Interconnection Process Overview

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Purpose of the Interconnection Process

- Facilitate interconnection of new generation by performing planning analyses and coordinating with the transmission owners to ensure system reliability and generation deliverability to all PJM load.

- Guide developers through the interconnection process on a timely basis while maintaining fair and equitable treatment between customers within the terms and conditions of the PJM Tariff.

- Provide the cost to physically connect the generator to the transmission system along with all necessary network upgrades.

Foundations of the Interconnection Process

- Adherence to federal policy
- Studies conducted consistent with annual RTEP studies
- Generation deliverable to all PJM load
- Cost assigned to the causer
- All projects treated equally regardless of size, location or fuel

Topics

- Process overview
- Interim deliverability and rights
- Recent trends
- Recent changes
- Other RTO processes

PJM Interconnection Process Overview

Process Diagram

PJM Department Roles

Interconnection Projects

- Single point of contact for study phases
  - Interconnection customers
  - Transmission owner
  - Interconnection Analysis engineers
- Process facilitation and mediation
- Draft & review reports
- Draft service agreements

Interconnection Analysis

- Model and study all projects
  - Load flow, short circuit and stability analysis
- Test system upgrades from transmission owners
- Calculate cost responsibility
- Coordinate with neighboring RTOs

Infrastructure Coordination

- Single point of contact for construction phase
  - Interconnection customers
  - Transmission owner
  - Interconnection Analysis engineers
- Oversight of billing
- Coordination of model in operations systems and final testing

Submitting a New Service Request

OATT Attachment N, Y, BB, S, EE, PP*

- N – Generation
- Y – Generation (≤2 MW synchronous, ≤5 MW inverter-based, and energy-only)
- BB – Generation (≤10 kW inverter-based & energy-only)
- S – Merchant transmission
- EE – Upgrade request
- PP – Long-term firm

Required Information

- Location
- Project size
- Ownership (site control for interconnection requests)
- Equipment configuration
- Planned in-service date
- Deposit
- Queue point data

*** NOTE:** Transmission service requests are received through OASIS and are then communicated to System Planning for inclusion in the New Services Queue with remainder of the New Service Requests.

Feasibility Study

- **Required**
  - Deposit for interconnection requests based on request receipt timing and MW size
  - Site control for generation requests
  - In-service date within 7 years of entering queue
- Customer can select a primary and secondary Point of Interconnection (POI)
- **Study Completion:** Target approximately 120 days after close of queue
- **Study participants:** PJM & TO (Contractor under TO)

- **Results**
  - Attachment facilities needed for interconnection
  - **Powerflow Analysis** – Identify thermal overloads and required upgrades (costs and construction schedule estimates for primary POI)
  - **Powerflow Analysis** – Identify thermal overloads with secondary POI (no cost/schedule estimates)
  - **Short-Circuit Analysis**
- Customers receive a Feasibility Study Report and have 30 days to sign a System Impact Study Agreement (SISA)

