

Overview of Production Cost Modeling

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March 26, 2008

What is a Production Cost Model?

- A production cost model simulates the dispatch of the electric system
- Includes generation, demand, and transmission infrastructure
 - Level of detail varies across different vendors' models
- Inputs allow for testing that includes changes in load levels, changes in fuel prices, changes in system topology, changes in available resources

Why Do We Need to Use a Production Cost Model?

- Attachment N specifies that the ISO will evaluate Market Efficiency Transmission Upgrades based on production cost savings.
 - Production Cost models are the standard way to calculate these numbers
- Attachment K specifies that the ISO will conduct Economic Studies
 - Any economic study of the electric system would typically use a production cost model (e.g. Scenario Analysis)

IREMM Simulation Model

- Inter-regional Electric Market Model (IREMM) is a specific production cost model used by ISO NE
- This model was used for the Scenario Analysis exercise in 2007 and various studies included in the Regional System Plan
- Able to accommodate a range of geographic and time scales
- Following slides will use IREMM as an example in providing an overview of production cost models

IREMM Simulation Model

- Production simulation model
 - Focus on production and marginal cost of energy to customers
 - Simulates salient factors of the power system
 - Customer loads
 - Resources
 - Generating units
 - Other resources
 - Transmission limitations and/or constraints between areas
 - Choice of fuels based on relative price and conversion efficiencies
 - Estimated emissions can be derived from these simulations
- Designed for broad economic studies with reasonable level of detail

Modeling Approach - Framework

- Designed to simulate the key aspects of the electric sector over its geographic scope:
 - Electric generation infrastructure across the Northeast
 - Major transmission limitations across the Northeast
- Allows analysis of market place fundamentals
 - Supply and demand balance
 - Effects of exogenous influences on fundamentals can be seen
- May be configured to represent nationwide:
 - 180 areas
 - 15,000 resources
 - 100 transmission “flowgates”

Modeling Approach - Resources

- Typically uses a single block representation of generating resources for dispatch
 - Forced Outage Rate (EFOR) and scheduled outage factor (SOF)
 - Single heat rate for entire unit
 - Multi-block representations are available
 - Multi-block bidding strategies
 - Multi-block heat rates
 - Multi-block emission rates
- Primary and alternate fuels
 - Each fuel can have a distinct variable O&M cost
 - Each fuel can have different emission rates
 - Switch based on monthly changes in relative fuel prices

Modeling Approach - Load

- Hourly load model
 - Input monthly peaks and energy targets
 - Scale hourly loads to meet target peaks and energy
- Loads increased over time to match input summer peak, winter peak and annual energy

Modeling Approach – Dispatch Simulation

- Chronological simulation
 - Limited ability to represent unit commitment in response to prices
 - Pumped storage pumping / generating based on heuristics
 - Conventional hydro load adjustment based on its monthly energy
 - Wind can be modeled by specifying an hourly wind profile
- Operating reserve can be specified
 - In terms of MWs and / or
 - Percent of load
- Dispatch simulation
 - Derated dispatch reflecting average EFOR
 - Monte-Carlo representation of EFOR is an alternative
 - Requires many simulations

Modeling Approach - Emissions

- Emissions based on energy production and fuel used
 - CO₂ emissions based on fuel's carbon characteristics
 - SO₂ based on fuel used with ability for each unit to have a unique emission rate reflecting scrubber technologies
 - NO_x emission rate based on
 - Unit specific emission rates for primary and alternate fuels
 - Rates may be changed over time
- Environmental control technology models included
 - SCR for NO_x control and
 - Scrubbers for SO₂
- Can provide insights into emissions from
 - New England
 - Elsewhere in North America if those areas are modeled
 - Leakage

Modeling Approach - Long Term Dynamics

- Ability to expand the resources according to need
 - Pre-specify expansion mix (percent for up to six technologies)
 - Expand to meet a percent reserve for each expansion group
 - Expansion group is a collection of areas
 - Expansion group share expansion resource proportionally to peaks
- Ability to automatically retire un-economic units
 - Infra-marginal revenues, less fixed O&M, plus “capacity value”
 - Units get retired

Modeling Results

- Typical results include
 - Production costs, Load Serving Entity Expenses
 - Marginal prices
 - Fuel consumption by type
 - Production by fuel type
 - Technology utilization
 - Emissions
 - CO2
 - SO2
 - NOx
- Various ways to summarize results
 - Hourly, Monthly, Annual
- Output easily extracted to MS Excel format

