i2X INTERCONNECTION INNOVATION e-XCHANGE
U.S. DEPARTMENT OF ENERGY

Queue Management & Cost Allocation
Pre-request Information (BPS) | 4/13/23

An initiative spearheaded by the Solar Energy Technologies Office and the Wind Energy Technologies Office

Meeting Notes

Notes synthesizing keys points, insights and questions from the meeting can be found here: box link.

The first half of this Teams call is being recorded and may be posted on DOE's website or used internally. If you do not wish to have your voice recorded, please do not speak during the call. If you do not wish to have your image recorded, please turn off your camera or participate by phone. If you speak during the call or use a video connection, you are presumed consent to recording and use of your voice or image.

Agenda

- Introduction to i2X Solution e-Xchanges (5 min)
- Stakeholder Presentations (40-45 min)
    - MISO
    - NextEra
    - EPRI
- Interactive Group Discussion (70 min)
    - Pre-request information type
    - Importance of information accuracy
    - Workload and potential for data automation
    - Best practices at current ISOs/RTOs/Utilities
    - Other options to inform pre-request interconnection stage

Interconnection Innovation e-Xchange (i2X)

Mission: To enable a **simpler**, **faster**, and **fairer** interconnection of clean energy resources while enhancing the **reliability**, **resiliency**, and **security** of our **distribution and bulk-power electric grids**

Stakeholder Engagement
Nation–wide engagement platform and collaborative working groups

Data & Analytics
Collect and analyze interconnection data to inform solutions development

Strategic Roadmap
Create roadmap to inform interconnection process improvements

Technical Assistance
Leverage DOE laboratory expertise to support stakeholder roadmap implementation

energy.gov/i2x

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Key Outcomes from Our e-Xchange Meetings

- Inform and formulate a ***publicly available***, strategic roadmap for interconnection
  - Topical challenges and issues
  - Practical solutions to implement and scale
  - Knowledge and data gaps and new solutions to pilot
  - Success goals and measures of success

- Summary documentation for each meeting regarding ideas discussed and opportunities for targeted stakeholder action

- Provide platform for ongoing engagement before and after meetings

- **Longer term vision** ➔ Solution e-Xchanges to continue building a national forum for all stakeholders as a community of practice, excellence, and innovation

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Upcoming Solution e-Xchanges to Consider Joining

BOLDED ITEMS FOCUSED ON BULK POWER SYSTEM TOPICS

1. **April 26th, 2023, 3-5 p.m. ET: How to Determine Hosting Capacity on the Bulk Electric System**

2. April 27th, 2-4 PM ET: DER Grid Readiness and Network Upgrades

3. **May 11th, 2-4PM ET: Managing the Bulk Power System Interconnection Study Process**

4. May 24, 2023, 2-4 p.m. ET: DER Interconnection Process Approaches & Flexible Interconnection

Follow the schedule of events on the i2X website.

https://www.energy.gov/eere/i2x/i2x-solution-e-xchanges

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Virtual Meetings Code of Conduct

1. *Assume good faith and respect differences*
2. *Listen actively and respectfully*
3. *Use "Yes and" to build on others' ideas*
4. *Please self-edit and encourage others to speak up*
5. *Seek to learn from others*

Mutual Respect . Collaboration . Openness

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Introduction of Stakeholder Presentations

Interactive Group Discussion Topics

Word Cloud Icebreaker:

What would be the most important pre-request information to provide?

[Go to **slido.com** and enter event code **i2x13**, then go to **Polls** tab]

ISO/RTO/Utility and Developer Surveys

- Prior to this meeting we surveyed the stakeholders on the topics related to pre-interconnection information to inform this discussion

- If you have not already done so, please consider filling in this short survey

- It will stay open until the end of the week and the updated results will be included in the meeting summary

- ISO Survey: https://www.surveymonkey.com/r/LGLY3ZH

- Developer Survey: https://www.surveymonkey.com/r/ZWNJ6QY

Respondent Summary – Organization Type

Answered: 10   Skipped: 0

- ISO — 3
- RTO — 2
- Vertically Integrated... — 4
- Transmission Service...
- Other (please specify) — 1 TO/TOP/TP

Answered: 29   Skipped: 0

- Developer — 27
- OEM
- Consultant working with... — 1
- Other (please specify) — 1 **Developer and has utility and owns transmission**
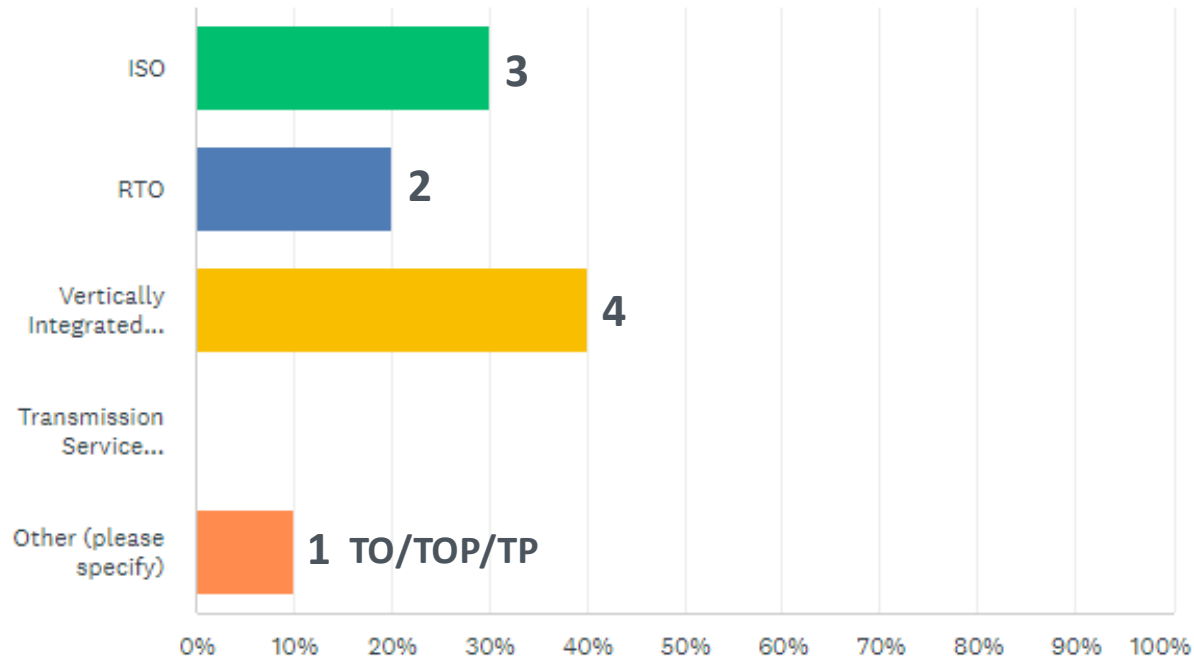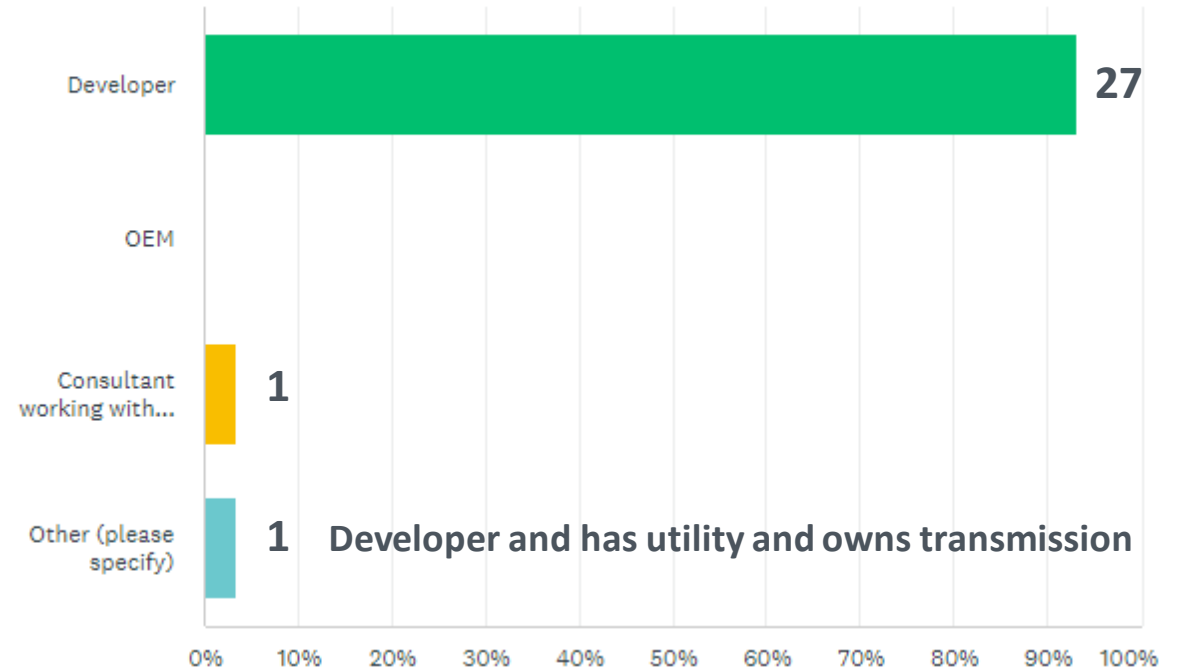
Will pre-request information improve interconnection process?

