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Independent System Operator

NYISO Capacity Expansion Planning Primer

Economic Planning Department

Electric System Planning Working Group (ESPWG)

October 25th, 2021 [REVISED]

Agenda

- Introduction to Capacity Expansion Planning
- Capacity Expansion in the System & Resource Outlook
- Capacity Expansion Model Status

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Introduction to Capacity Expansion Planning

DRAFT – FOR DISCUSSION PURPOSES ONLY

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Capacity Expansion Planning Overview

What?
Power system planning that co-optimizes generation capital cost and production cost to determine a least cost future generation capacity buildout

Why?
To inform NYISO studies & stakeholders of potential future generation buildout

How?
Optimization software paired with detailed generation, transmission, load, and cost data, forecasts, and policies

Where?
System & Resources Planning, Market Design, etc.

Image source: https://ceocoachinginternational.com/2016-crystal-ball-exercise/

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Capacity Expansion Planning Details

- **Capacity Expansion Planning simulates optimal investment and retirement in resources to meet load, policy targets, and other operational/capacity constraints**
- **Provides a forecast as to how the resource mix could look like in the future, under various scenarios and assumptions about:**
  - Load Forecast
  - Policy Constraints
  - Investment Cost
  - Technological Progress/Limits
  - Operating Cost
  - Generation vs. Transmission trade-offs

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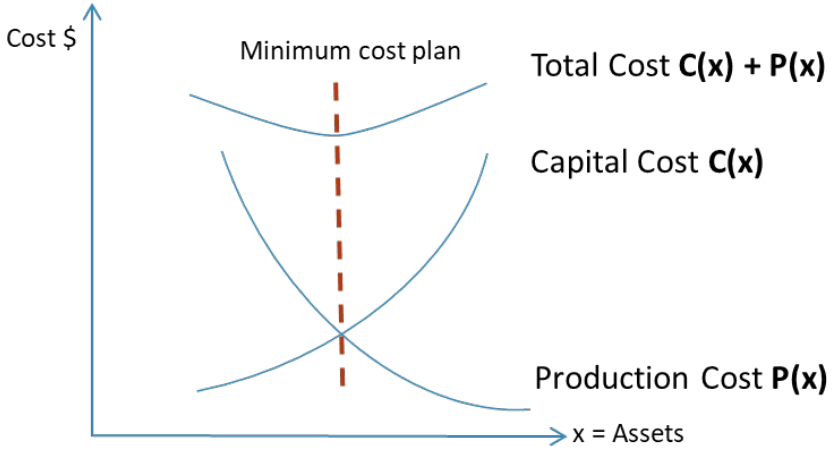
Capacity Expansion Optimization

- **Capital Costs C(x)**
  - Cost of new generator builds
  - Cost of transmission expansion
  - Cost of generator retirements
- **Production Costs P(x)**
  - Cost of operating the system with any given set of existing and new builds and transmission network
  - Notional cost of unserved energy



Minimize [NPV C(x) + P(x)]
formatted as a Mixed Integer Program

Source: *Energy Exemplar Training Material*

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Previous Methods Used

- The 2019 CARIS Phase 1 study relied on a production cost model that simulated hourly system operations minimizing operating cost over a 10-year horizon
- In the model, future builds and retirements are fixed ahead of simulation, based on some rules of thumb (reliability, environmental policy, etc.)
- For example, in the 2019 CARIS Phase 1 70x30 Scenario, future generation builds were determined based on a spreadsheet analysis and closest POI, to build renewable resources to meet the 70x30 policy target
- Such approach could result in a sub-economic resource mix that would not capture the competitive advantage among resources in terms of Levelized Cost of Energy (LCOE), location, and timing

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Supplemental Software: Plexos

- In 2020 the NYISO tested several new power system analysis software tools to supplement its existing toolset in Economic and Public Policy Planning
- Of the tools tested, it was found that Energy Exemplar's Plexos software Long Term (LT) module and other features best fit the need

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Capacity Expansion in 2021 Outlook

Capacity Expansion in The Outlook

- **The Capacity Expansion model develops preferable zonal generation buildout in the NYCA over the 2021-2040 study period, while respecting the CLCPA policy targets**
- **The Capacity Expansion model will provide insight on the following:**
  - What type of generation gets built and how much?
  - What zone does generation get built in?
  - When does generation get built?
  - What is the capital vs. operating cost to meet renewable and zero-emission goals?
  - What areas have economic generation opportunity that is limited by inter-zonal transmission?

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Capacity Expansion in The Outlook (cont.)

- The Capacity Expansion model will build off the assumptions used in the Base and Contract databases, and incorporate additional assumptions as applicable to the Policy case, to simulate optimal generation builds over the study period
- Capacity Expansion specific assumptions include, but are not limited to:
  - Candidate technologies for capacity expansion
  - Public policy constraints (i.e. CLCPA targets)
  - IRM & LCRs
- Results from the Capacity Expansion model will be used as inputs to the Policy case production cost model in MAPS

