GenX: Configurable Capacity Expansion Model

Technology #18987

Applications

The inventors present a decision support tool that determines optimal investment decisions in power generation assets. This copyrighted software called GenX has application to regulators involved in long-term power system planning and to stakeholders interested in determining future investments needed to supply future electricity demand at a minimum cost.

Problems Addressed

Classic methods and metrics used to inform decision-making for power systems planning include capacity expansion models and levelized cost of electricity (LCOE) calculations to compare the economics of individual technologies. While these classic approaches offer information about different technologies independently, they lack consideration of other important factors that exist and interact within the entire power generation system at large. Such factors include carbon emissions constraints, implications of intermittent renewable energy, demand-side management practices, energy storage, and changing capacity factors. GenX presents an optimization model that enables analysis of operational flexibility and capacity planning to support generation asset investment decisions from a system-wide perspective.

Technology

This non-patented configurable capacity expansion model determines investment decisions on generation assets that, if operated optimally subject to operational constraints like ramps and cycling, can fulfill the electricity demand of a particular system at minimum cost while also meeting limits on CO2 emissions. Given a set of pre-specified conditions, the model co-optimizes five interlinked power system features to produce a snapshot of the minimum cost generation capacity mix that meets detailed operational constraints and CO2 emissions limits. These include capacity expansion planning, optimal generation dispatch, optimal power flow between zones, cluster unit commitment operations, and interactions between electricity and heat markets.

The methodology employed in GenX encompasses three components: the primary component decides which power plants to build and where; the secondary component accounts for capacity operational decisions; and the third component decides how to use electricity-to-heat capacity to reduce the system's total cost for electricity generation. Model implementation is in Julia Language.

Advantages

- Capable of modeling new technology (e.g. advanced nuclear and storage)
- Models operational flexibility and network interactions in a single optimization problem

Categories For This Invention:

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Intellectual Property:

Copyright Software

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