ISO/RTO/Utilities Response

Answered: 10   Skipped: 0
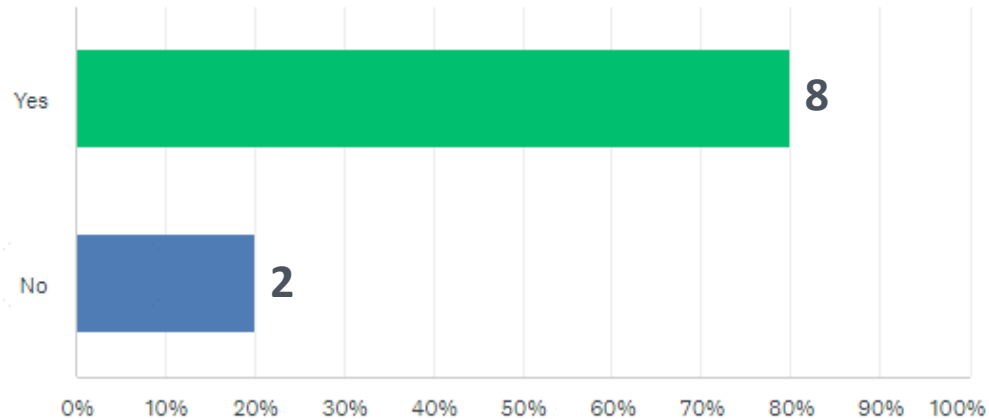
Developers Response

Answered: 29   Skipped: 0
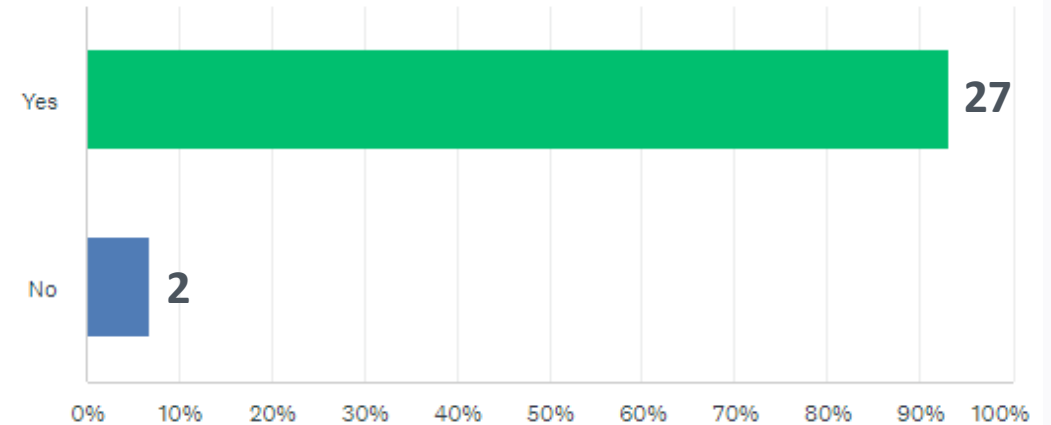
According to developer survey:
- Pre-request information provided online (9)
- mix of online and upon request (13)
- upon request (1)
- not provided at all (4)

Key commentary: the information needs to be reliable and have acceptable engineering accuracy

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Topic #1: What additional pre-request information could be useful?

Developers Response
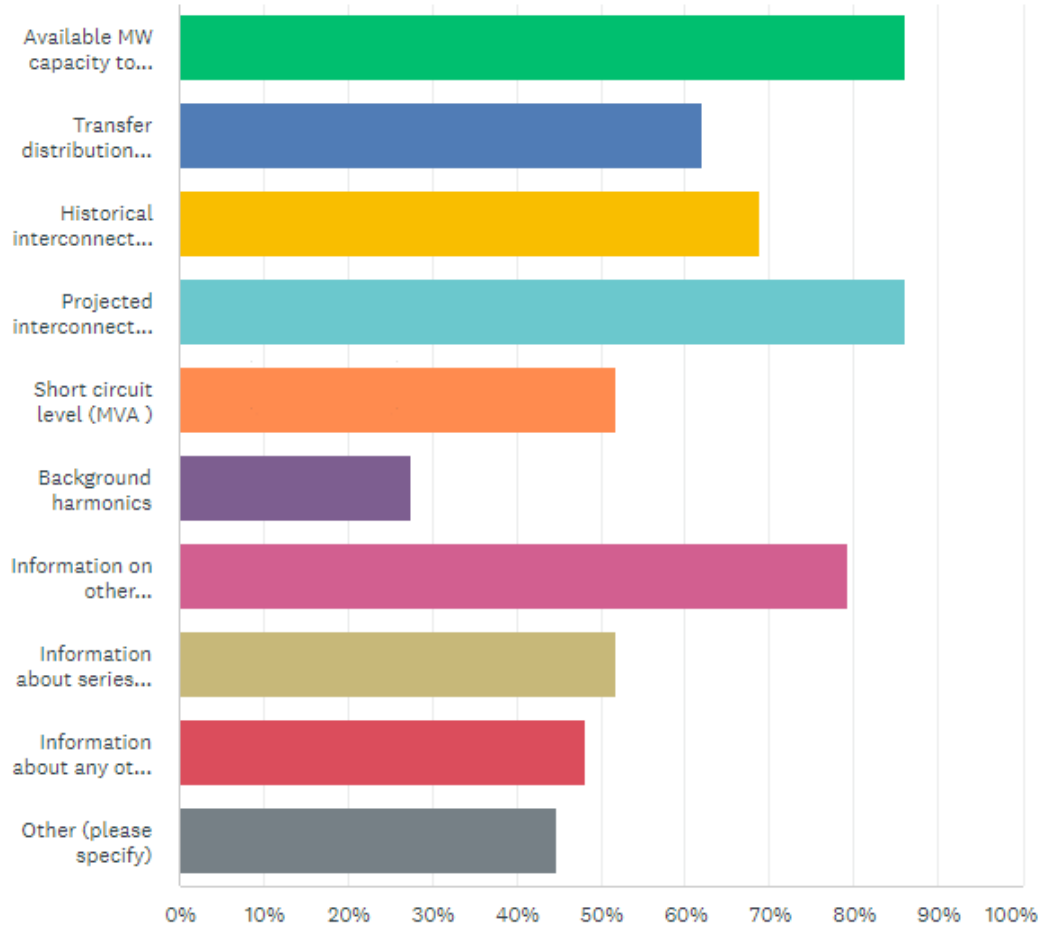
Answered: 29   Skipped: 0

ANSWER CHOICES	RESPONSES	
Available MW capacity to connect at each transmission node	86.21%	25
Transfer distribution factors from a given transmission node	62.07%	18
Historical interconnection costs, including network upgrade costs, for a point of interconnection (POI) or a region (averaged across multiple POIs)	68.97%	20
Projected interconnection costs, including network upgrade costs, for a POI or a region (averaged across multiple POIs)	86.21%	25
Short circuit level (MVA)	51.72%	15
Background harmonics	27.59%	8
Information on other generators at a POI or in the vicinity (location, type and capacity of other generators)	79.31%	23
Information about series compensated lines in the vicinity of a POI	51.72%	15
Information about any other power electronic equipment in the vicinity of a POI (SVCs, STATCOMs, etc.)	48.28%	14
Other (please specify) Responses	44.83%	13
Total Respondents: 29		