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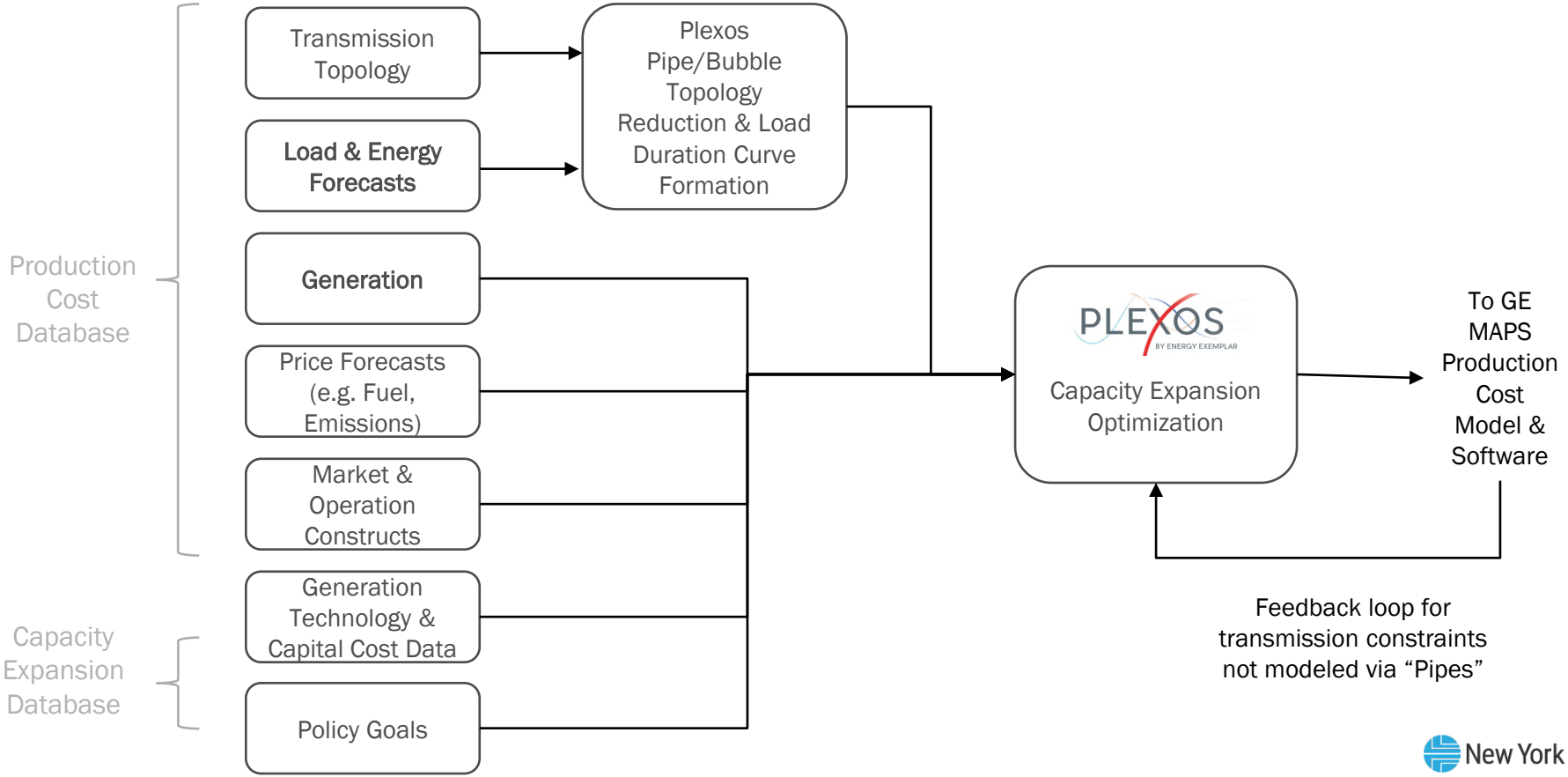
Capacity Expansion Process Flow



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Capacity Expansion Details

- **PLEXOS creates a pipe-and-bubble equivalent model in Long Term (LT) Planning by performing a nodal to zonal reduction of the transmission system**
  - Bubbles = 11 NYISO Zones
  - Pipes = Interzonal transmission with appropriate interface limits
- **PLEXOS uses time slices instead of 8760-hour load and generation profiles**
  - Capacity expansion optimization is computationally intensive
  - There are 16 time slices per each year, grouped by season and hour of the day
  - The time slices capture seasonal and diurnal variation in wind, solar, and load profile

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Preliminary CapEx Assumptions

- Additional section added to end of assumptions matrix titled “Capacity Expansion Model”
- Posted to 10/25 ESPWG materials
- Primary Data Sources
  - EIA Annual Energy Outlook
  - NREL Annual Technology Baseline (ATB)
  - US EPA Documentation

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Further Reading…

- **Publications for more information on capacity expansion planning, modelling, and studies:**
  - U.S. EIA Annual Energy Outlook 2021: Electricity Market Module
  - NYISO Climate Change Impact & Resilience Study: Phase 2
  - NYSERDA Zero Emissions Study
  - NREL Interconnection Seams Study
  - NREL Annual Technology Baseline
  - NREL ReEDS Model
  - ISO-NE Pathways Study (Ongoing)

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Capacity Expansion Model Status

Capacity Expansion Model Progress

- Database fully developed
- A large number of test simulations performed to sanity check and validate optimization behavior
- Several small tweaks being performed now
- Preliminary model assumptions to be discussed at November ESPWG meeting

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Questions, Feedback, Comments?

- Email additional feedback to: JFrasier@nyiso.com

Our mission, in collaboration with our stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policymakers, stakeholders and investors in the power system

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