2 Basic Industry Structures

Traditional, since the early 20th Century:
• Generation, transmission, distribution in one company (vertical integration)

Restructured (starting ~2000):
• Generation divested into Independent Power Producers (IPPs).
• Independent System Operator/Regional Transmission Organization runs transmission.
• Utility owns T&D

Source: Devin Hartman, R St Institute
Electric Industry Functions Operate Separately

5 General Functions that must be performed in any structure:

- Interconnection
- Transmission Service
- Resource Adequacy
- Generation/load dispatch and balancing
- Transmission operations

Industry restructuring 1995-2005 separated them

On-going challenge: to make them work together effectively
Federal Power Act and Federal Energy Regulatory Commission (FERC) Requirements

Legal requirements:

Rates, terms, and conditions of wholesale energy and transmission must be:

• Just and reasonable
• Not unduly discriminatory or preferential

General framework:

Transmission is a common carrier

Service is provided on an “open access” basis to all parties

Yet, FPA carves out generation and bundled retail service for states. Thus, vertically integrated utilities can still perform the five functions in an integrated bundled fashion.
Interconnection approaches
1990s-2020s

• Pre 2003
  • Non-standard terms and conditions, frequent litigation, opaque, time-consuming
  • Vertical market power concerns (use transmission to favor own generation)

• 2003-2008
  • Order 2003 (2003): standard terms and conditions
    • Large Generator Interconnection Procedures (LGIP), Large Generator Interconnection Agreements (LGIA)
    • Sequential, first-come, first-served.
    • Allows participant-funding in ISO/RTO areas
    • Worked fine for fewer, large plants placed on strong parts of the network.
    • Many smaller and geographically distributed wind plants entered 2005-8, enlarging queues.
  • Order 661 (2005): Interconnection for wind generators
Interconnection approaches
1990s-2020s, cont’d

• 2008, 2012 Reforms
  • Two rounds of FERC- and RTO-led ratcheting up requirements on generators—site control, deposits, etc.
  • Massive growth of smaller and widely distributed solar, storage, and wind plants 2018-23.

• 2018 Order 845
  • Greater flexibility on types of interconnection service.
  • Added transparency
Key Organizations in Interconnection

- Transmission Provider: RTO or vertically integrated utility or both
- Transmission Customer: often an independent power producer (IPP). Could be the utility or a neighboring utility.
- Economic regulators: FERC and State Commissions
- Reliability Regulator: North American Electric Reliability Corporation (NERC)
- End-use customer: load-serving entity or large buyer
Lack of Transmission Contributes to Interconnection Logjams

- Many miles of new transmission in 2013, then dropped to a trickle
- Most regions are not planning for future resource mix

TABLE 2. PLANNING AUTHORITIES CURRENT USE OF EFFICIENT PRACTICES

<table>
<thead>
<tr>
<th>Region</th>
<th>Proactive Generation &amp; Load</th>
<th>Multi-Value</th>
<th>Scenario-Based</th>
<th>Portfolio-Based</th>
<th>Joint Interregional Planning</th>
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</table>


Other Ways to Deliver Power In Addition to New Lines on New Rights of Way Would Also Help Resolve Interconnection Challenges

- Power Flow Control
- Dynamic Line Ratings
- Topology Optimization

Grid-Enhancing Technologies

- High-Performance Conductors
  - Replace aging wires
  - Composite core
  - Superconductors

Increasing Circuit-Mile Replacements

Big transmission CAN be built!

• Planning
  • Proactive,
  • all electricity system benefits,
  • probabilistic/scenario based,
  • portfolio of network upgrades,
  • all technology options

2013 success
Recent examples of transmission planning that is integrated with interconnection

- MISO Long Range Transmission Plan
  - 53 GW of new renewables
  - ~$10 billion

- California ISO 2022-23 Transmission Plan
  - 4-7 GW of new power needed annually through 2032
  - 4.8 GW of out-of-state wind needed—helps resource adequacy
  - 45 projects
  - $7.3 billion
Interconnection Requirements that Must Be Abided in Today’s Circumstances

- Interconnection processes must be **timely** to be just and reasonable.
  - Queue logjams must be resolved in some way.

- **Costs must be minimized** to be just and reasonable
  - Incremental small investments in response to each service request cost more per MW delivered than larger investments, due to economies of scale in transmission.

- **Cost must be predictable and more certain** to be just and reasonable.
  - Complicated, ever-changing incremental cost estimates may no longer be just and reasonable given today’s circumstances (different resource mix).

- Interconnection must be effectively integrated with transmission planning, resource adequacy, transmission service, operations.
  - In particular, transmission planning and interconnection have significant overlap.
  - The FERC Planning NOPR may require holistic multi-purpose planning. If so that would likely improve the interconnection process.