



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

An EERE collaboration between SETO & WETO

Bulk Power/Energy Working Group

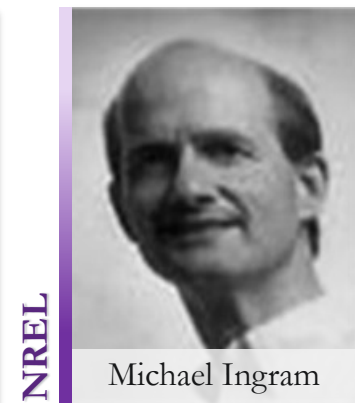
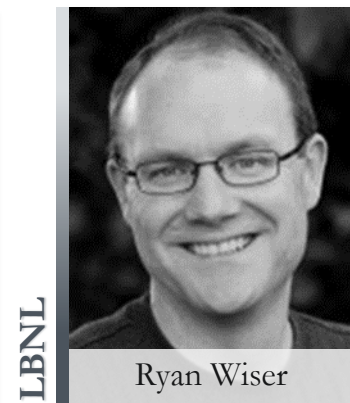
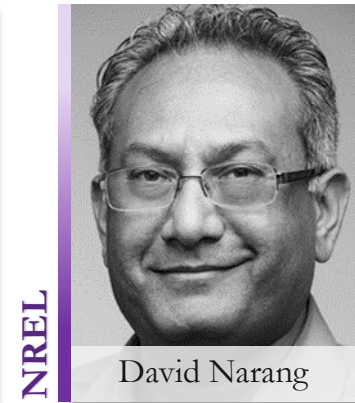
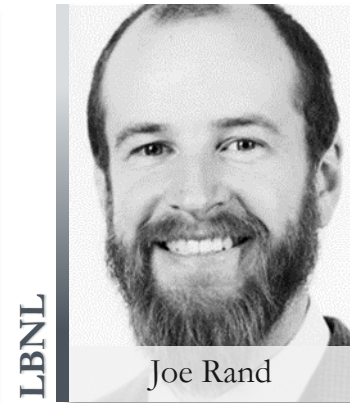
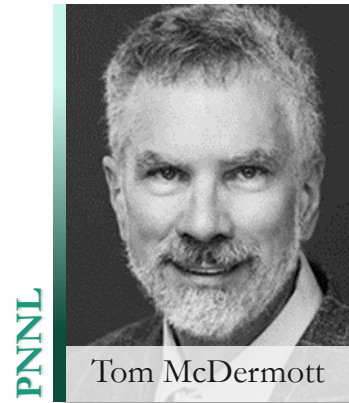
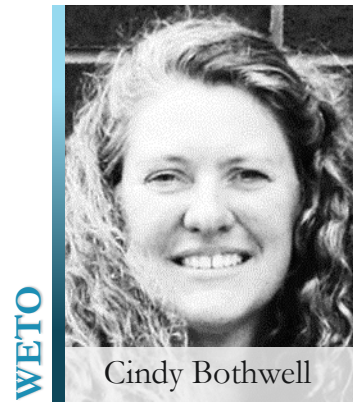
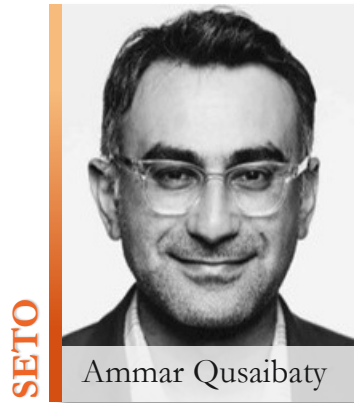
3:30 – 5:00 pm January 31st, 2023

Agenda

1. Introduction to i2x and WG
2. Study Guide Outline
3. Discuss Best Practices

i2x@ee.doe.gov | energy.gov/i2x

i2X Leadership team



i2X Key Elements

Mission: To enable a **simpler, faster, and fairer** interconnection of clean energy resources all while enhancing the **reliability, resiliency, and security** of our electric grid.