System Impact Study

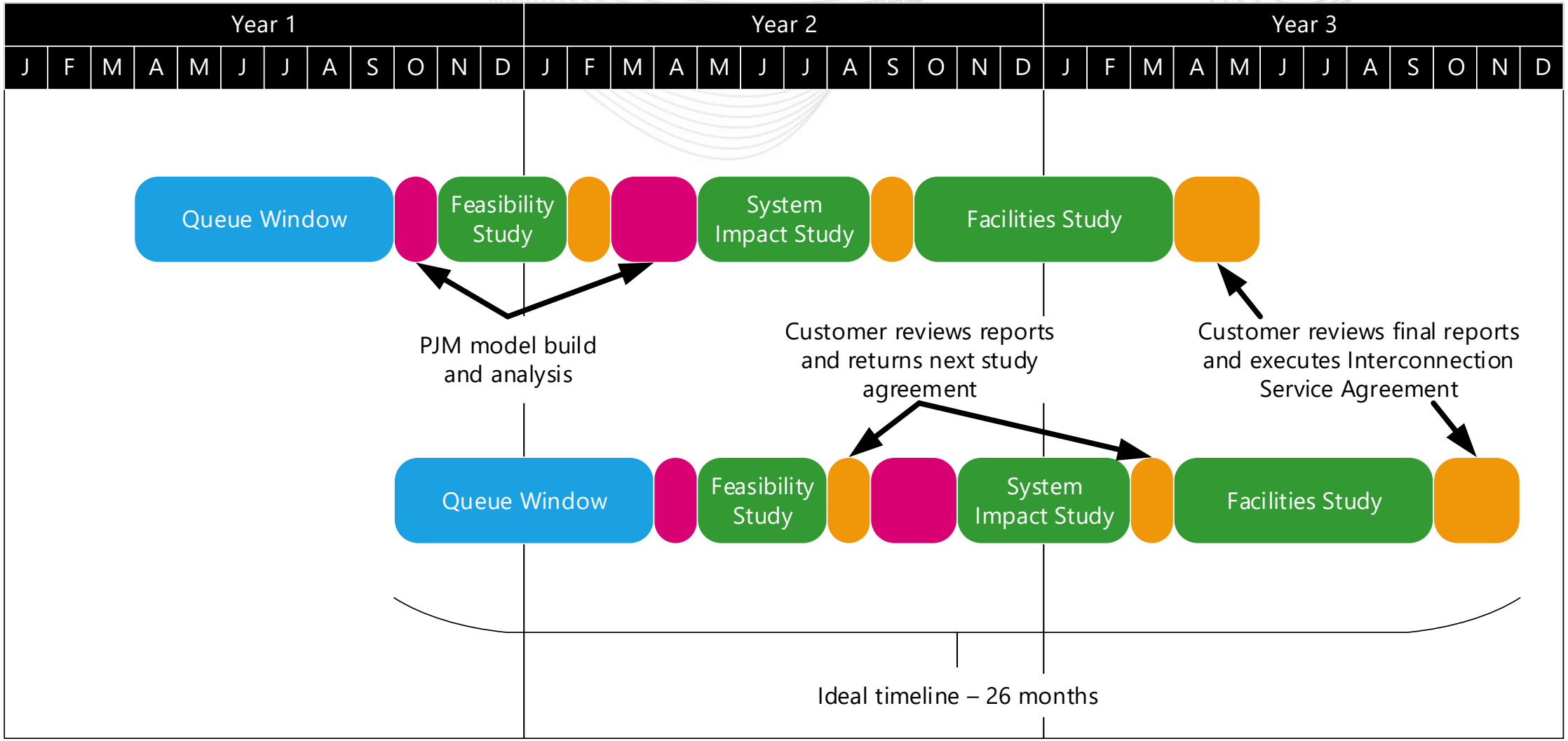
- **Required**
  - Deposit based on MW size
  - Initial Air Permit Application (N/A for solar/wind projects)
  - Ownership (Transmission Interconnection Requests)
- Customer must select a single POI (if two were evaluated in the Feasibility Study)
- **Study Completion:** Target 120 days after start of queue study or execution of System Impact Study Agreement
- **Study participants:** PJM & TO (contractor under TO) and affected systems (FSA)

- **Results**
  - Summer-peak powerflow analysis
  - Light-load powerflow analysis (if applicable)
  - Short-circuit analysis
  - Other Powerflow analyses as applicable
  - Cost estimates and allocations
- Customers receive a System Impact Study Report and have 30 days to sign a Facility Study Agreement (FSA)

Facilities Study

- Conduct governed by procedures as set forth in Attachment D of Manual M-14A
- **Required**
  - Deposit based on MW size
- **Completion**
  - Dependent on individual transmission owner zone and queue volume
- **Study By**
  - TO (or contractor under direction of TO)
  - Affected system study
- Potential for System Impact Study re-tool analysis
- Stability analysis
- Additional studies as required by type of technology being connected
- Facility Study Report: conceptual design
- Attachment facilities
- Network upgrades
  - Cost estimates
  - Preliminary engineering and construction schedule

