection documents (i.e., the tariff, business process manual, and handbook).
	Recommended Implementation Plan
	Based on suggestions from the stakeholder process, the EDCs will submit their “revised application interconnection process” to the NJ BPU for review within six months of the conclusion of the stakeholder process. NJ BPU will establish the regulatory process for adoption of revised queue process mechanisms. NJ BPU to post the most up to date tariff on their website, and the EDCs to revise their business process documents and / or handbooks to reflect the new processes within six months of the revised tariff being posted and accepted.
	Rationale

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	"First ready, first through" approaches with cluster studies, streamlined engineering study options, milestone phase gates and well-defined screening processes are in use by utilities with high rates of renewables adoption including CA and NY, and can be effective in introducing process efficiency. Forming a stakeholder process[91] puts the experts of each service area (i.e., the EDCs) in collaboration to consider input from the NJ BPU and their interconnection customers. Conducting a process evaluation for Level 2 and Level 3 interconnection projects to identify deficiencies in the application process in advance of conducting the stakeholder process will beneficially narrow the scope of the stakeholder process. The stakeholder process, supported by findings from a process evaluation, will be more effective in addressing interconnection customer complaints, and action items from the stakeholder process may then be more rapidly implemented. A deep-dive process evaluation would support the NJ BPU in developing clear and specific criteria that improve how projects move through the interconnection process.
F&R #7	**Finding #7: Alternative cost allocation and cost recovery options for accelerated interconnection of renewables have not been evaluated in New Jersey**
	The evaluation of innovative cost allocation approaches are needed in addition to the traditional cost-causer approach to effectively prepare the grid to integrate DER. NJ BPU has a policy for infrastructure investments,[92] however the existing policy does not include criteria by which the need for grid modernization would be assessed to justify a grid-forward grid modernization approach. NJ does not currently have a mechanism to rapidly evaluate innovative cost allocation and cost recovery options that could enable NJ to meet state renewable energy goals.
	Recommended Actions
	NJ BPU should establish a steering committee and working groups to research and recommend additional cost recovery options beyond the cost-causer approach. Alternatives which comply with the concept of prudently incurred costs and do not systematically favor private, unregulated developers at ratepayers' expense should be researched. The stakeholder process shall leverage the help of a regulatory sandbox, within 18 months to test technologies and policies that accelerate the grid's ability to enable state policy goals.

[91] A public stakeholder process is different than a taskforce or working group composed of stakeholders. A stakeholder process is a formal public proceeding run by a governmental authority, initiated by the EDC, whereas a taskforce is not.

[92] E.g., The NJ Infrastructure Investment Program, casetext.com/regulation/new-jersey-administrative-code/title-14-public-utilities/chapter-3-all-utilities/subchapter-2a-infrastructure-investment-and-recovery/section-143-2a1-infrastructure-investment-program-purpose-scope-and-general-provisions

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	Recommended Implementation Plan
	a) NJ BPU to initiate an advisory group for grid modernization to evaluate innovative cost recovery approaches. b) For example, the advisory group may evaluate approaches such as the NY "Cost Sharing 2.0", an approach designed for equitable integration of DER as a condition of rate-based cost recovery.[93,94] The advisory group should also identify policies such as the MA Grid Modernization Docket which pre-approves grid modernization investments by demonstrating how the investments cost-effectively support DER integration, and other statewide goals for consideration by the NJ BPU. c) The advisory group should assess mechanisms being implemented in other states, such as cluster studies, by which grid modernization costs are spread over a broader set of renewable resource interconnection customers on a feeder. d) The advisory group should consider whether DER penetration forecasts are useful to inform "make-ready" investments in some cases, to preemptively upgrade the distribution system in key locations.
	Rationale
	Innovative options for fair cost recovery will enable NJ to meet the statewide clean energy goals.
F&R #8	**Finding #8: EDCs do not currently submit integrated DER plans as recommended in the EMP**

