Stitching seams with different threads: US versus EU electricity markets

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- High level view of EU electricity markets:
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  - Implications for renewables in EU.
High level view of US electricity markets.

- Majority of US electric energy now served in “organized” markets.
- Operated by Independent System Operators/Regional Transmission Organizations (ISOs/RTOs).
- Bilateral trade between utilities/regions in “old” world supplemented through additional centralized trading options:
  - Bilateral trade options include across seams between ISO/RTO markets.
Salient characteristics of ISO/RTO markets.

- Centralized *day-ahead* (DA) market operated by ISO/RTO with unit commitment and locational pricing:
  - Day-ahead market is ostensibly a *forward* market, not a spot market,
  - But “make-whole” payments to compensate for some commitment costs (and other issues) mix in some “physical delivery” aspects.

- DA market considers both energy and ancillary services.
Salient characteristics of ISO/RTO markets.

- Centralized *real-time* (RT) market operating by ISO with locational pricing:
  - The “spot” market, settled on deviations from day-ahead positions,
  - Explicitly designed to match, where possible, design of day-ahead market,
  - Generators can participate in both day-ahead and real-time, but real-time involves physical dispatch,
  - Arbitrage facilitated between day-ahead and real-time to further match DA and RT,
  - Short-term unit commitment in some markets.
Salient characteristics of ISO/RTO markets.

- Additional “reliability” practices of ISO/RTO such as emergency protocols under scarcity,
- Financial transmission rights auction operated by ISO/RTO,
- Capacity markets operated by some ISOs/RTOs that arrange for capacity to be available in three years’ time:
  - Capacity not differentiated between energy and reserves/ancillary services.
Salient characteristics of ISO/RTO markets.

- Traditional bilateral contracting between market participants.
- Exchanges that facilitate longer-term contracting:
  - Chicago Board of Trade,
  - Intercontinental Exchange.
Resistance is useless

- Remainder of US, particularly in West outside of California, served by more traditional vertically-integrated models:
  - But organized markets grown geographically over years.

- “Seams” between inside organized market and outside organized market has typically been “stitched” through growth of organized market.
Growth of PJM

Phase 1, Until April 2004
Phase 2, May to September 2004
Phase 3, October to December 2004
Phase 4, January to April 2005
Phase 5, After May 2005

PJM today

PJM and MISO footprints.

Source: www.miso-pjm.com
Growth of Western Energy Imbalance Market

- California ISO has operated DA and RT nodal markets in California since 2009:
  - Also supported bilateral (hourly and longer term) trading with entities in other states.

Source: https://www.westerneim.com
ISOs/RTOs today.

Source: www.ferc.gov
Implications for renewables in US.

- “Organic” growth of ISO/RTO markets has resulted in large areas operating under uniform real-time pricing rules.

- Wide geographical scale of ISOs/RTOs allows for averaging of net load variability in a “single” large system.

- Widely rehearsed advantages of wide-scale balancing for renewable integration.
Implications for renewables in US.

- Temporal resolution of real-time market:
  - Update generator base-points every 5 minutes,
  - Some net load following capability for “free” due to action of real-time market,
  - Ancillary services primarily for intra-five minute variability and uncertainty.

- Wide-scale real-time markets have facilitated and will continue to facilitate integration of renewables in US markets.

- Over 15% by energy in ERCOT in 2016.
Seams.

- Possibility of further states joining organized markets.

- Participation in organized markets:
  - Entities outside of organized markets have always had options to trade with organized markets on hourly and longer timescales, but in addition,
  - Recent “Energy Imbalance Market” in California enables integration into California real-time market by entities outside of California, with further enhancements to come.
Seams between RTOs.

Today have several large, adjacent RTOs:
- Not going away, nor being supplanted,
- Institutional barriers to further comprehensive integration of adjacent RTOs.

What happens in seams between these existing RTOs?
- Typical existing arrangements allow bilateral trades/schedules between markets,
- Ongoing seams development to improve efficiency of trading in organized markets.
Seams between RTOs.

- Ongoing seams development has aimed at facilitating integration of inter-RTO trading into real-time market:
  - Focus on real-time is based on argument that efficient trading in all forward markets stems from efficient real-time trade.
High level view of EU electricity markets.

Development of markets in several countries, with combination of day-ahead and intra-day trading:

- Power exchange-based day-ahead and intra-day trading ignoring intra-zonal transmission constraints and separated from,
- Balancing “market,” operated by transmission system operator to deal with “technical” issues.

Not seen in US markets post-California crisis.
High level view of EU electricity markets.

- Finest temporal resolution of balancing market varies from 15 to 60 minutes:
  - Ancillary services typically required to cope with variation over longer duration between market adjustments than in US markets.
  - Balancing market not viewed as US-style “real-time” spot market,
  - Balancing market designs vary from country to country, but typically designed to encourage only limited trading.
High level view of EU electricity markets.

- What about seams between countries?
- As in US, bilateral trading possible.
- Several power exchanges span seams between countries for day-ahead and intra-day trading.
- Additionally, “Price coupling of regions” has recently added day-ahead (and eventually intra-day) pan-EU trading options through EUPHEMIA.
High level view of EU electricity markets.

- Why not real-time/balancing market seams management?
  - Obvious answer is lack of consistently designed balancing or real-time markets, reflecting historical development in each country.

- Institutional barriers to consolidating EU Transmission System Operators:
  - Analogous to situation with adjacent ISOs/RTOs in US.
US versus EU seams management.

- In both, bilateral contracting has always allowed trading across seams,

- US version of centralized seams management focuses on real-time,

- EU version of centralized seams management focuses on day-ahead and intra-day trading,

- Why the difference?
  - Are the needs of electricity markets in the US and EU really so different?
Implications for renewables in EU.

- Intra-day markets provides options in EU for trading that are absent in US:
  - Facilitates renewable integration.

- Wider-scale markets with later “gate closure” would facilitate renewable integration in EU.

- But the various balancing market designs makes wide-scale balancing difficult without significant redesign:
  - Inherent flexibility of transmission, hydro cannot be fully exploited for short time scale variations.
Conclusion

- The threads used to bind the seams in the US and EU are very different:
  - Organic growth of geographical scope of real-time market with seams managed in real-time, versus
  - Seams managed in day-ahead and intra-day.

- Renewable integration is facilitated by wide geographical scale, closer to real-time adjustment of thermal generation.

- Current EU balancing markets are not as flexible in enabling this capability as US real-time markets.
References


References


References

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