Interconnection Process Timing

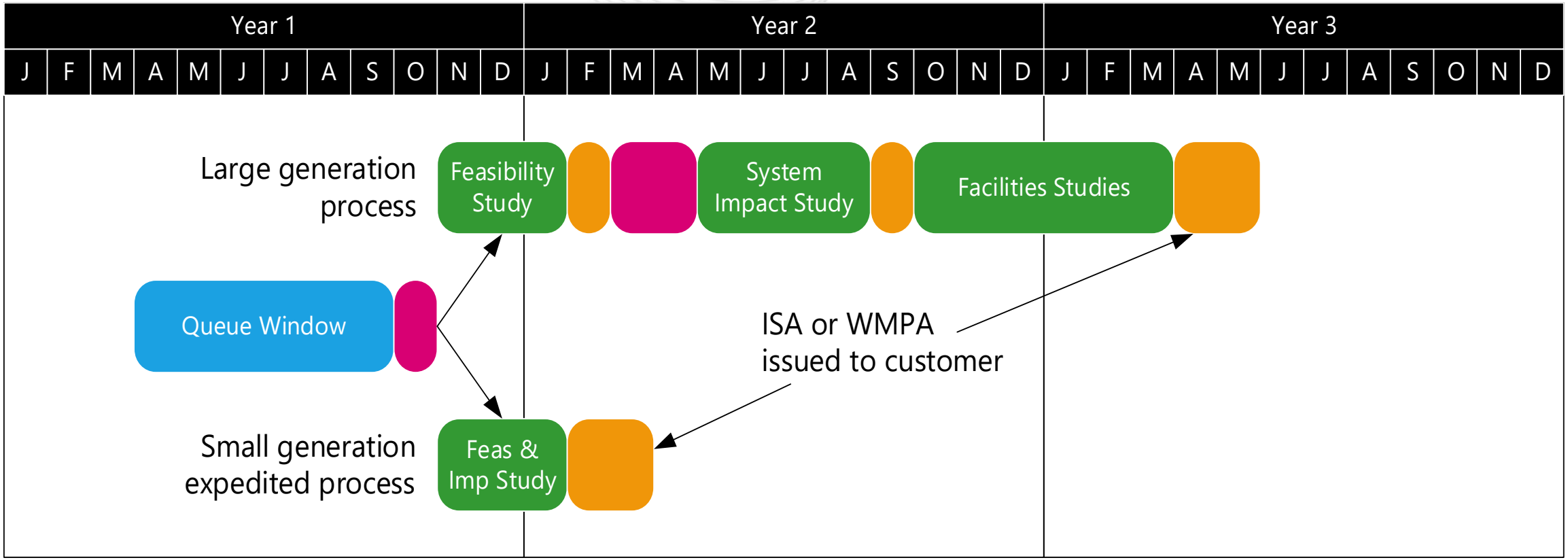


Small Generation Timeline (≤20 MW)

- Feasibility and System Impact Studies combined during the Feasibility Study window.

- Permitted when:
  - Project is 20 MW or less
  - Does not cause any transmission system violations
  - Does not request a Secondary Point of Interconnection

Small Generation Timeline (≤20 MW)



Interim Interconnection Service Agreement

- Can be requested at any time prior to the issuance of an Interconnection Service Agreement
- Allows engineering and procurement to start while the project is under study
- Scope must be mutually agreed to by customer and transmission owner
- Does not allow a project to interconnect or grant any rights

Project Modifications: Tariff Section 36.2A

Material Modification: A change that has a material adverse impact/effect to any later subsequently queued project in relation to scope, cost or time.