Other suggestions:

- Interconnection queue information (POI, tech type, etc.)
- Planned retirements and transmission upgrades
- Affected System costs
- Substation information (bays, expandability, etc.)
- Up-to-date study cases

ISO/RTO/Utility Responses

Answered: 6   Skipped: 4
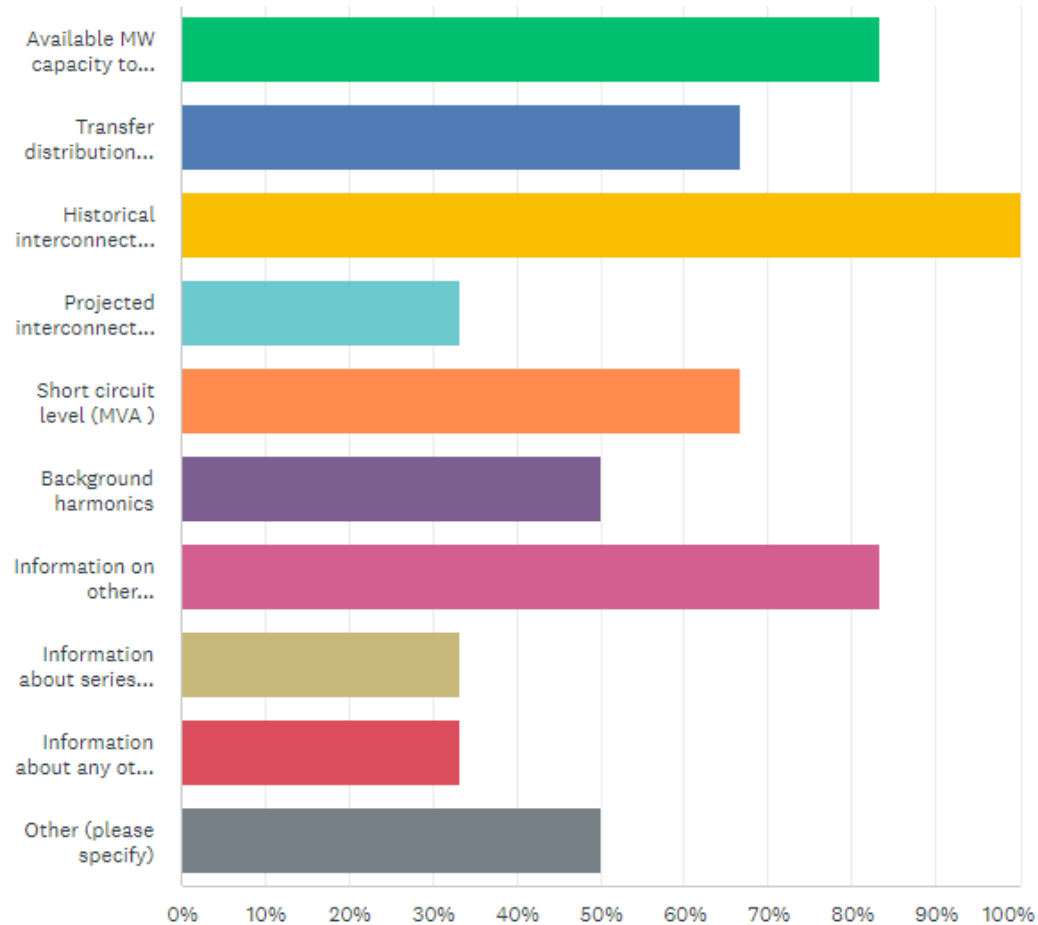
ANSWER CHOICES	RESPONSES	
Available MW capacity to connect at each transmission node	83.33%	5
Transfer distribution factors from a given transmission node	66.67%	4
Historical interconnection costs, including network upgrade costs, for a point of interconnection (POI) or a region (averaged across multiple POIs)	100.00%	6
Projected interconnection costs, including network upgrade costs, for a POI or a region (averaged across multiple POIs)	33.33%	2
Short circuit level (MVA)	66.67%	4
Background harmonics	50.00%	3
Information on other generators at a POI or in the vicinity (location, type and capacity of other generators)	83.33%	5
Information about series compensated lines in the vicinity of a POI	33.33%	2
Information about any other power electronic equipment in the vicinity of a POI (SVCs, STATCOMs, etc.)	33.33%	2
Other (please specify) Responses	50.00%	3
Total Respondents: 6		

Other suggestions:

- Grid stability metrics
- Substation information (bays, expandability, etc.)
- Information on modeling and studies requirements
- Available MW capacity may not be useful or up-to-date

Topic #1: What additional pre-request information could be useful?
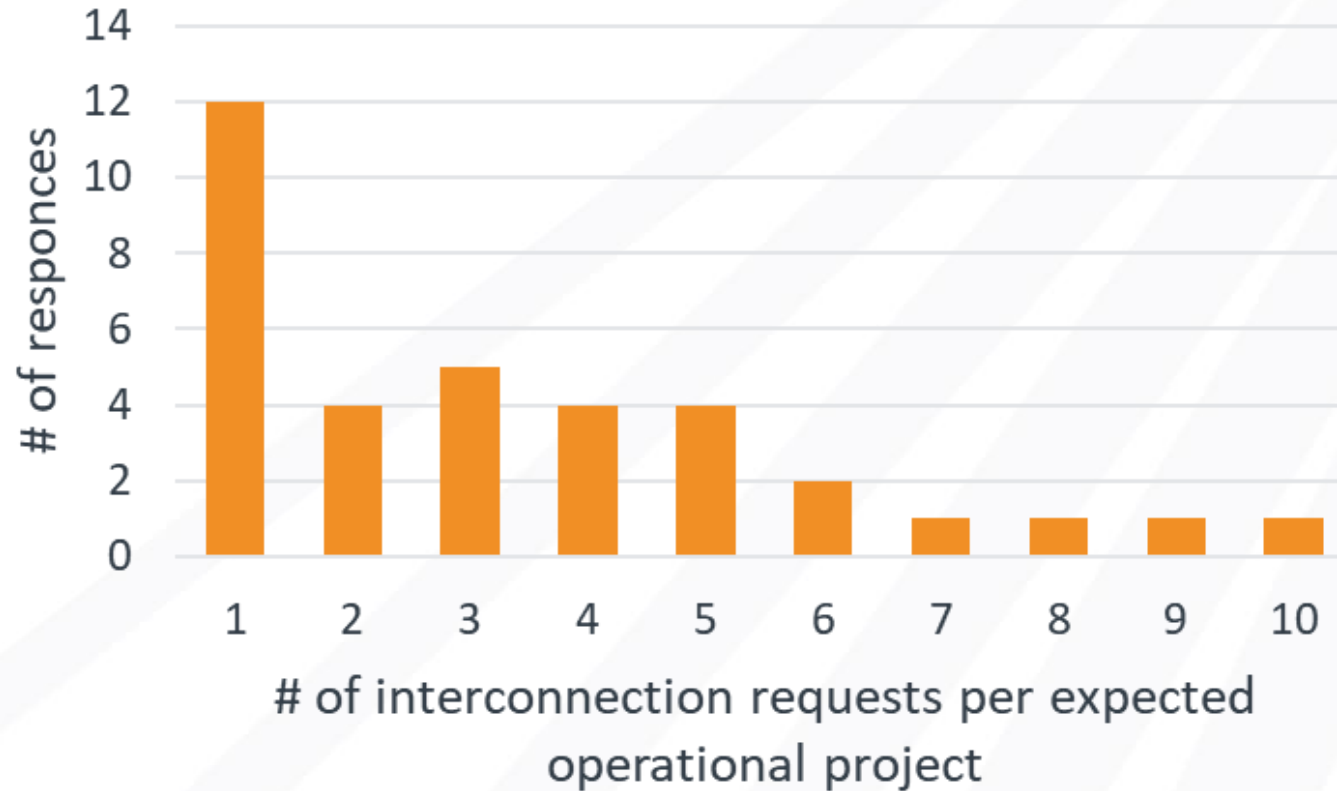
* Ranges of answers are treated as multiple choice for the purpose of the chart

Topic #1: What additional pre-request information could be useful?

