Solution Algorithms for large Energy System Models based on Warm-starting of Mixed Integer Linear Solvers

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Define the topology and all input data:
1) Defining boundary conditions
   - Weather Conditions
   -or Geometric Demand Data
   - Carbon Limits
2) Technology & Network Selection
   - Which Technologies
   - Which Networks
3) Defining Economic Data
   - Technology Investment ($M$ costs
   - Network Investment ($M$ costs
   - Energy & Capital Prices
   - Capital Coefficients

Sure, here is what we need to do:
We would like to design an energy system for heat, hydrogen and electricity generation. Can you help us?

Stage 1

Objective Function
Minimize total annual costs OR

Subject to
\[ ax + by \leq b \]
\[ x \geq 0, y \geq 0 \]

Solution of the mixed-integer problem:
1) Rounding up (SP): All integer constraints relaxed to continuous variables. Identifies a lower bound on the solution
2) Branch & Bound: Finds a feasible solution within a distance to the best bound obtained, is also a solution in the second stage

On the top, you can see the hydrogen network, including a hydrogen storage and an electricity network between onshore and offshore node. We assume that the electricity network can be built (or not depending of it is optimal or not). On the bottom, you can see the lower level of buildings of our model that transferring the electrification to the storage and design and operation of the system over a year.

Contribution of this work

Stage 2

The optimal solution of stage 2 is a possible solution in stage 1.

Optimal Design

Technology sizes
Wind Turbine
Battery Storage
NG Furnace
Cavern Storage
SMR
Natural Gas Furnace
Hydrogen Furnace
Network sizes
Electricity
Hydrogen

The optimal solution of stage 1 is a possible solution in stage 2.

Optimal Operation

References

ERSA (2018). Energy systems research for sustainable energy systems. Technological and environmental balances.