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

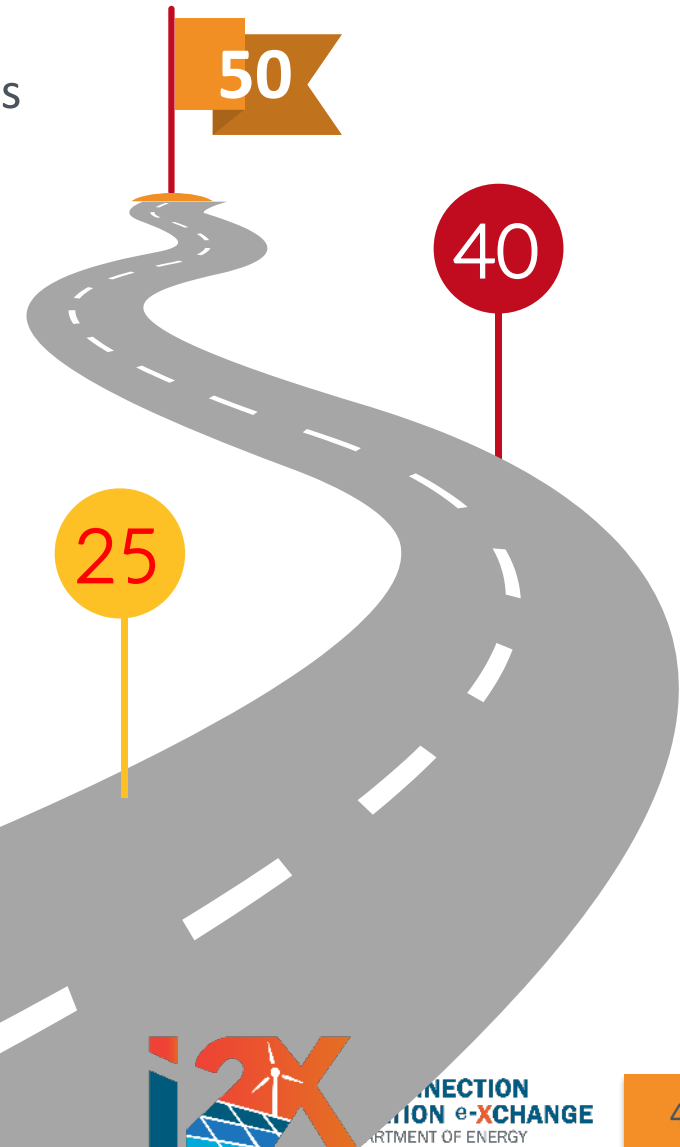
Leverage DOE laboratory expertise to support stakeholder roadmap implementation



