SpineOpt: A flexible energy system modelling framework in Julia

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7 September 2021
Agenda

- Motivation & Key features of SpineOpt
- Basics of SpineOpt (~20’, Maren Ihlemann)
  - SpineOpt building blocks
  - Live Demo
- Flexible temporal structure (~10’, Topi Rasku)
- Break
- Flexible stochastic structure (~10’, Topi Rasku)
- Representation of different energy sectors (10’, Jody Dillon)
- Accommodating increased detail and complexity (10’, Jody Dillon)
- Q&A
Motivation: Why have the requirements for energy system models changed?

- More (variable) renewable energy sources
- Short-term detail in long-term planning models
- More uncertainties
- More integration across energy sectors
- Models become more and more complex
- More collaboration needed between different stakeholders
Key features of SpineOpt

Generic concept
• Generic data structure
• Flexible temporal structure
• Flexible stochastic structure
• Flexible linking of models/Decomposition

Multi-sector modelling & wide range of applications
• Long-term planning, Detailed UC, Hydro scheduling, Heat system optimization, Gas network optimization …

Fully open-source
• Julia (SpineOpt; ~back-end)
• Python (toolbox; ~front-end)
• Github (Development)

github.com/Spine-project/SpineOpt.jl
spine-project.github.io/SpineOpt.jl/latest/
Basics of SpineOpt: Spine Project Overview

- **Problem agnostic toolbox (WP2)**
  - Original data sources
  - Data conversion tools (WP4)
  - Problem independent data store (T2.2)
  - Problem independent GUIs (T2.4)
  - Spine API (T2.2.2.5)
  - Portable data parcel format (T2.5)

- **Interfaces (T2.5)**
  - Python (API)
  - Julia (API)
  - GAMS

- **Models**
  - Spine generic energy system model (WP3)
  - Other models

- **Events**
  - **Sep 8, 17:00-18:30 CEST**
  - **Sep 10, 14:00-15:30 CEST**
  - **Sep 9, 14:00-16:00 CEST Applications**
Basics of SpineOpt: SpineOpt’s building blocks

**Model**
- holds general information about the optimization problem
  - e.g. `model_start: 2000-01-01 00:00`

**Temporal block**
- defines the model's temporal resolution(s)
  - e.g. `resolution: 1h`

**Stochastic structure**
- defines the sequence(s) of the stochastic scenario(s)

**Stochastic scenario**
- defines the available stochastic scenarios

**Node**
- place where balances energy flows
  - may also represent a storage technology
  - e.g. `has_state: true`

**Commodity**
- (optional) used to assign a tradable good to energy flows
  - e.g., electricity, heat, oil, gas, water, etc.

**Connection**
- represents transport flows between different nodes

**Unit**
- represents arbitrary conversion processes to and from nodes
  - e.g. `number_of_units: 3`
Live Demo: Basic energy system model

Gas price: 5€/MWh

1 Gas Plant
Efficiency: 40%

Capacity/unit: 50 MW (El)

Demand/MW:
00:00 10
01:00 20
02:00 40
03:00 50
04:00 30

Capacity/unit: 20 MW

3 Wind turbines
Availability:
00:00 0.2
01:00 0.1
02:00 0.5
03:00 0.1
04:00 0.2
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