- Please go to slido to make comments and add questions of your own: **slido.com** and enter event code **i2x13**

- For verbal commentary, please use the raise hand feature and we will call on you

- Additional related / associated questions:
  - Do developers have enough information to make efficient siting decisions?
  - Are exploratory projects being submitted mostly as an information gathering exercise?
  - Can pre-request information help reduce exploratory applications?

Discussion Best-Practices

1. *Assume good faith and respect differences*
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Topic #2: How accurate can/should pre-request information be?

ISO/RTO/Utility Responses

How often should the information in Q6 be recalculated and updated to be useful?

Answered: 6   Skipped: 4

Developers Response

How often should the information in Q6 be recalculated and updated to be useful?

Answered: 29   Skipped: 0
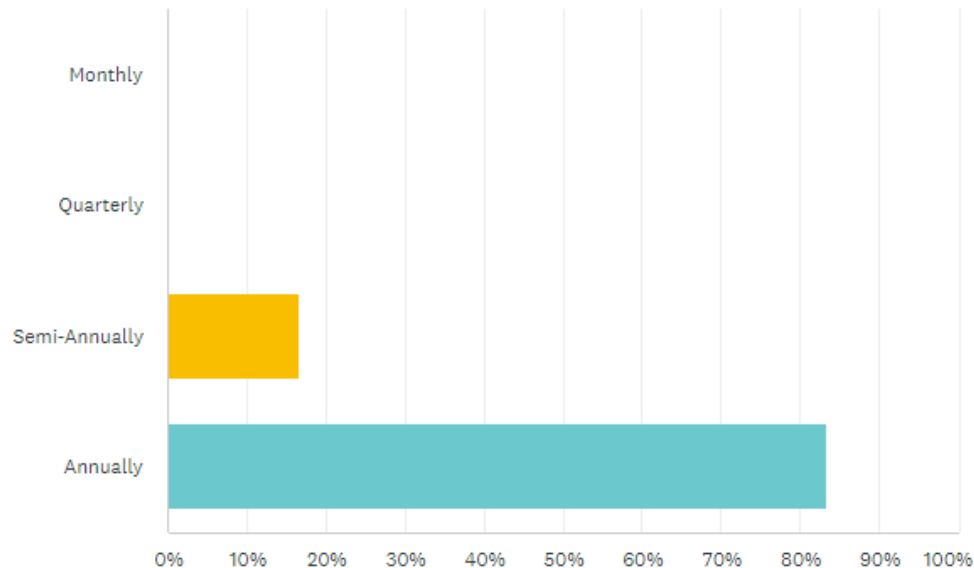
Other suggestion from ISO/RTO/Utility:
- Based on schedule of updates (approved transmission upgrades, dropouts from earlier queued clusters)
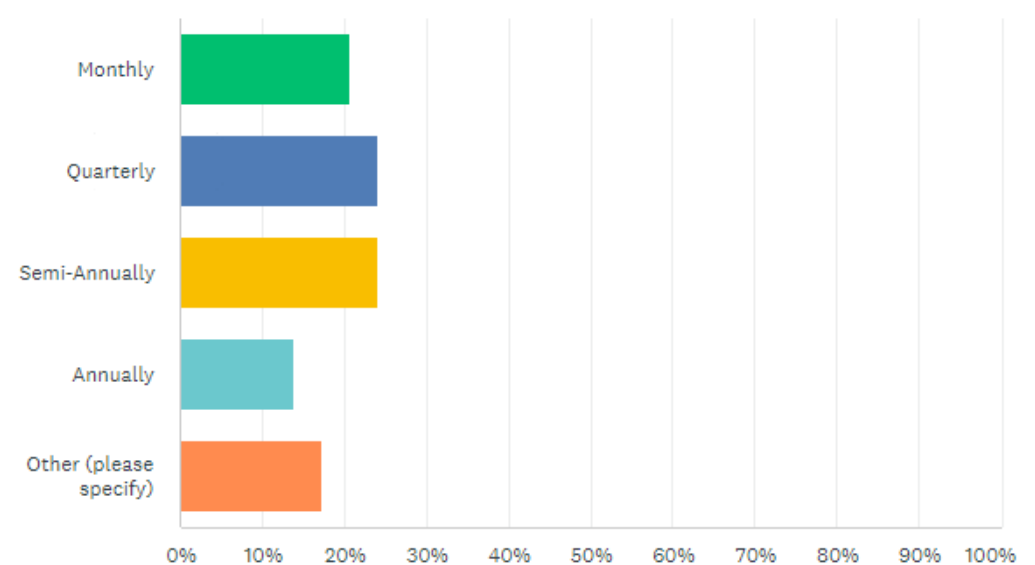
Other suggestion from Developers:
- Updated every time a higher-queued or current-queued cycle is completed

Topic #2: How accurate can/should pre-request information be?

ISO/RTO/Utility Responses

If the information should be based on a planning case, what planning year(s) should the case be for (e.g., current year +2, +5, +10 years)?
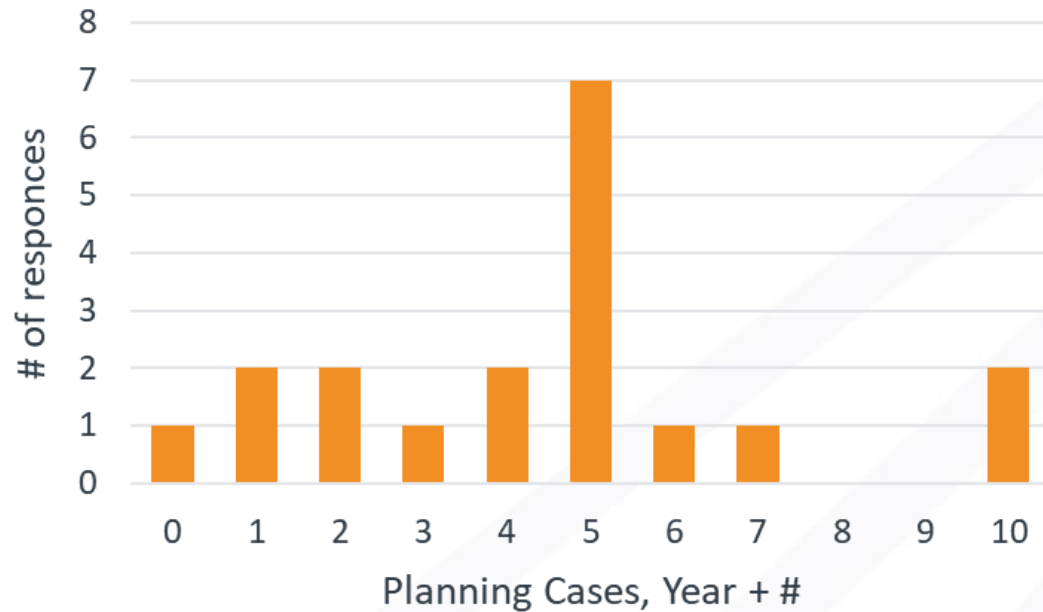
Developers Response

How many years prior to the year of commercial operation is the information in Q6 needed to be useful?
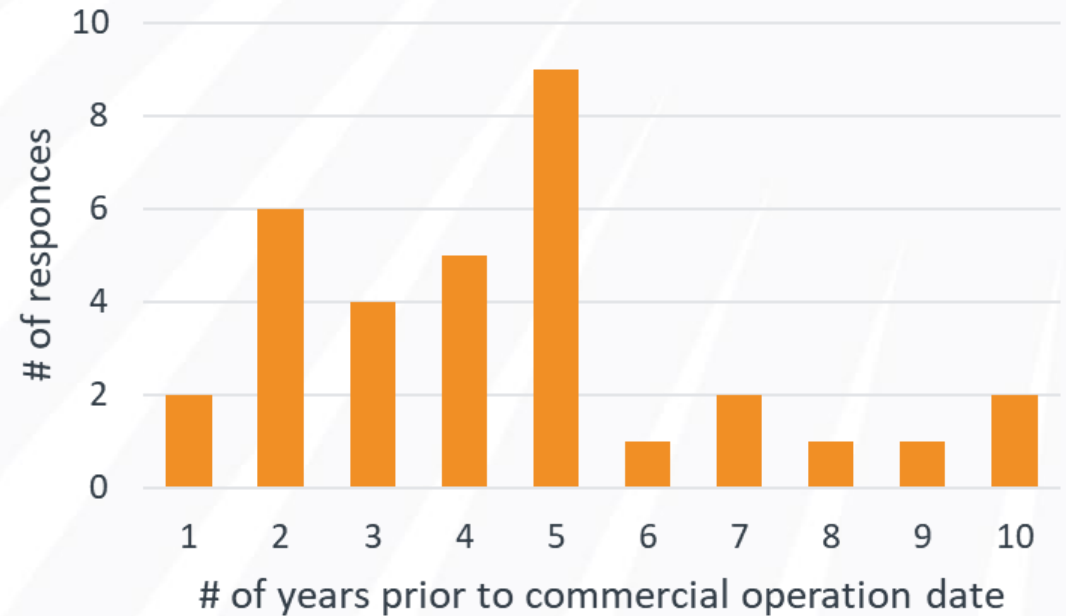
Topic #2: How accurate can/should pre-request information be?