5-Year Strategic Roadmap

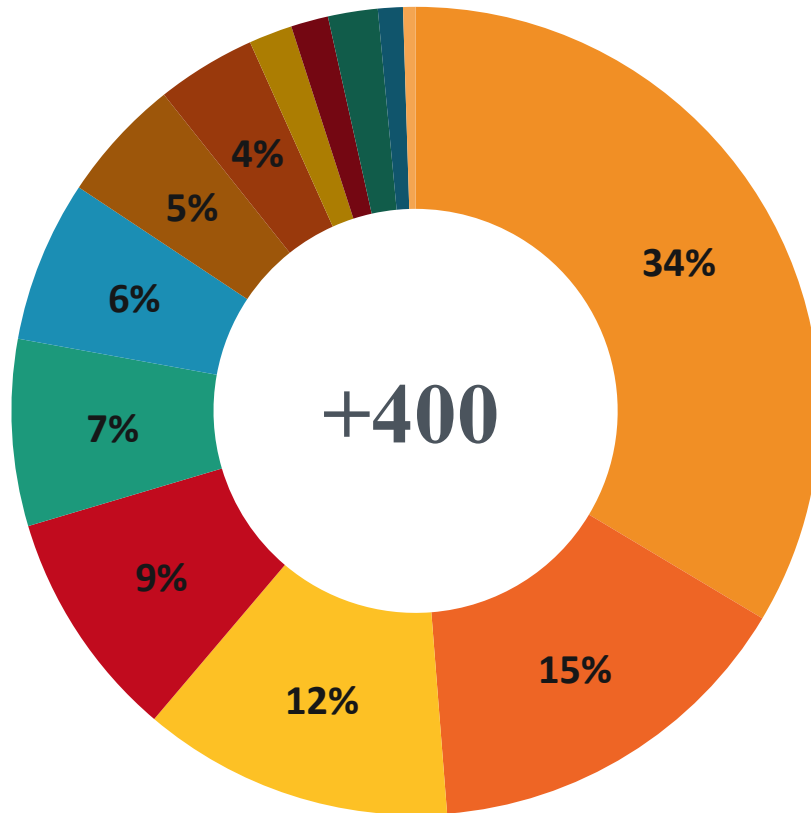
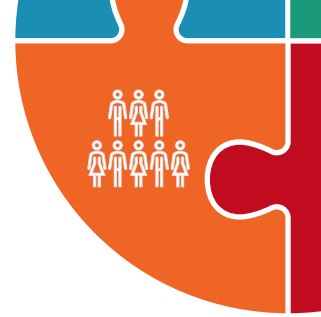
Goal: 50% cost and 50% schedule reduction, transitioning to no more than 1 year from application to build, increasing the approval rate of interconnections

- Expert-Informed goal setting (*KPIs in development*)
- Success milestones & gaps to address
- Transparent key performance indicators
- Covers both DER & BPS and their interplay
- Customizations for size and region
- Covers challenging topics
- Stakeholder Actions. Multi-stakeholder actions
- Transition planning for new processes
- Buy-in, Adoption, and Updates



