Economic Dispatch and ERCOT: Presentation to the Texas House Regulated Industries Committee

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Outline

- What is economic dispatch?
- What savings are possible with economic dispatch across ERCOT?
- Environmental advantages of economic dispatch,
- How to achieve economic dispatch across ERCOT?
- Bilateral contracting and economic dispatch.
What is economic dispatch?

- Sharing generation between generators to minimize the total fuel costs,
- If two generators are running and one has higher production costs than the other:
  - Shift generation from the more expensive to the less expensive generator.
Example with two generators.

Cost ($ per hour)

Green generation

Red generation

Power Generation (MW)
Sharing power generation between two generators.

- Back off higher cost generator:
  - reducing by 1 MW in red region saves $5 per hour,

- Generator with lower cost should be run harder:
  - increasing by 1 MW in green region costs $3 per hour,

- Net savings $5 - $3 = $2 per hour for this shift:
  - keep shifting until (incremental) costs are all equal,
  - basis for economic dispatch.
Improved dispatch of two generators.

![Graph showing cost per hour for green and red generation]

- Green generation: $3 per hour for 1 MW
- Red generation: $5 per hour for 1 MW
Other benefits of economic dispatch.

- Besides lowering costs,
- Newer, more efficient generators:
  - Produce less emissions,
  - Save natural resources.
Economic dispatch.

- Sharing generation between all generators to minimize overall operating costs.
- Basic idea is well over 50 years old.
- Refinements include considering effects of:
  - Transmission limits (“nodal prices”),
  - Cost to start-up generators (“unit commitment”),
  - Transmission losses,
- Technology for calculating optimal dispatch is well-established and continues to be refined.
Do we have economic dispatch in ERCOT today?

- Individual firms may achieve economic dispatch within their individual portfolios:
  - To meet their bilateral contract obligations,
  - Just as traditional utilities met their demand in ERCOT.
Do we have economic dispatch in ERCOT today?

- But more savings are possible if economic dispatch is performed across all of ERCOT:
  - Back off generators that are more expensive,
  - Increase production at less expensive generators,
  - While satisfying transmission limits.
Why can’t firms achieve ERCOT-wide economic dispatch today?

- Unlike other industries, transmission limits impose complicated, inter-related limitations on the deliverability of energy,
- Plans to start-up efficient generation must be made day-ahead,
- Hard for firms to coordinate their individual trades to minimize costs overall,
- Day-ahead economic dispatch by ERCOT would perform this coordination.
What savings might be possible?

- To get a full answer we need to represent transmission limits:
  - Cost/benefit study will address this in detail,

- However, the thousands of MW of combined-cycle gas turbine (CCGT) plant recently installed in ERCOT provide an example of the possible savings:
  - Much of this capacity is not being fully utilized,
  - An example is the two-year old, American National Power plant in Hays County that has recently been shut down.
Combined-cycle versus gas-fired boilers.

- CCGT generators are operationally very efficient:
  - To generate one MWh of electric energy requires about 7 million British thermal units (Btus) of gas,
  - Assume a gas price of $5 per million Btu,
  - Cost of production is $35/MWh.

- Compare to a typical gas-fired boiler:
  - About 10 million, or more, Btus per MWh,
  - At the same gas price this is $50/MWh,

- Savings is $15/MWh by using the CCGT.
Combined-cycle versus gas-fired boilers.

- In ERCOT there are *thousands* of MW of gas-fired boiler capacity,
- Suppose that *some* CCGT generation could be used instead of gas-fired generation in ERCOT.
- Suppose that as little as 250 MW of gas-fired boiler production were backed off for 2000 hours per year (less than 3 months),
- Suppose that CCGT plant produced this power instead,
- The savings would be **$7.5 million** per year!
Environmental issues.

- As well as being more efficient than gas-fired boilers, new combined-cycle plants have very low emissions,

- Greater use of new combined-cycle plant will reduce emissions in Texas because:
  - Less fuel is burned (in example, 30% less fuel),
  - Less emissions per unit fuel used (50% to 90% less emissions per unit fuel),

- Multiplicative effect means reduction in emissions by 65% or more!
How to achieve the savings of ERCOT-wide economic dispatch?

- ERCOT needs a day-ahead bid-based economic dispatch process:
  - Generator owners submit to ERCOT unit-specific bids for their individual plants,
  - ERCOT finds the best commitment and dispatch decisions to minimize total bids,
  - Gets the right generation mix started-up day-ahead,
  - Considering transmission constraints,
- ERCOT can choose the right generation mix overall rather than firm-by-firm.
Bid-based economic dispatch and bilateral contracting.

- Bid-based economic dispatch is completely consistent with bilateral contracting:
  - Bilateral contracts arrange longer-term financial positions between generators and retailers,
- If generator also bids its capacity into ERCOT then economic dispatch ensures that the most efficient plant is actually used day-by-day:
  - In previous example, if the generator bid $50/MWh and there is $35/MWh generation available then ERCOT uses the less expensive generation,
  - Saves $15/MWh,
  - Everyone is better off.
Economic dispatch and bilateral contracting.

- If a firm prefers to not bid then it just schedules its bilateral transactions as it does now:
  - Informs ERCOT of transactions so that ERCOT can consider the transmission needed,
  - ERCOT will still calculate prices,
  - If the firm finds that, day after day, the ERCOT price is lower than its production cost then this is a signal that the firm should consider participating in the market,
  - Why wouldn’t a firm choose to participate?
Why is it difficult for firms to achieve economic dispatch today?

- The “zonal” price signals available to generators today are coarse:
  - reflect only the small volume in the “balancing market,”
  - do not include the effects of many detailed transmission limits,
- The current market design doesn’t guarantee the starting of the correct units,
- Does not provide a transparent price signal reflective of a liquid market,
- Lacks system-wide coordination.
Summary

- Coordinated ERCOT-wide bid-based economic dispatch is the optimal solution:
  - Best economics,
  - Best environmental approach,
  - Best use of natural resources,
- Consistent with bilateral contracting,
- The Public Utility Commission’s decision to support the nodal market is good for Texas because it includes bid-based economic dispatch.