- Please go to slido to make comments / questions of your own: **slido.com** and enter event code **i2x13**

- For verbal commentary, please use the raise hand feature and we will call on you

- Additional related / associated questions:
  - Is detailed information needed? Are indicative heatmaps sufficient to avoid applications in certain areas?
  - How frequently does this information need to be updated? Monthly? Quarterly?
  - How to evaluate the accuracy of the information?

Discussion Best-Practices

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Topic #3: Can pre-request information calculation metrics be automated?

ISO/RTO/Utility Responses

Which entity or entities should provide pre-interconnection information to interconnection customers?

Answered: 7   Skipped: 3
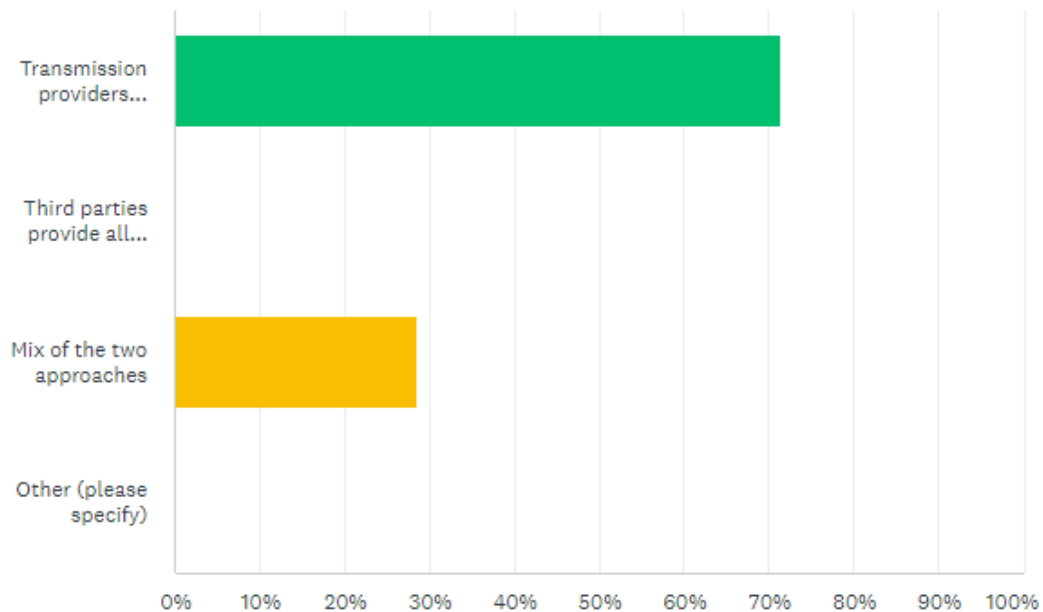
"Ideally this should be automated, but this would be immensely complex"

"We make certain information available on a self-serve basis"

"Information is based on study cases that are produced for transmission planning purposes"

Topic #3: Can pre-request information calculation metrics be automated?

- Please go to slido to make comments / questions of your own: **slido.com** and enter event code **i2x13**

- For verbal commentary, please use the raise hand feature and we will call on you

- Additional related / associated questions:
  - Can ongoing interconnection/planning study results be used to calculate metrics for pre-request information?
  - Who should provide this information? Transmission providers? 3rd parties? A mix?
  - What concerns do ISOs / Utilities have over staff needs related to these items?

Discussion Best-Practices

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Topic #4: What data sharing best practices are already happening today?

Key information sources listed by ISO/RTO/Utilities:

- Interconnection queue information (POI, tech type, etc.)

- "Red zone" map showing where new projects are likely to drive cost-prohibitive upgrades

- Heatmaps or Grid capacity availability / Screening tool for new projects on existing base cases

- Base case models

- All existing study reports for interconnection requests

- Reports on existing system constraints and reliability needs

- Reports from planning studies

- Planned transmission upgrades

- Historical POI information

- Online portal with necessary information for the developers (modeling, financial, etc.)

Topic #4: What data sharing best practices are already happening today?

- Please go to slido to make comments / questions of your own: **slido.com** and enter event code **i2x13**

- For verbal commentary, please use the raise hand feature and we will call on you

- Additional related / associated questions:
  - Opportunities for short term wide adoption by different territories?
  - Longer term issues that some areas are actively working through?

Discussion Best-Practices

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Topic #5: What else could be done pre-request?

- Please go to slido to make comments / questions of your own: **slido.com** and enter event code **i2x13**

- For verbal commentary, please use the raise hand feature and we will call on you

- Additional related / associated questions:
  - How can developers be better informed about relevant data prior to submitting a request?
  - Are there other opportunities beyond data availability? Big ideas?
  - Can methods used for calculation of pre-interconnection metrics be made transparent?
  - How might developers/consultants replicate interconnection study results in a simple way, in advance of submitting a request?

Discussion Best-Practices

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MISO Point of Interconnection (POI) Tool

i2x Solutions e-Xchange

April 13, 2023

Purpose & Key Takeaways

Purpose: Introduce and provide a demonstration of the MISO POI tool

Key Takeaways:

- MISO POI Tool is designed to help Interconnection Customers pre-screen for potential POIs

- The results are for information only and do <u>not</u> include voltage or stability constraints

POI - Point of Interconnection

Background

- Interconnection Customers want to get a general idea on WHERE a good POI would be for the planning horizon

- Heat Map: Better overview of the Planning Horizon system condition

- Interactive Tool provides a better customer experience

High Level Introduction of the Tool

- The results are informational only
- A tutorial on how to use the tool is provided when first launching it
- Tool can be used to pre-screen for potential POIs, to eliminate POIs with excessive thermal overloads
- It is not meant to replace any existing process, such as Preliminary Transmission Feasibility Study
- The results DO NOT include voltage or stability constraints

High Level Steps for using the POI Tool

1. Select an area on the map

2. Enter a MW request amount (Required)

3. Filter POI based on kV Level (Optional)

4. Select POI to see results

5. Save results (Optional)

Select an Area on the Map

Enter a MW Request Amount (Required)

Filter POI based on kV Level (Optional)

