A Model of a System

Policy Fields
Program technology PF

Organization
Program technology 01

Front line
Program technology r1

Organization
Program technology 02

Front line
Program technology r2
“Scientific ingenuity has demonstrated that, in the electric world, to get the most economical results, we must have monopoly. [...] If we are subjected to the will of a great monopoly that reaches from the Canadian boundary to the Gulf of Mexico [...] we will become in reality, slaves....”

*Congressional Record, February 29, March 5 and 9, 1928*
“Look, dear. I'm just one little consumer. How can I fight a utility?”

Change can be EASY and/or HARD
Divergent Priorities

Enhanced Centralization

- Enhanced efficiency and reliability
- More efficient use of resources
- Electrification of transport
- Deep decarbonization of electricity generation
- Local generation, control and cultural change
- Small-scale generation with local transmission and distribution
- Focus on social changes

Enhanced generation, control and cultural change

Decentralization

Large-scale renewable generation with extensive long-distance transmission

Incremental Change

- Distribution network improvements for integration of distributed generation
- More efficient use of resources
- Enhanced efficiency and reliability

Radical Change

- Deep decarbonization of electricity generation
ENERGY LAW AND POLICY

Lincoln L. Davies, Alexandra B. Klass,
Hari M. Osofsky, Joseph P. Tomain,
& Elizabeth J. Wilson
RTOs: The Most Important Organizations You Have Never Heard Of

- Alberta Electric System Operator
- Ontario Independent Electricity System Operator
- Midcontinent ISO
- Southwest Power Pool
- Electric Reliability Council of Texas
- California ISO
- ISO New England
- New York ISO
- PJM Interconnection
70%
Ancillary Services Markets

Energy Markets (Day Ahead and Real-Time)

Capacity Market

From Sascha von Meier
How RTOs Make Decisions (on paper)

MISO Org. Chart

PJM Org. Chart
MISO Board of Directors

- Transmission Owners Committee
- Alternative Dispute Resolution Committee (ADRC)
- Advisory Committee (AC)
- Organization of MISO States Committee
Market Subcommittee MSC

- Demand Response Working Group DRWG
- Supply Adequacy Working Group SAWG
- Trading Hubs Task Force THTF
- FTR Working Group FTRWG
- Market Settlements Working Group MSWG
- Seams Management Working Group SMWG
- Credit Practices Working Group CPWG

Reliability Subcommittee RSC

- Operations Working Group - Closed OWG-CLOSED
- System Operator Training Working Group SOTWG
- Available Flowgate Capability Working Group AFCWG

Planning Advisory Committee PAC

- Planning Subcommittee PSC
- Interconnection Process Task Force IPTF
- Loss of Load Expectation Working Group LOLEWG
FOLLOW THE RULES


Wind Power Classification

<table>
<thead>
<tr>
<th>Wind Resource Class</th>
<th>Potential</th>
<th>Wind Power Density at 50 m</th>
<th>Wind Speed at 50 m</th>
<th>Wind Speed at 50 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>400-500</td>
<td>7.0 - 7.5</td>
<td>15.7 - 16.8</td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>500-600</td>
<td>7.5 - 8.0</td>
<td>16.3 - 17.9</td>
<td></td>
</tr>
<tr>
<td>Outstanding</td>
<td>600-800</td>
<td>8.0 - 8.8</td>
<td>17.9 - 18.7</td>
<td></td>
</tr>
<tr>
<td>Superb</td>
<td>800-1600</td>
<td>8.8 - 11.1</td>
<td>19.7 - 24.8</td>
<td></td>
</tr>
</tbody>
</table>

*Wind speeds are based on a Weibull k value of 2.0
“We could sit down with crayons and write on a map a few lines that would make all kinds of sense to make stuff move around. Then we would take 20 years to figure out who pays for it.”

--CAISO Stakeholder
Cost Allocation = Blood Sport
Midwest ISO real-time LMP, 9/7/2011, 9:25 a.m.

Source: Midwest Independent System Operator
Rules Matter

(A lot)
Regional Transmission Organizations

Previento

Physical Model:
- spatial refinement
- thermal stratification
- regional upscaling
- forecast uncertainty
Figure A51: Day-Ahead Scheduling Versus Real-Time Wind Generation
2012–2013

Figure A52: Seasonal Wind Generation Capacity Factors by Load Hour Percentile
Dispatchable Intermittent Resources (DIR)

Source: JT SMITH, MISO
"Come into my algorithm, and I can dispatch you down for five minutes rather than for five hours, and then bring you back up once my congestion issue is gone."

- MISO Focus Group participant
Figure A53: Wind Curtailments
2012–2013

- Manual Curtailments
- Of Which, Now DIR
- DIR Economic Curtailment

Figure A54: Wind Generation Volatility
Caveats

- Bad outcome can become (dominant) part of system logic
- Some parts of system are more visible/controversial than others
- Path dependency / policy lock-in
- DURABILITY and FLEXIBILITY v. Political Risk
- Many ways to kill a policy (formulation, agency choice, authority, implementation, funding, personnel, process, enforcement etc…)
- Effectiveness can shift with political regimes, social norms
HOPE (1)

• This is NOT new: the system has always embodied multiple conflicting values and logics
• Some change can be easy
• Yesterday’s impossibilities are today’s realities
• Innovation systems are GLOBAL, Implementation is LOCAL
  – (niches= biodiversity hot spots?)
HOPE (2)

• Create architecture for system change and implementation
• Where are
  – Goals shared?
  – Bright spots for experimentation?
• Broaden question to encompass multiple logics
• Target easier part of system for change
  – Many paths for same functional change?
• Change is inevitable...
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Wind on the Wires