FERC NOPR RM22-14

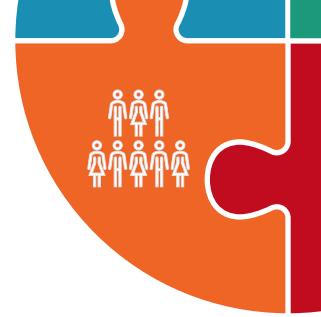
Response to i2X has been incredible



Partner organization by sector

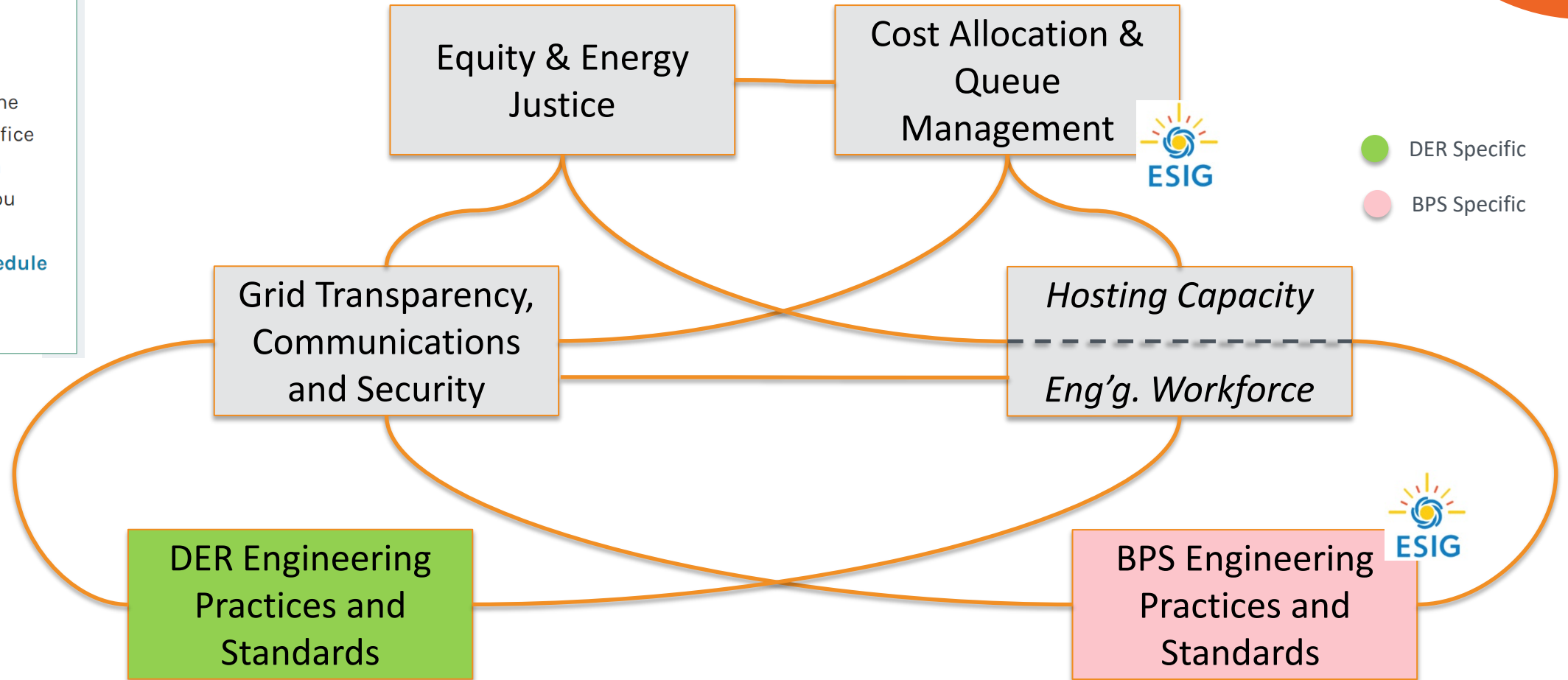
- Project Developer, EPC, or IPP
- Solutions Provider (e.g. software, tools, controls)
- Other (e.g. Consulting, Law Firms)
- Educational or Research Institute
- Electric Utility (e.g. IOU, Co-op, Muni)
- Government (Federal, State, Local, & Tribal)
- Energy Justice or Environmental Group
- Trade Association or Member Organization
- Energy Offtaker or Corporate Energy Buyer
- Advocacy & Policy Development
- Regulator (e.g. PUC)
- Independent System Operator
- Financial Institution or Energy Investments

Working Groups to Inform the Roadmap



Contact Us

Email the i2X team at i2X@ee.doe.gov. The i2X team also has "office hours" where you can discuss any issues you have with interconnection. [Schedule your call today](#).



i2X Partner Opportunities:

- Join a Working Group

IEEE 2800 and other Standard Support via a Complementary “Essential Grid Operations for Solar (EOS)” Project

OpenEI Information Data Apps

Standard Development Organizations (SDO)

This information helps researchers and other stakeholders to connect with Standard Development Organizations (SDO).

Video Introduction [edit]

Essential Grid Operations from Solar Project

The Benefits and Methods for Solar Energy Technologies Office (SETO) Project Teams

Enhancing Standard Development Organization (SDO) Working Groups (WG)

Narrator: Thomas.McDermott@pnnl.gov
Guest Appearances: Ben Kroposki (NREL), Jens Boemer (EPRI), Jeremiah Miller (SEIA)
Recorded: May 21, 2022 PNNL-SA-173670

- Summary Slides: [File:SDO WG Engagement.pdf](#)
- Sample Presentation: [File:McDermott 1007.pdf](#)

Articles [edit]

- Advancing State-of-the-Art for Inverter-Based Resource Interconnection Standards, by Robert M. Reedy, DOE: [PDF](#)
- Generic EMT Modeling for IBR, by Jing Xie and Tom McDermott, PNNL: [PDF](#)
- CIM for Bulk Power System EMT, by Tom McDermott, PNNL: [PDF](#)

SETO Project and SDO Contacts [edit]

- Tables: [DOCX](#)