Select POI based on Name

View Results from Analysis

Link to the MISO POI Tool
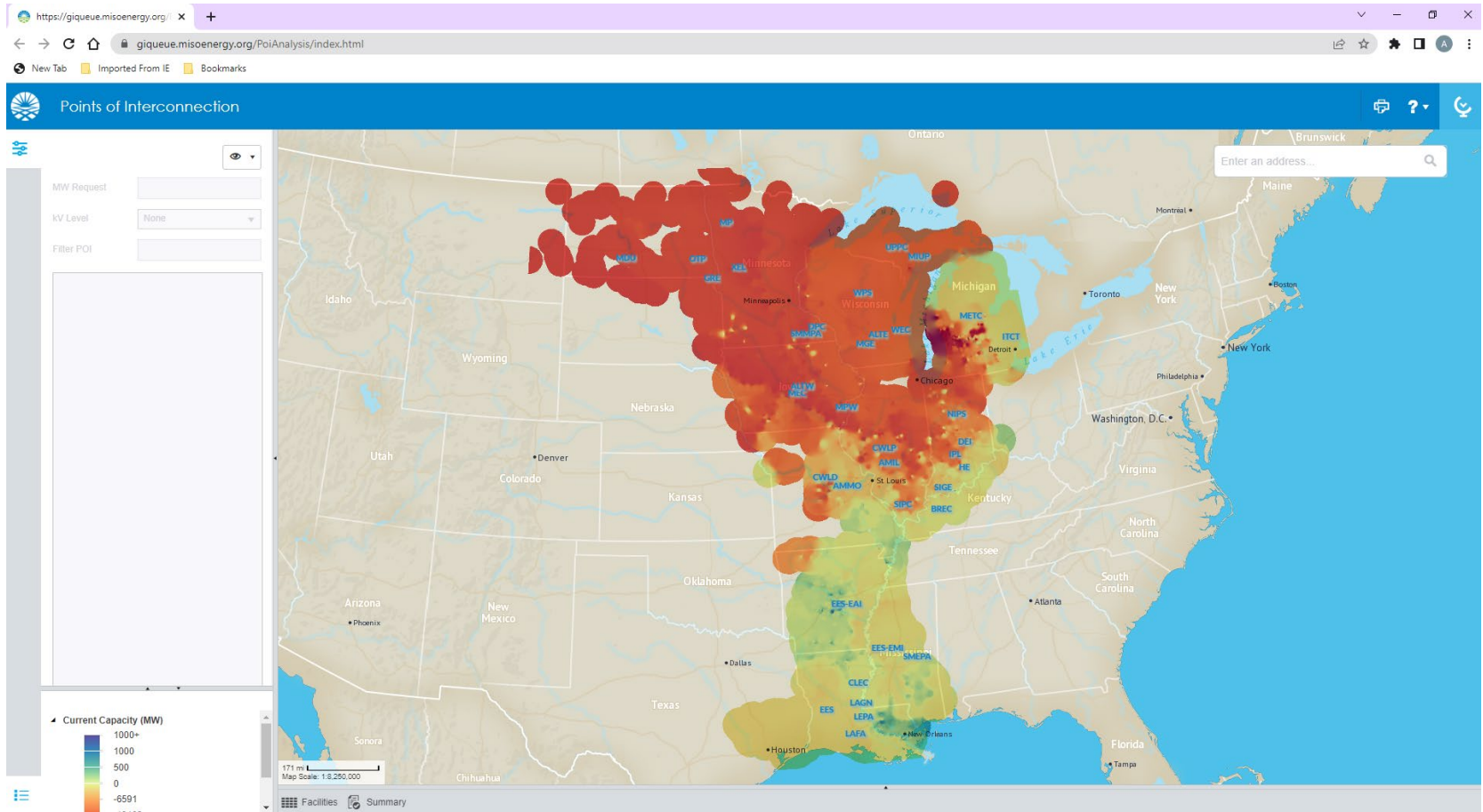
Tool Link: https://giqueue.misoenergy.org/PoiAnalysis/index.html

Link to MISO Interactive Queue Map
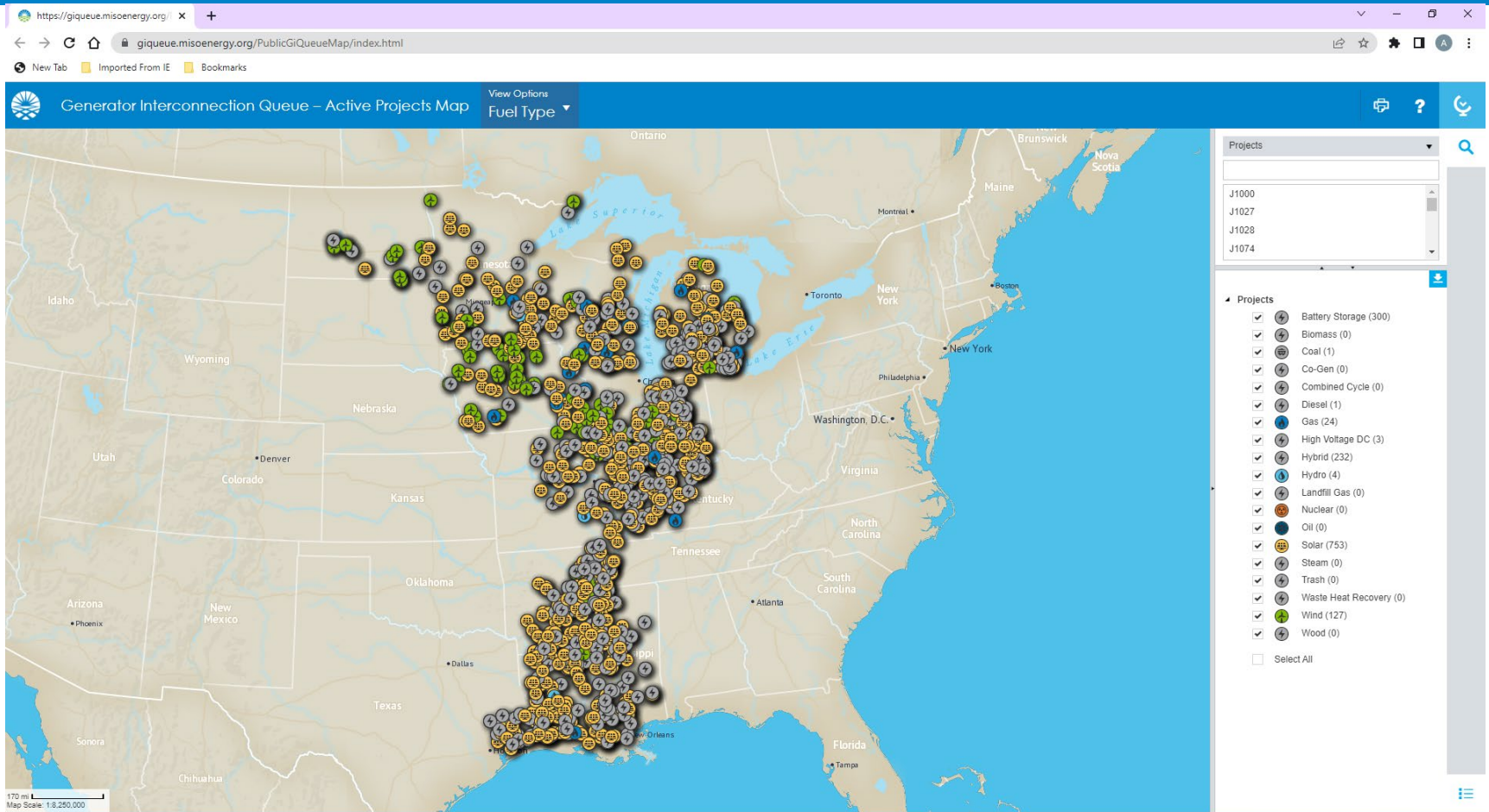
Tool Link: https://giqueue.misoenergy.org/PublicGiQueueMap/index.htm

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Screening tools for interconnection studies

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Interconnection Pre-Request Information for Bulk Power Systems

DOE i2X Solution e-Xchange
April 13, 2023 (Virtual)

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- Positions you as a leader in addressing industrywide challenges

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Who We Are

Founded in 1972, the Electric Power Research Institute (EPRI) is the world's preeminent independent, non-profit energy research and development organization, with offices around the world.
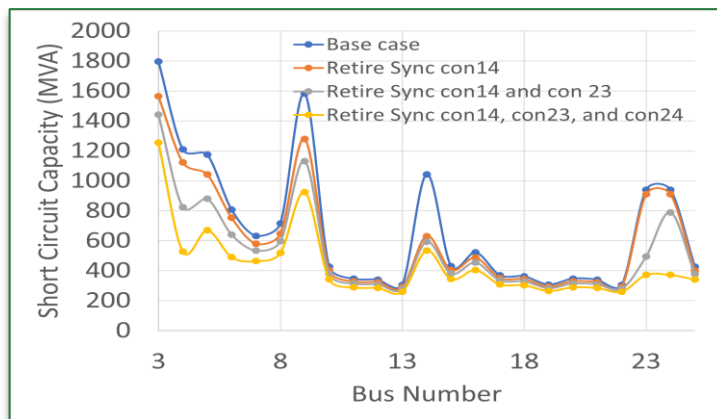
Our Experts

EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe.