[93] *"As detailed in the Interim Modification Order, the first mover rule requires the developer of the first interconnection project that triggers a need for a system modification to bear 100 percent of the upgrade cost, subject to potential reimbursement by other projects that interconnect later and benefit from the upgrade. By contrast, the Cost-Sharing 2.0 Proposal utilizes a pro rata concept under which a project pays only for the specific distribution hosting capacity assigned to it, as opposed to the entire cost of the upgrade. Thus, Petitioners assert, the cost of distribution system upgrades would be equitably allocated to each DG and/or ESS project interconnected on the same substation."* nyseia.org/_files/ugd/a89dc9_7e6753f13be34be98574867398045ad5.pdf

[94] *"The proposal would apply to two categories of distribution system modifications: utility-initiated upgrades and market-initiated upgrades… These [utility-initiated] projects, where a planned upgrade may be enhanced to provide additional hosting capacity, are referred to as Multi-value Distribution (MVD) projects. The Petitioners assert that coordinating the expansion of DG capacity with work that is already being planned to address asset maintenance or reliability issues is a cost-effective approach to increasing hosting capacity. In the case of MVD projects, the utility would bear the cost of the in-kind replacements, and the Participating Projects would pay pro rata shares of the costs of the incremental DER-related upgrade."*
nyseia.org/_files/ugd/a89dc9_7e6753f13be34be98574867398045ad5.pdf

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	Integrated DER (IDER) plans are an effective means for planning distribution grid expansion to interconnect clean energy resources, identify prudent grid modernization investments, and establish principles for cost recovery. IDER plans are recommended in the EMP, however NJ BPU has not yet directed the EDCs to submit IDER plans. Grid modernization investments will be best informed once these plans are approved by the NJ BPU.
	Recommended Actions
	a) NJ BPU should direct the EDCs to develop Integrated Distribution Plans (IDPs) per the EMP and should provide direction to the EDCs regarding information to be included as minimum filing requirements in their IDP / IDER plans. For instance, the EMP states the EDCs should "optimally and most cost effectively plan for and accommodate increased demand through electrification and further penetration of DERs" however the EDCs have requested more clarity on what to include in their IDP / IDER plans to satisfy this planning requirement. b) IDP / IDER plans are complex and include critical considerations beyond the interconnection process. Therefore, NJ BPU should clarify what the EDCs should include in their IDP / IDER plans more broadly in order to meet state energy goals. The NJ BPU should direct the steering committee and working groups on focused topic areas such as EV charging, environmental justice, industry best practices around investment and electrification.
	Recommended Implementation Plan
	a) NJ BPU should consult industry experts as necessary to gain insights as they develop guidance to follow for the IDP/IDER plans. NJ BPU should set a date by which EDCs shall submit integrated DER and Integrated Distribution Plans consistent with the EMP's one year time limit. b) NJ BPU should reference frameworks such as that in IREC and GridLab's *A Playbook for Modernizing the Distribution Grid*[95] to effectively inform grid investments.
	Rationale
	Submitting IDER plans and IDPs as recommended in the EMP will help ensure the NJ electric grid is positioned to participate fully in the energy industry's complex transition toward a clean, modern, safe, reliable, resilient, and independent power infrastructure by providing a basis for grid modernization budgets in NJ.
F&R 9	**Finding #9: There is no mechanism for renewable resources co-located with non-renewable resources to receive full credit for their renewable generation under the NEM program**

[95] IREC and GridLab, gridlab.org/wp-content/uploads/2020/05/Grid-Modernization-Playbook-report-1.pdf