Category: Solar

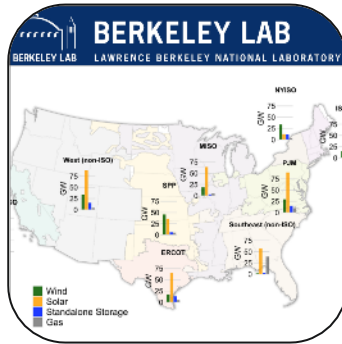
- Leadership and contributions for IEEE P2800.2 (IBR conformance)
- Adoption of IEEE 2800 and 1547
- Leadership and contributions for IEEE P1729 (DER hosting & dynamics)
- Interoperable communications
- EMT modeling
- Event response analysis
- Revisions of IEEE 1547 and 1547.4

Task 2: Filling Data Gaps to Support Key Metrics

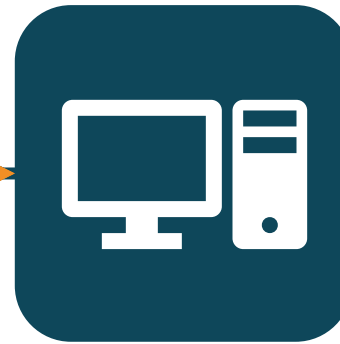
SolarTRACE



Queued Up



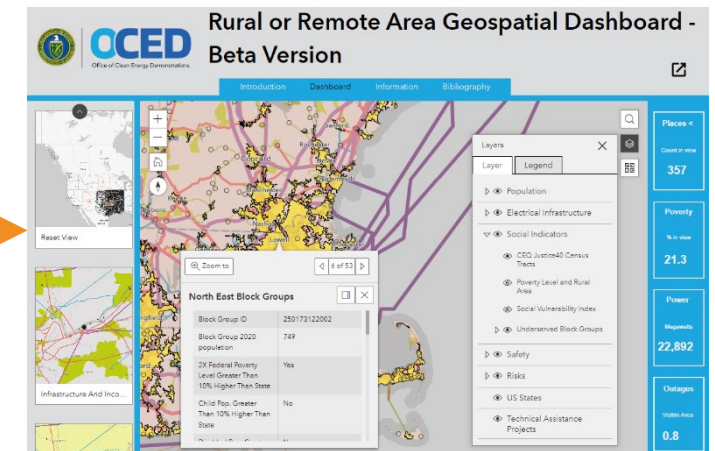
Data Hub



Metrics



Portal (Option)



Known Gaps

- 50kW - 5MW
- Environment
- Equity
- Custom Data



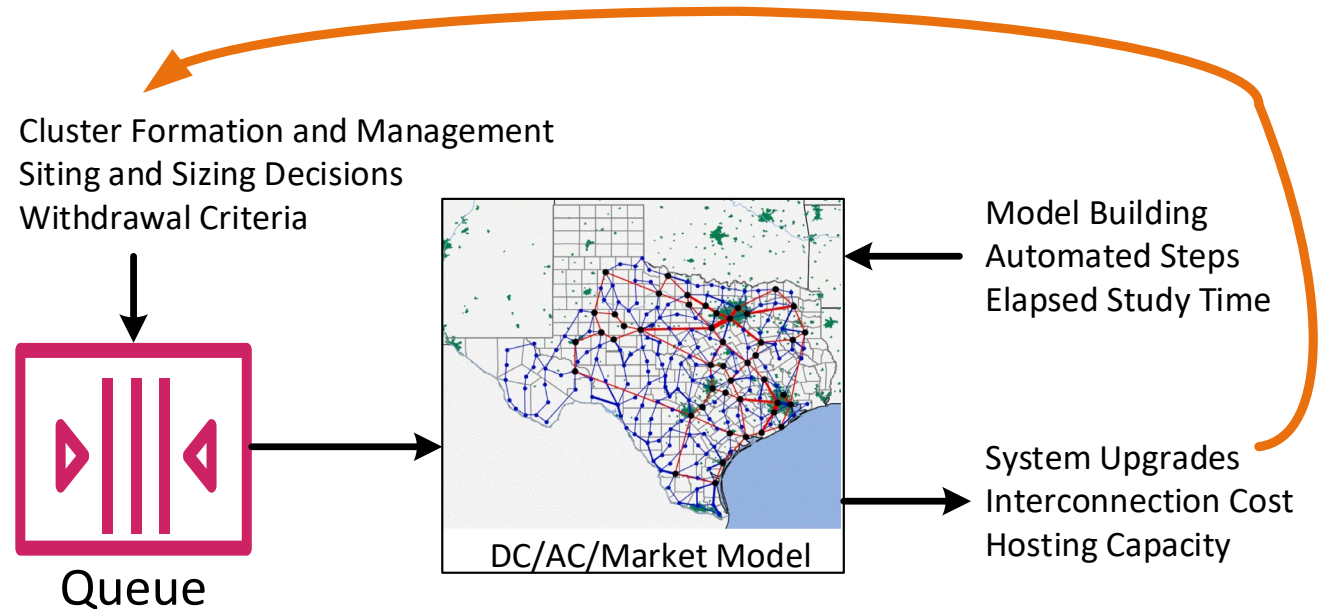
IX Costs /
Grid Upgrade
Costs
(Withdrawn)