Types of screening tools/methods that could be used
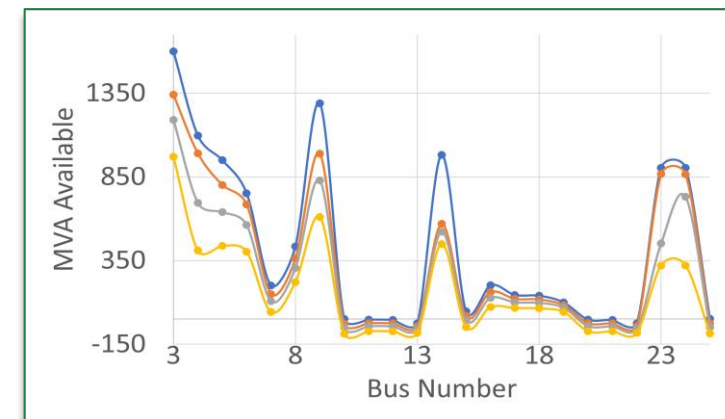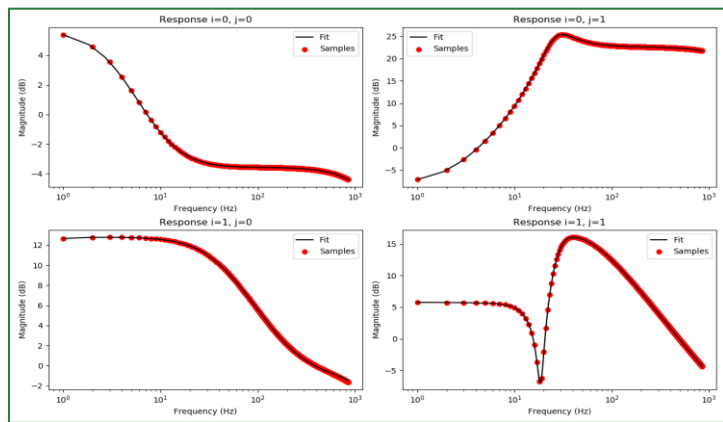
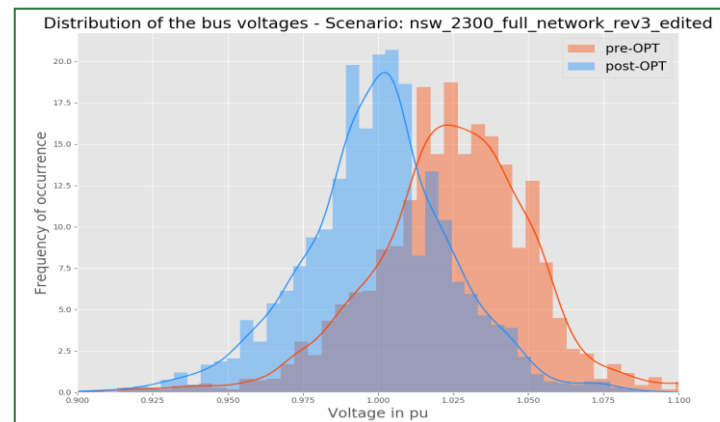**Hosting capacity**
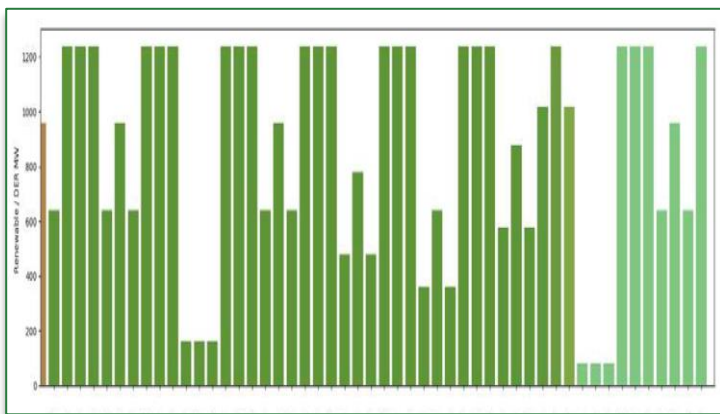
Short circuit capacity

Remaining MVA

Frequency spectrum

Voltage control area

Hyperlinks navigate to related locations on EPRI website

Transmission Hosting Capacity Tool

EPRI

Transmission Hosting Capacity Tool (THCT)

Features	Data Requirements	Compatibility
• Assesses co-related impact of generation retirement and increase in renewable generation/DER • Evaluates impact/limit of increase in load withdrawal • Evaluates effectiveness of BESS locations to alleviate thermal and voltage constraints	• Powerflow scenarios • Contingencies to be evaluated • Generator interconnection locations • Generator retirement schemes • Violations criteria	• Siemens PTI PSS®E • GE-PSLF™ • DIgSILENT PowerFactory

- Can all IBRs in the GI queue be hosted by the transmission network?
  - If not, what is the limit of the network, and where is the limiting element?
- Is one particular generator retirement scheme better than another scheme?
- How much load withdrawal can be sustained by the existing network?
- How much BESS will be needed for transmission deferral?

All results should be evaluated based on contingencies and topologies identified

EPRI

Case Studies

Entity type	Number of studies done	Main study objectives/results
Utility	4	Allowed to identify suitable sites for potential IBR/DER connection Allowed study of various interconnection scenarios at one time to evaluate maximum interconnection capacity of the system.
System operator	2	Study impact of different generation interconnection queues to identify the limiting transmission corridors. Subsequently identify improvements in hosting capacity due to mitigating actions

Hosting capacity for different contingency categories
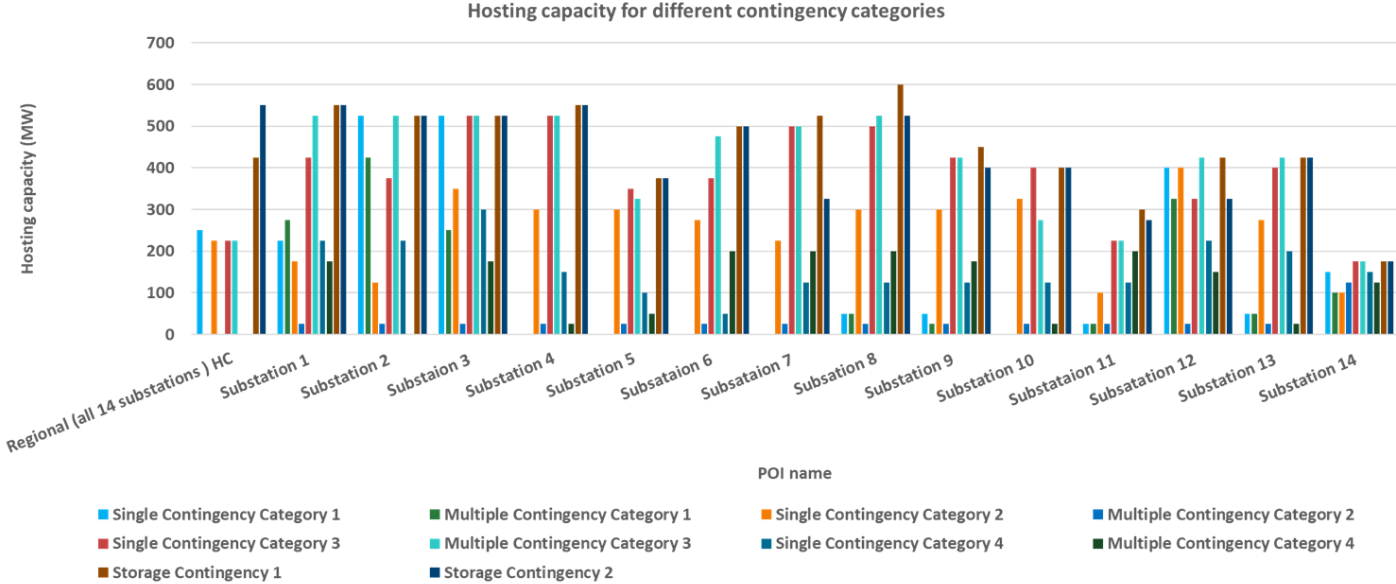
Grid Strength Assessment Tool

Grid Strength Assessment Tool (GSAT)

| Value	Evaluates	Compatibility
Provide insights on • Network locations/conditions which could be susceptible to issues related to weak grid conditions • The need for detailed studies	• Generic SCR • Weighted SCR • Composite SCR • Minimum available SCC • Advanced EPRI metric	• Siemens PTI PSS®E • GE-PSLF™ • DIgSILENT PowerFactory

- Minimum available SCC
    - Provides insight into potential locations of instability based on impact of other IBRs in the network
    - Can be used to determine an initial rating of system strengthening devices that are required
- EPRI's advanced metric
    - Completely analytical, and no requirement of a dynamic run
    - Uses few dynamic data values (e.g. controller gains, time constants) of the IBR
    - Is expressed as critical clearing time before converter instability
- Data requirements
    - Powerflow case files, contingency definitions, locations for evaluation, few dynamic performance data

Case Studies

Entity type	Number of studies done	Main study objectives/results
Utility	6	Insights into screening metrics to quickly identify areas in the power system in which Inverter Based Resources (IBR) are likely to experience adverse impacts due to weak grid conditions.