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	N.J.A.C.14:8-5 only allows Class I renewable resources (e.g., solar technologies, photovoltaic technologies, wind energy, fuel cells powered by renewable fuels, geothermal technologies, wave, or tidal action, and/or methane gas from landfills or a biomass facility, provided that the biomass is cultivated and harvested in a sustainable manner) to participate in the NEM program. There is no mechanism for renewable resources co-located with non-renewable resources to receive full credit for their full renewable generation under the NEM program.
	Recommended Actions
	a) NJ BPU should provide a rulemaking that non-renewable fuel sources should be separately metered from renewable sources, and cannot be combined for net metering purposes. This will allow renewable generation owners to receive full credit without penalty for co-located non-renewable sources, and without sacrificing resource sufficiency. b) NJ BPU should establish a working group focused on identifying the implications and potential benefits of multiple co-located resources behind the meter, including energy storage and forms of generation other than solar PV (e.g., hydrogen).
	Recommended Implementation Plan
	Informed by the working group established under F&R #5, NJ BPU to update N.J.A.C. 14:8-5 and/or future expanded tariff to include language for separate metering for renewable and non-renewable fuel sources. The working group should consider that co-located resources may not be operating at the same time—renewable and non-renewable operation may be mutually exclusive despite co-location on the same site.
	Rationale
	Some non-renewable fuel sources are considered cleaner than the current fuel (carbon, oil etc.) sources used. Non-renewable fuel sources include hydrogen and natural gas. CHP is considered an energy efficient form of generation under certain specified heat recovery conditions.

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Appendix A. Stakeholder Meeting Presentation Decks and Recordings

Meeting content is permanently hosted at https://njcleanenergy.com/gridmod.

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Appendix B.Strawman NJ Generator Interconnection Tariff

Based on the California Rule 21 interconnection tariff, Guidehouse created an illustrative outline of a tariff for New Jersey that includes a fast-track process and explicit provisions describing NEM scenarios.

The purpose of this Appendix is to show how the existing N.J.A.C. 14:8-5 interconnection guidance could be expanded to provide more detail and clarity for stakeholders, including developers and interconnection customers, resulting in a more streamlined, transparent renewables interconnection process.

Guidehouse created a simplified table of contents (TOC) for both N.J.A.C. 14:8-5 and the PG&E ELECTRIC RULE NO. 21 GENERATING FACILITY INTERCONNECTIONS document (documents embedded below).

N.J.A.C. 14_5.8.pdf   ELEC_RULE_21_PG&E.pdf

The first section below is the simplified TOC for N.J.A.C. 14:8-5. The second section shows an integrated TOC based on the PG&E TOC, where the N.J.A.C. 14:8-5 TOC headings are superimposed on the PG&E TOC. This approach shows where there is comparatively less detail in N.J.A.C. 14:8-5 compared to the Rule 21 based PG&E document, which is considered best and common practice for renewables interconnection onto the distribution grid.

A working group tasked with expanding the scope of N.J.A.C. 14:8-5 should compare each section in the Integrated TOC below with the current topics covered by the N.J.A.C. 14:8-5 and revise the N.J.A.C. 14:8-5 to cover all the recommended topics from Rule 21 document. Any sections completely missing from N.J.A.C. 14:8-5 (e.g., Sections Pertaining to Export Rules and Requirements) should be added.

N.J.A.C. 14:8-5 TOC

- Interconnection definitions
- General interconnection provisions
- Certification of customer-generator interconnection equipment
- L1 Interconnection review
- L2 Interconnection review
- L3 Interconnection review
- Interconnection fees
- Testing, maintenance, and inspection after interconnection approval

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- Interconnection reporting requirements

Integrated NJAC 14:8-5 TOC and Rule 21 Table of Contents

Applicability

Applicability
Definitions
Applicable codes and standards
Retail customer energy storage devices

Definitions (N.J.A.C.14:8-5: Interconnection definitions)

General Rules, Rights and Obligations

Authorization required to operate
Separate agreements required for other services
Services under this tariff limited to interconnection
Compliance with laws, rules, and tariffs
Design reviews and inspections
Right to access
Confidentiality
Provides additional subsections on Scope and Required Disclosure
Prudent operation and maintenance required **(N.J.A.C.14:8-5: Testing, maintenance, and inspection after interconnection approval)**
Curtailment and disconnection
Local furnishing bonds
Coordination with affected systems
Transferability of interconnection request
Special provisions applicable to certain net energy metered applicants
Special provisions applicable to non-export energy storage generating facilities
Compliance with established timelines
Modification of timeline