- Changes that result in a Material Modification will not be accepted by PJM for current queue position held.
- A project may never increase the Maximum Facility Output (MFO) or Capacity Interconnection Rights (CIR) without an additional new service request.
- A change in fuel type would require a Material Modification review.
- Significant changes to POI are considered material. Project must be withdrawn, and a new interconnection request submitted for the modification. (Tariff Section 36.2A.3)

Permissible Technological Advancement: New Tariff Section 36.2A.22

A Technological Advancement submitted to PJM no later than the return of an executed Facilities Study Agreement (or return of an executed ISA if a Facilities Study is not required) is classified as a **Permissible Technological Advancement** if the proposed change does not:

- Increase the capability of the generating facility
- Represent a different fuel type
- Cause any material adverse impact(s) on the transmission system

If a proposed technological advancement is deemed a Permissible Technological Advancement, then the proposed change will not be considered a Material Modification, and no additional PJM study will be required. All other proposed technological changes will require a study to determine if the change would constitute a Material Modification.

Reduction Rules: Tariff Section 36.2A.1.1

Modification Prior to the Commencement of the Feasibility Study (Tariff Section 36.2A.1.1)

Interconnection customer may reduce its project by up to **60 percent** of the electrical output. Timing of the announcement depends on which month of the queue they entered:

i. For projects that enter the queue in months 1–5, customer must identify the change prior to the close of business on the last day of the sixth month.

ii. For projects that enter the queue in month 6, the customer must identify the change no later than close of business on the day following the completion of the scoping meeting.

Reduction Rules: Tariff Section 36.2A.1.2

Modification After the Start of the Feasibility Study but Prior to Executing a System Impact Study Agreement (Tariff Section 36.2A.1.2)

Interconnection customer may reduce its project by up to **15 percent** of the electrical output. For a request to reduce by more than 15 percent, customer must request PJM to determine whether such a change would be a Material Modification. PJM will allow the customer to reduce the size of its project:

i. To any size if PJM determines the change is not a Material Modification, or

ii. By up to **60 percent** of the electrical output if PJM determines it is material; however, in this case the project would be removed from its current position and be assigned a new queue position at the beginning of the subsequent queue, and your future studies will be performed consistent with the timing of studies for projects submitted in the subsequent queue.

Reduction Rules: Tariff Section 36.2A.2

Modifications After the System Impact Study Agreement but Prior to Executing an Interconnection Service Agreement (Tariff Section 36.2A. 2)

Interconnection customer may reduce its project by the greater of **10 MW or 5 percent** of the electrical output. For a request to reduce by more than this, customer must request PJM to determine whether such a change would be a Material Modification. PJM will allow the customer to reduce the size of its project:

i. To any size if PJM determines the change is not a Material Modification, or

ii. By up to the greater of **50 MW or 20 percent** of the electrical output if PJM determines it is material; however, in this case the project would be removed from its current position and be assigned a new queue position at the beginning of the subsequent queue, and a new **System Impact Study** will be performed consistent with the timing of studies for projects submitted in the subsequent queue.

Agreements

Agreement Type	New Service Customer	FERC Jurisdictional ?
Interconnection Service Agreements (ISA)	Generation/Transmission Interconnection Customer	Yes
Wholesale Market Participation Agreements (WMPA)	Generation Interconnection Customer	No
Interconnection Construction Service Agreement (CSA)	Generation/Transmission Interconnection Customer	Yes
Upgrade Construction Service Agreement (UCSA)	Transmission Interconnection Customer (Merchant Network Upgrades)	Yes

ISA and CSA Overview

Interconnection Service Agreement

- Grants rights to interconnect and generate
- Defines project milestones
- Describes the project's point of interconnection
- Describes system upgrades and costs
- Outlines metering requirements
- Security requirement
- Persists after construction

Construction Service Agreement

- Outlines construction responsibility
- Contains upgrade construction schedule
- Contains notification and insurance obligations
- Terminates after construction

Wholesale Market Participant Agreement

- Connects to distribution line
- No prior wholesale sales
- Requires customer to pursue a two-party Interconnection Agreement with TO
- Grants rights to participate in PJM's market
- Persists after construction

Agreement Implementation

PJM's Responsibilities:

- Periodic construction status meetings
- Outage coordination
- Billing and cost tracking for each network upgrade number
- Metering and telemetry from IC to PJM
- Test energy injection
- Project close out