i2X Partner Opportunities:

- Suggest Gaps and New Data Sources
- Grid Data Rights and Transparency WG

Task 3 - Sprint Study of A Better Queue

- Assume clusters per NOPR
- Incorporate new equity metrics
- Shared costs of system upgrades
- When is a project ready to proceed?
 - Site control and power purchase agreement
 - Payments to stay in queue
 - Project financing in place
- Cluster formation and management options
- Model-building improvements
- Tool and re-study automation



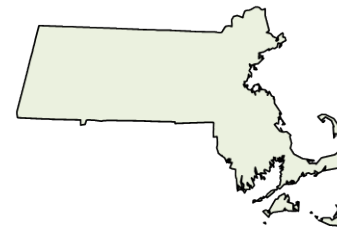
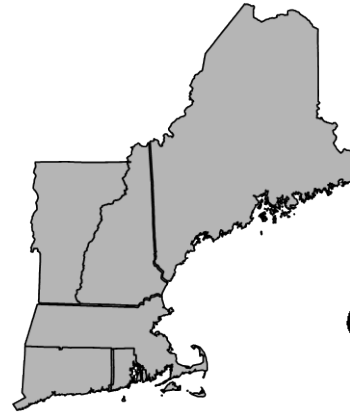
Ref: <https://doi.org/10.1109/PESGM46819.2021.9638030>
and <https://doi.org/10.1016/j.apenergy.2020.115182>

i2X Partner Opportunities:

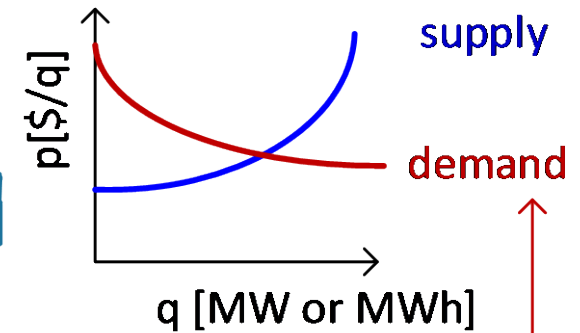
- Cost Allocation & Queue Management WG

Task 3 - Sprint Study of an Auction-Based Process

- Parallels to wideband spectrum auction
- Relationship between resource procurement processes, often under state jurisdiction, and interconnection processes under FERC jurisdiction
- Set-asides for communities and underserved populations
- Incorporate new equity metrics
- Identifying locations and quantities for new solar and wind resources
- Investing in renewable energy development zones (transmission)
- Requirements to participate
- Bid clearing mechanisms



Capacity Market?
Energy Market?