N.J.A.C.14:8-5: General interconnection provisions

Interconnection Request Submission Process
Optional Standard and Enhanced Pre-Application Reports
Subsections on Standard and Enhanced Pre-Application Reports
Interconnection Request Process
Subsections on Applicant's steps toward completing an interconnection request and site exclusivity

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N.J.A.C.14:8-5: Interconnection fees

Interconnection Request Fee and Study Deposit
Subsection on Detailed Study Deposit

Interconnection cost responsibility
Subsections on costs identification, interconnection costs, producer costs, and cost allocation

Interconnection request validation and assignment of queue position
Subsections on interconnection request acknowledgment and deficiencies and interconnection queue

N.J.A.C.14:8-5: L1, L2, L3 Interconnection review

Modification to interconnected generating facilities
Modifications to existing equipment

Review process for interconnection request
Overview of the interconnection review process
Subsection on valid interconnection request, track review, detailed studies, compliance with timeline

Engineering Review Details
Initial Review Screens
Supplemental Review Screens
Detailed Study Screens

Generating Facility Design and Operating Requirements
General Interconnection and Protective Function Requirements
Prevention of Interference
Technology Specific Requirements
Supplemental Generating Facility Requirements

Smart Inverter Generating Facility Design and Operating Requirements
General Interconnection and Protective Function Requirements
Prevention of Interference
Technology Specific Requirements
Supplemental Smart Inverter Requirements Faults
Communication Requirements
Scheduling Capability Requirements

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Monitoring And Telemetry Requirements
Control Through Communication Capabilities

Metering, Monitoring and Telemetering
General Requirements
Metering By Non-Distribution Provider Parties
Net Generation Output Metering
Point of Common Coupling (PCC) Metering
Telemetering
Location
Costs Of Metering
Multiple Tariff Metering

Dispute Resolution Process
Scope
Procedures
Performance During Dispute

N.J.A.C.14:8-5: Certification of customer-generator interconnection equipment

Certification And Testing Criteria
Introduction
Certified And Non-Certified Interconnection Equipment
Type Testing
Product Testing
Commissioning Testing
Periodic Testing
Type Testing Procedure Not Defined In Other Standards

Sections Pertaining to Export Rules and Requirements

Inadvertent Export
Non-Export
Limited Export
Expedited Interconnection Process for Non-Export Energy Storage Generating Facilities

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Appendix C.Illustrative Pre-Application Process, NJ Community Solar Use Case

Pre-Application processes lower execution and procurement risk for all stakeholders including utilities, developers, and retail electric customers. Using New Jersey's Community Solar Energy Pilot Programs as an example, an interconnection Pre-Application process can create value for all stakeholders by reducing sunk time and expenses during the project development cycle. Community Solar Energy Pilot Programs can be designed to incorporate a Pre-Application study as part of the proposal evaluation process. Leveraging these Pre-Application study results would enable a developer to design their project to EDC interconnection requirements before NJ BPU makes a final Community Solar Program project award, without congesting respective interconnection queues with speculative project designs.

Specifically, Pre-Application processes enable developers to receive detailed as-is EDC distribution system information at potential points of interconnection for projects in neighborhoods and communities where there is a high likelihood of acquiring community solar subscribers. This information is used to generate realistic project budgets, schedules and preliminary designs based on actual EDC system conditions. Through this process, high quality community projects are developed and ultimately submitted for formal interconnection study.