Interim Deliverability and Rights

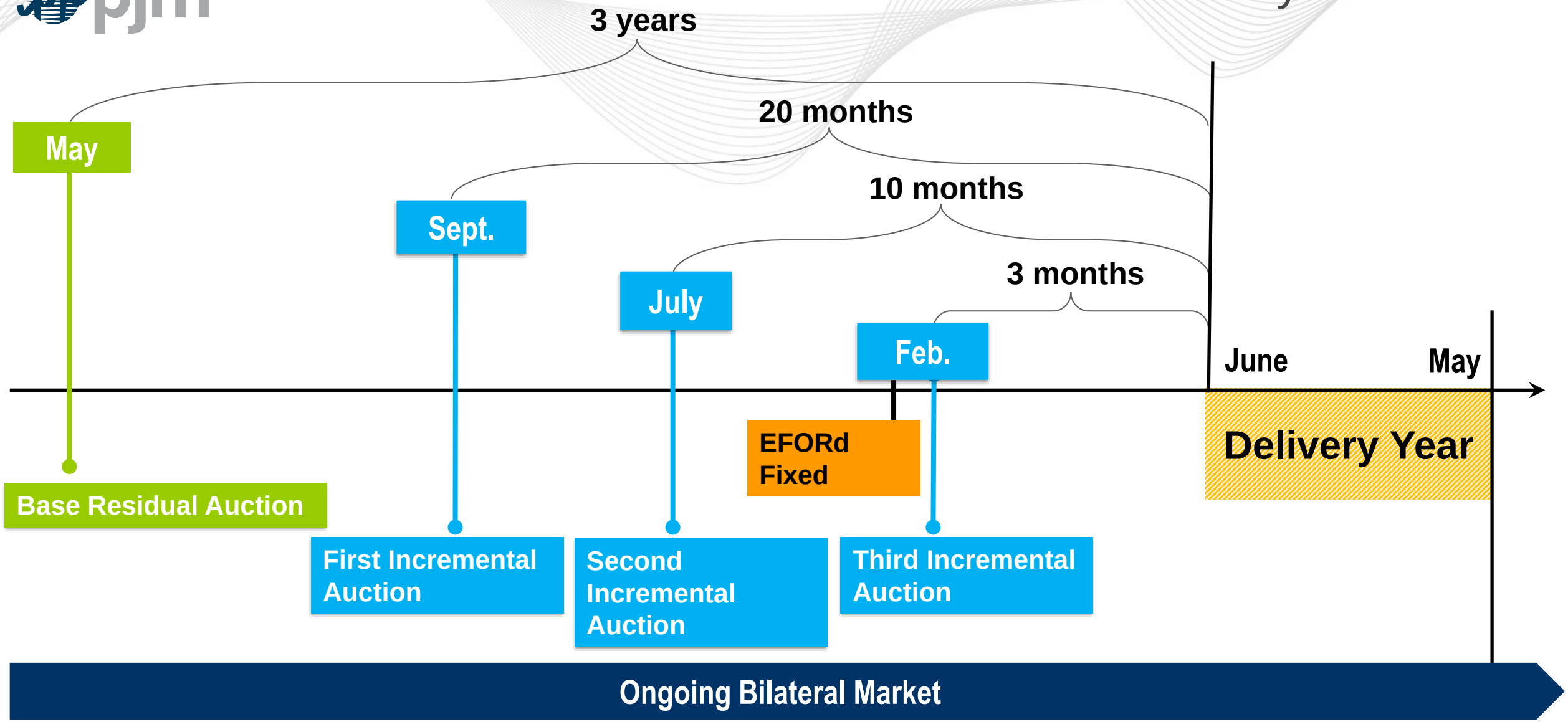
Interim Deliverability Study

Interim Deliverability Study is targeted toward:

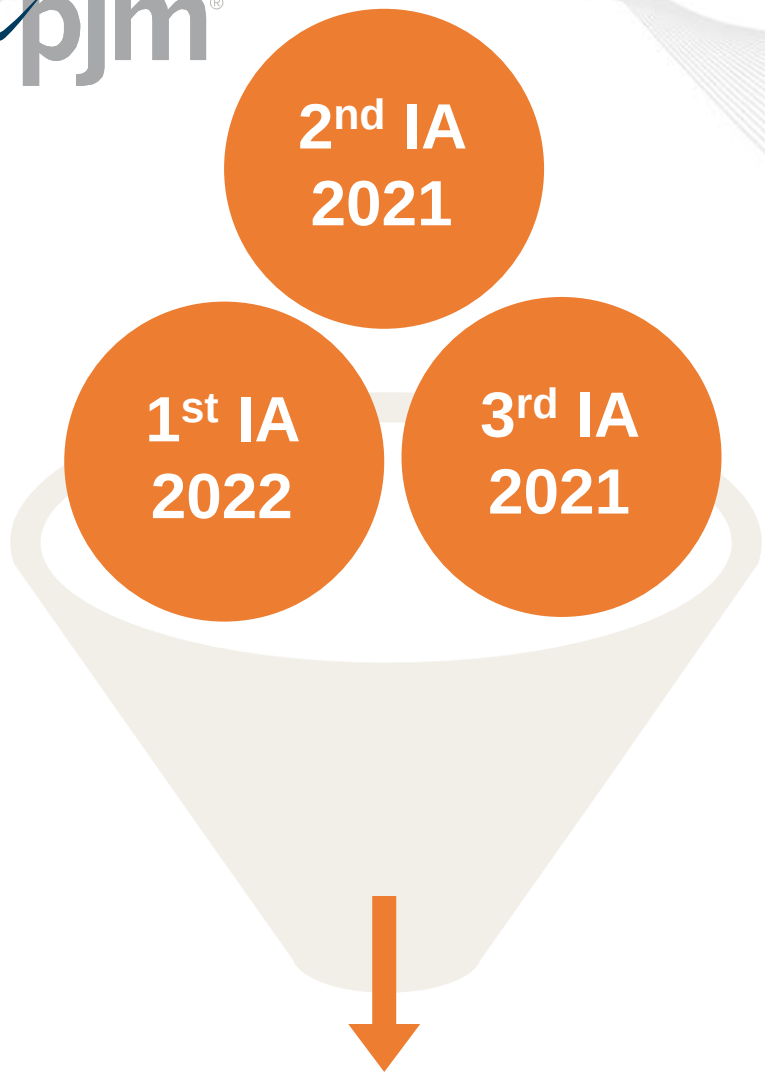
- Projects coming into service prior to the study year
- Projects that are dependent on a network or baseline upgrade that expect the dependent reinforcement to be not completed at the time of the project coming online*

*Only facilities identified at constraints in the System Impact Study will be monitored

Incremental Auction Study Timeline



Example Schedule for 2020



2nd IA 2021

- **Study Begin**: February 2020
- **Study End:** June 2020
- **Auction Date:** August 1st Week

1st IA 2022

- **Study Begin:** June 2020
- **Study End:** August 2020
- **Auction Date**: October 1st Week

3rd IA 2021

- **Study Begin:** September 2020
- **Study End:** January 2021
- **Auction Date**: March 1st Week

*BRA studies are performed as needed

Recent Changes

Recent Changes

Education / Transparency

- Order 845 metrics
- Pre-queue / Post-ISA training
- Improved manual language for site control

Flexibility

- Order 845 permissible technological advancement
- Deficiency cure changes

Process

- Streamlined small generation analysis
- Improved Attachment Y treatment
- Improved PJM tools for analysis and reporting
- 6-month schedule for TOs
- Delayed start of stability analysis

PJM Personnel

- Increased contractor support
- Realigned interconnection departments

Education and Transparency

Change	Realized Benefits
Order 845 performance metrics (link)	Standard method to compare the volume, performance rate and study duration for interconnection processes across the country
Pre-queue training (link)	Recorded training walking through the application process and Queue Point along with high-level overview of process
Improved manual language for site control	Increased clarity on requirements for site-control evidence

