Tulipa Energy Model

TulipaEnergy

Analysis Pipeline

Data

Tulipa is generalized, so scenario specifics – like the geographic scope, technologies, energy carriers, and time resolution(s) – are dictated by the analyst through the scenario data.

Problem Formulation

Objective Function · Variables · Constraints

Tulipa's problem formulations are as tight and compact as we can make them.

- Tight: Smaller feasible region.
- Compact: Fewer constraints for the same feasible region.

This means Tulipa can handle large scenarios faster and with less computational burden than other models.

Model Features

Some of Tulipa's features include:

- Fully flexible temporal resolution
- Investment in technologies and transport (grid) capacity
- Seasonal & Non-seasonal storage
- Multi-year transition pathways
- Ramping & Unit Commitment
- Multi-in, Multi-out conversions

Solver

Tulipa is tested using the open-source solver HiGHS, as well as the commercial solvers Gurobi and XPress.
In principle, analysts can use whatever solver they have available.

Optimal Solution

System Cost · Investments & Operations · Marginal Costs

Tulipa formulates both investment and dispatch problems. The solution shows investment and operation outcomes assuming perfect (optimal) market competition.

We have also developed a secondary package, NearOptimalAlternatives.jl, which uses MGA (modelling to generate alternatives) to produce multiple diverse solutions to a scenario.

Design Vision

The main difficulty in modelling energy systems is including sufficient complexity while staying within computational limits.

Existing models focus on either granular detail or broad scope, but they cannot do both without sacrificing accuracy.

Tulipa's core is built on research innovations that break this trade-off – solving complex problems both *faster* and with *higher accuracy* – enabling detailed European-scale analyses that were thought unsolvable.

Partners

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