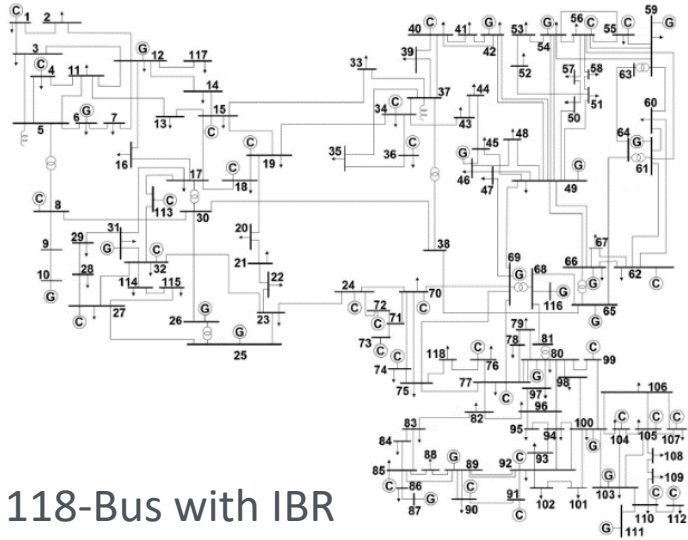


**Hosting Capacities and
Impacts Pre-determined**

i2X Partner Opportunities:

- **Cost Allocation & Queue Management WG**

Boot camps: EMT Studies and CIM for IBR



IEEE 118-Bus with IBR

<https://doi.org/10.1109/TEM.2019.2920271>

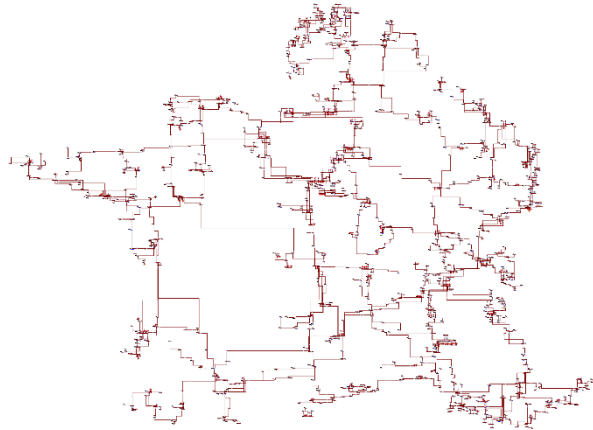
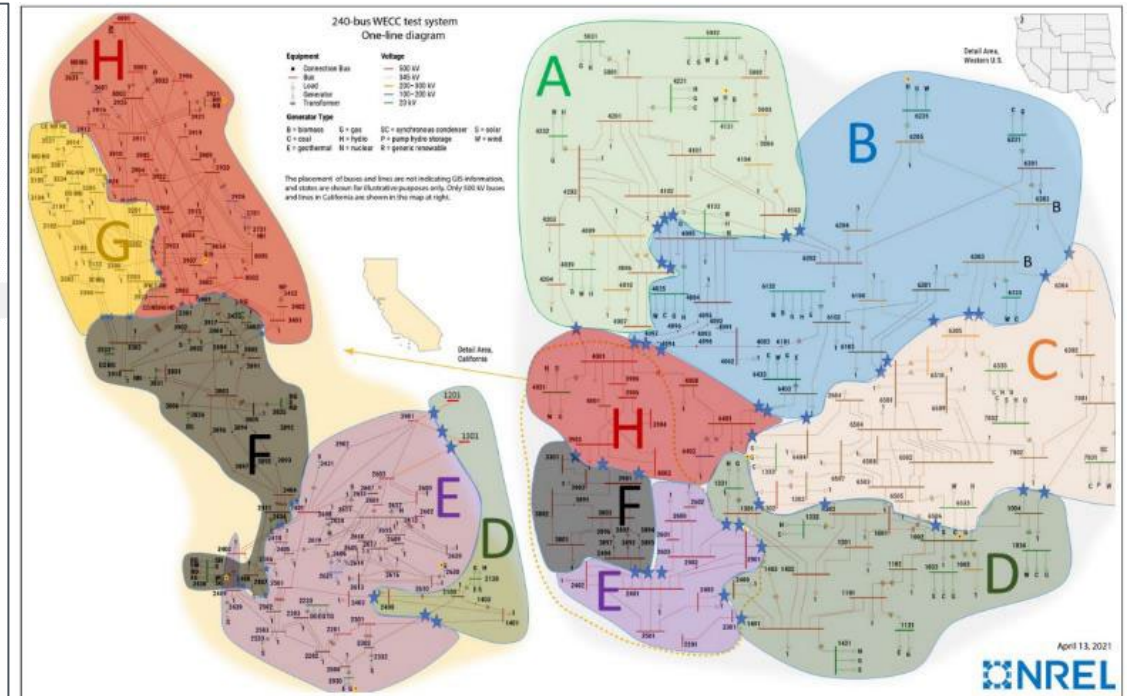