Flexibility

Change	Realized Benefits
Order 845 permissible technological advancement	Allows customers to change technology (turbines, inverters, etc.) without a Material Modification analysis
Deficiency cure changes	Customers have the opportunity to correct application deficiencies within 10 business days no matter when the request is submitted

Process

Change	Realized Benefits
Streamlined small generation analysis	Improved internal processes to increase the number of small projects eligible for a combined Feasibility/System Impact Study
Updated Attachment Y treatment	Updated procedures to issue Attachment Y studies for requests on distribution lines within 90 days of submission of all required information
Improved PJM Tools for analysis and reporting	Improvements to TO analysis reports and standardized format of interconnection study reports
6-month schedule for TOs	Schedule shared with TOs to assist in work planning in advance of interconnection deadlines
Delayed start of stability analysis	Reduced scope for System Impact Studies to help issue studies on time

PJM Staffing

Change	Realized Benefits
Contractor support	Supplementing PJM staff with contractors to perform study work, draft reports and manage projects
Department realignment	Creation of geographic teams to improve focus and communication with TOs and customers

Continued Challenges

- Large volume of projects leading to large volume of violations and upgrades
  - Total queued generation just below installed capability
  - Pockets of high density of proposed generation requests
  - Lower-voltage system infrastructure not designed to deliver high quantities of energy
- Timeline to complete Facilities Studies
  - Large scope from network upgrades
- Duration to complete study process versus timeline to construct facilities
- Timelines with Affected System Studies

Interconnection Workshop Summary

Workshop Goals

- Provide a clear foundation and understanding of the current interconnection processes and trends
- Develop a clear understanding of the major issues affecting our interconnection customers and Transmission Owners with our current process
- Learn our interconnection customers' goals – time to interconnect, cost to interconnect, etc.
- Develop a path forward to achieve interconnection customer goals to develop future solutions acknowledging tradeoffs while preserving system reliability and cost assignment.

- PJM presented a comprehensive overview of our process
  - Overview of interconnection studies & interconnection agreements
  - What interconnection customers can expect during that process.

- Recent improvements PJM has made to alleviate bottlenecks in the interconnection queue.

- Briefly discussed other RTOs, and what they are experiencing in their queues as compared with PJM.

- This session was designed as a listening session to collect stakeholder feedback.

- We asked stakeholders to focus on these areas:
  - how the process works
  - where you are experiencing issues,
  - what your thoughts are on challenges we may face given the trends that PJM laid out in Workshop 1
  - What are your top three objectives when entering the PJM Queue or what would you like any process improvements to do?

- The stakeholder presentations encompassed 69 unique concerns raised with 135 suggestions for improvement. The concerns were captured in twelve categories:

Category	Description
Affected Systems	Processes to coordinate work with affected systems such as MISO or NYISO
Agreements	Processes affecting our study agreements, Interim ISAs, ISAs & CSAs
Application	Requirements to submit new requests to PJM
Base Case	Cases used for the interconnection studies
Construction	Issues around construction activities and suspension
Cost Responsibility	Cost accuracy and financial responsibility to reinforce the transmission system
Disputes	Methods to resolve disputes between any party
Interim Operation	Operation of a facility prior to the completion of studies and construction of upgrades
Schedule	Queue window frequency and duration. Also duration of study phases
Staffing	PJM and Transmission Owner staffing
Studies	All study phases and assumptions used to conduct studies
Transparency	Access to information ahead of and during the interconnection process

Category	High	Medium	Low
Studies	112	47	18
Cost Responsibility	99	11	66
Schedule	94	35	48
Base Case	90	55	31
Affected System	88	72	16
Application	84	46	47
Agreements	67	75	34
Interim Operation	54	83	39
Staffing	54	89	32
Construction	46	28	102
Transparency	38	85	52
Disputes	3	60	113

Contact

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Interconnection Process Overview

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