Figure C-1: Pre-Application Process Flow

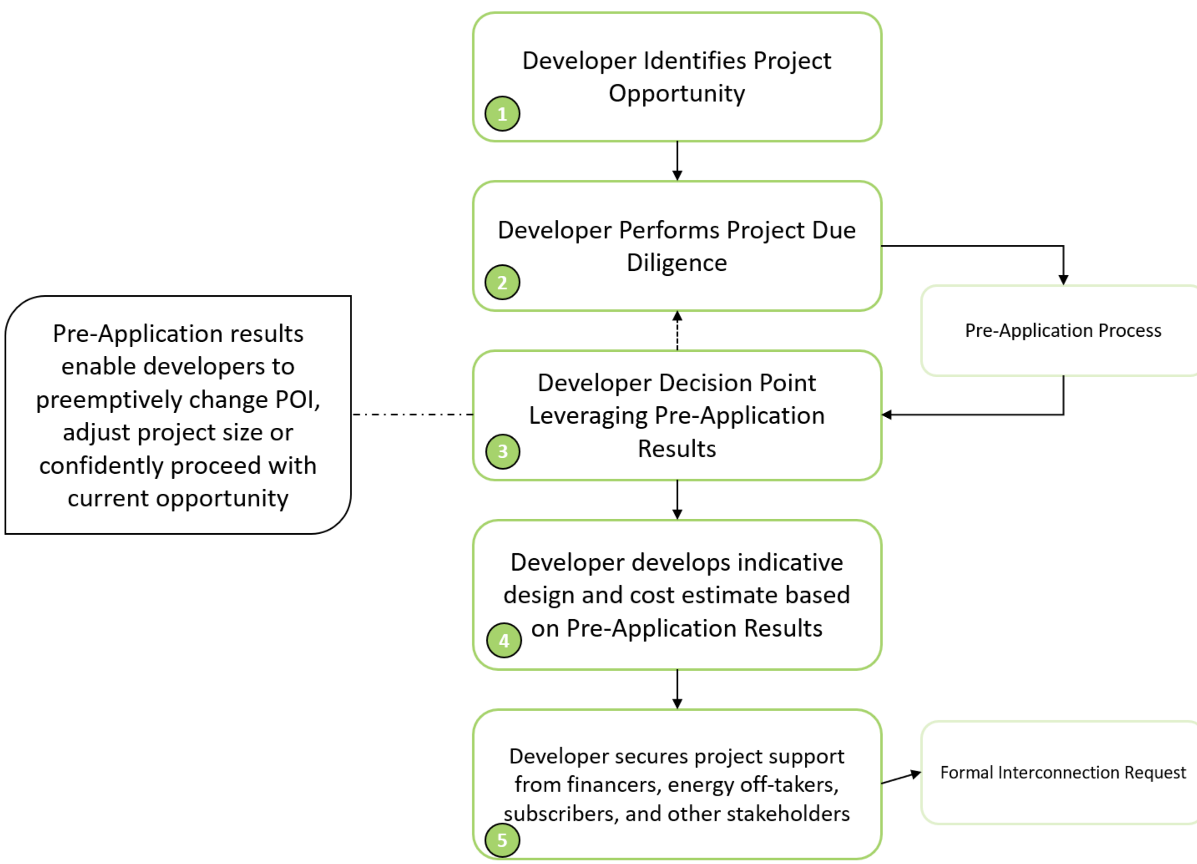

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Table C-1: Pre-Application Value Creation

Community Solar Project Development Phase	Pre-Application Value per Project Phase
2	Community Solar Developer formalizes project technical parameters early in preparation for pre-application process Interconnection customer becomes familiar with EDC processes and procedures before a formal application is made.
3	Community Solar Developer analyzes results of pre-application study to optimize project cost and schedule: Reduce project capacity to mitigate overloaded equipment (transformers, conductors, etc.) or increase project size as additional interconnection capacity exists improving project economics Change project location or specific point of interconnection (POI) to avoid overloaded equipment or complicated system protection requirements Developer’s perform early-stage engineering to design projects to match EDC specific system conditions and design specifications.
4	Developer can use positive pre-application results to reduce financing cost, secure funding, apply for permits and acquire site hosts and/or subscribers.
5	EDCs receive formal interconnection requests for projects that are more likely to proceed given due diligence performed by community solar developer in Phases 2, 3 and 4. EDCs queues have higher quality Level 2 and 3 projects more likely to reach operations; engineering resources are used efficiently, and the level of effort required to support interconnection customer success is lower.

Source: Guidehouse

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