Fig. 5 French 225 kV grid after CIM import in EMTF

https://www.ipstconf.org/papers/Proc_IPST2017/17IPST099.pdf

- ▷ RelayDynamics
- ▷ StatorCurrentLimiterDynamics
- ▷ StaticVarCompensatorDynamics
- ▷ StatcomDynamics
- ▷ WECCDynamics
 - ▷ WeccDynamics
 - ▷ WeccBESS
 - ▷ WeccBESS
 - ▷ WeccDERA
 - ▷ WeccDERApvmod
 - ▷ WeccDynamics
 - ▷ WeccPVD1
 - ▷ WeccREECA
 - ▷ WeccREECB
 - ▷ WeccREECC
 - ▷ WeccREGCA
 - ▷ WeccREPCA
 - ▷ WeccWT12T
 - ▷ WeccWT1PB
 - ▷ WeccWT2E
 - ▷ WeccWTGARA
 - ▷ WeccWTGPTA
 - ▷ WeccWTGTA
 - ▷ WeccWTGRQA
 - ▷ WeccDynamicsLookupTable
 - ▷ «enumeration» WeccLookupTableF
- ▷ IEEE1547Dynamics



WECC 240-Bus with IBR

<https://www.nrel.gov/docs/fy22osti/82287.pdf>

Guide to Interconnection Studies of Renewable Bulk Electric System Resources

1. Introduction
2. Utility Organization Preparation
 - a) Tools and Automation (*)
 - b) Maintenance of Grid Data (*)
 - c) Links to System Planning (**Cost Alloc. WG**)
 - d) Workforce Training
 - e) Adoption of Standards (*)
 - f) Report Format and Delivery
3. Developer Organization Preparation
 - a) Plant Models and Validation (*)
 - b) Applications to Interconnect
 - c) Adoption of Standards (*)
 - d) Response to Data Requests
 - e) **Scoping Meetings**
 - f) **Material Modification Studies**
4. Phases of the Interconnection (depending on FERC Final Rule)
 - a) Interconnection **Application Review**
 - b) Feasibility Study (**still used in some places?**)
 - c) **Informational Study**
 - d) Impact Study
 - e) Facility Study
 - f) **Pre-commissioning Conformity Assessment**
 - g) Commissioning Tests
 - h) **Post-commissioning Model Validation**
 - i) Post-commissioning Monitoring
5. Special Topics
 - a) When to use EMT (**coordinate with pending NERC EMT guide**)
 - b) DER Aggregation
 - c) Hosting Capacity on the Bulk System
 - d) **POI screening and SCR studies.**
 - e) **Affected System Studies (timeliness, disruptiveness, interaction between FERC and DER project queues)**
 - f) **Jurisdiction to Distribution and Sub-transmission**
6. EMT Study Boot Camps
 - a. Test systems and tools
 - b. Sample problems
7. Forward-looking Improvements
8. References

Key:

- **Suggestions made during the Teams meeting**
- **Items of special importance**

Minutes

- See notes on slide 13
- See attached *WG_chat_anon_1.txt* for in-meeting comments
- Email Thomas.McDermott@pnnl.gov with suggestions, questions, or to volunteer as a reviewer
- Next WG meeting will be topical, on ideas for bulk system hosting capacity
- The third (possibly final) WG meeting will be to review the draft guide