Study results will help in determining which connection points (more than one IBR requesting interconnection) are likely to experience weak grid issues |
| System operator | 4 | Fast critical contingencies scanning for N-1, N-1-1 and N-2 network constraints and outage assessments that may impose short circuit based limits for IBR integration and operation |
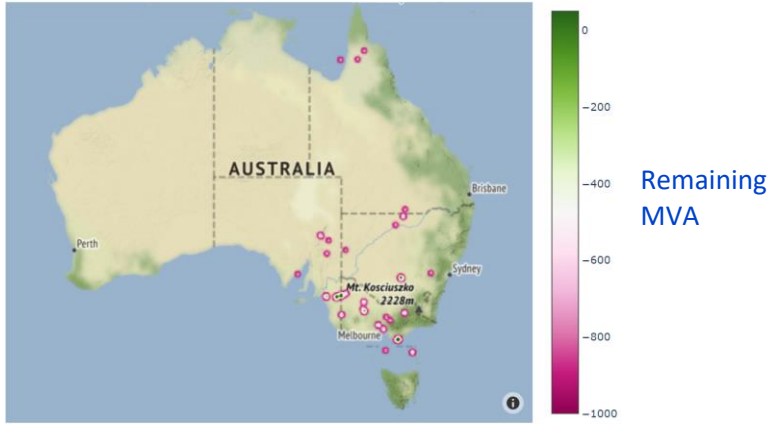
Since case study results may be classified as CEII, a synthetic NEM network used to show visualization of results

EPRI

Network Impedance Scan Tool

EPRI

Network Impedance Scanning Tool (ZSCAN)

| Features	Data Requirements	Compatibility
• Computes the resistance and reactance vs frequency of a network • Accounts for various topological configurations • Allows user to provide input-impedance characteristic of other IBRs in the network	• Powerflow scenarios • Contingencies to be evaluated • Generator interconnection locations • Impedance-frequency characteristic of existing IBRs	• Siemens PTI PSS®E

- Is there risk for SSR, SSCI, or SSTI?

- Will presence of nearby IBRs introduce control interactions?

- Will there be a need to re-tune new IBR devices?

All results should be evaluated based on contingencies, topologies, and operating point studied

EPRI

Case Studies

Entity type	Number of studies done	Main study objectives/results
Utility	1	Evaluate risk of SSR and SSCI due to interconnection of generation resources
System operator	-	Identify impact of change in IBR control structure on SSR and SSCI Verify accuracy of reduced network model for detailed studies
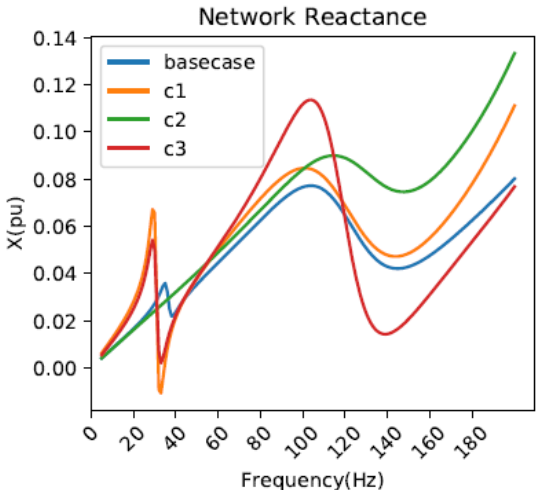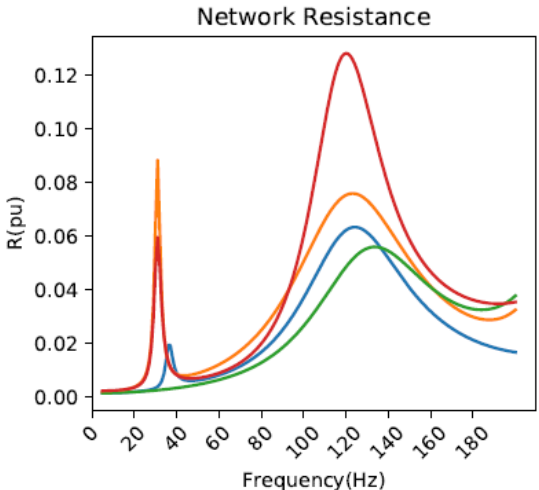
Voltage Control Area Tool

EPRI

Voltage Control Area (VCA Studio)

Features

- Optimize voltage schedule, status of shunt devices, and transformer tap ratio
- Evaluate Reactive Power margin/reserve for each VCA
- Find minimum number of control actions to mitigate voltage violations during contingencies
- Optimize voltage settings and bandwidth for automatic switching shunts
- For planning, find optimal site & size of new shunt devices

Data Requirements

- Power flow scenarios (Raw files)
- Contingency files
- Bus coordinates (optional)

Objective

- Maximize dynamic var reserve
- Minimize reactive power circulation
- Solve voltage schedule conflict between multiple IBRs/generators
- Minimize switching shunts actions due to load & IBRs variability
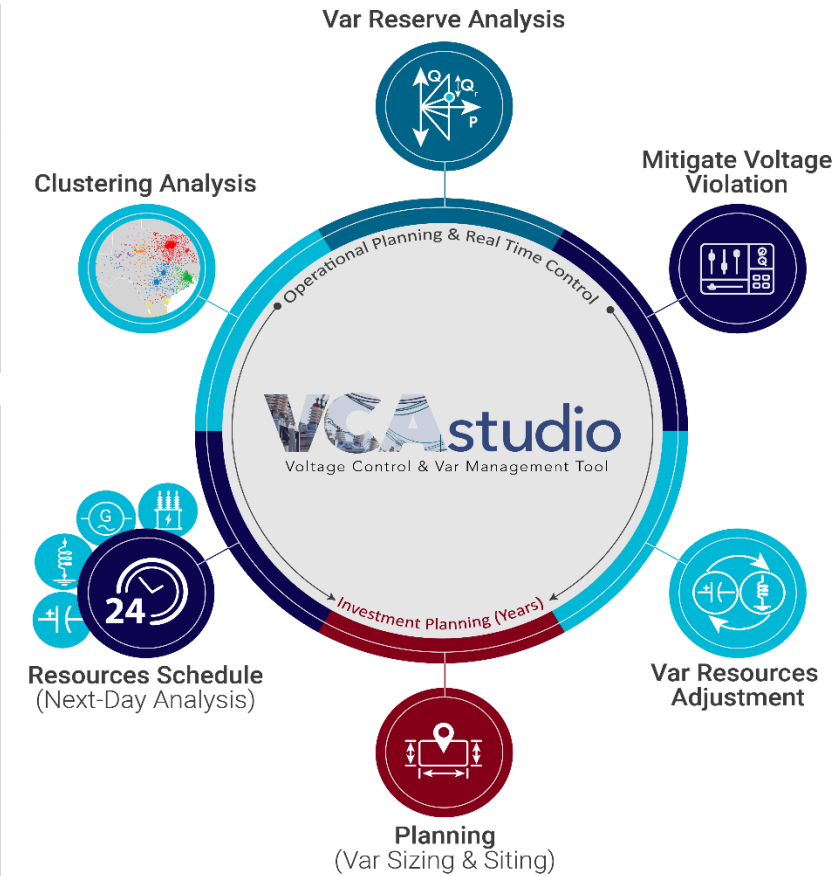
VCA Studio can be utilized to determine location and size of required reactive power resources

Case Studies

Entity type	Number of studies done	Main study objectives/results
Utility	6	Find size and site of new shunt devices
System operator	-	Find optimal control actions to minimize voltage violations Schedule voltage setpoint and shunt devices in the system for next day analysis.

EPRI

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