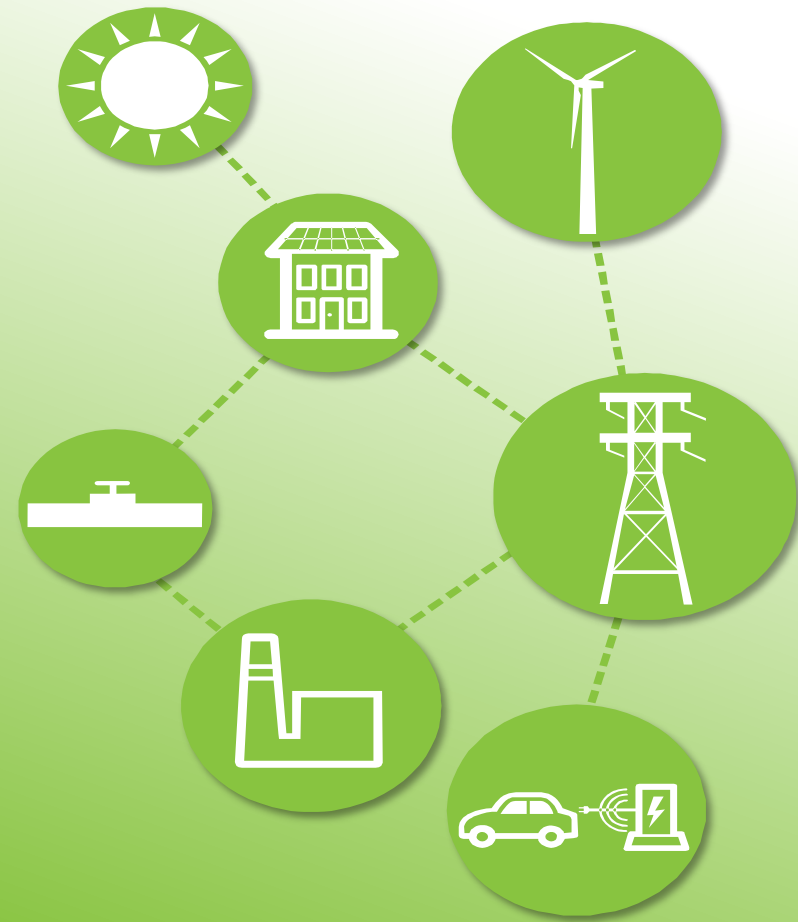




Spine

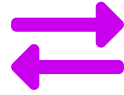


Analyzing cross-border balancing capacity coordination in a high-RES power system

Using the open-source energy system model generator
SpineOpt

Maren Ihlemann, KU Leuven

Case study on Cross-Border Integration



no coord. (NO)

“exchange” (EX)

“sharing” (SH)

	Ongoing	Planning	Not planned
Activation	Coordinated	Coordinated	Coordinated
Procurement*	Uncoordinated	Coordinated	Coordinated
Sizing*	Uncoordinated	Uncoordinated	Coordinated

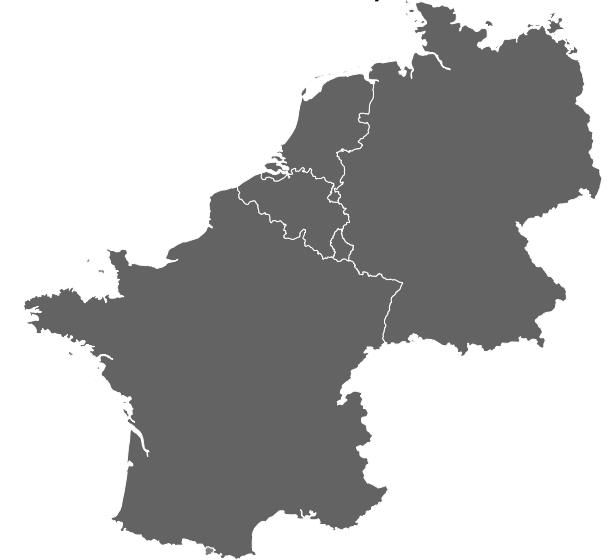
*Need to allocate cross-control area interconnection capacity!

- IGCC
- MARI
- TERRE
- PICASSO

- EBGL 2017
- All TSO' proposal
2019

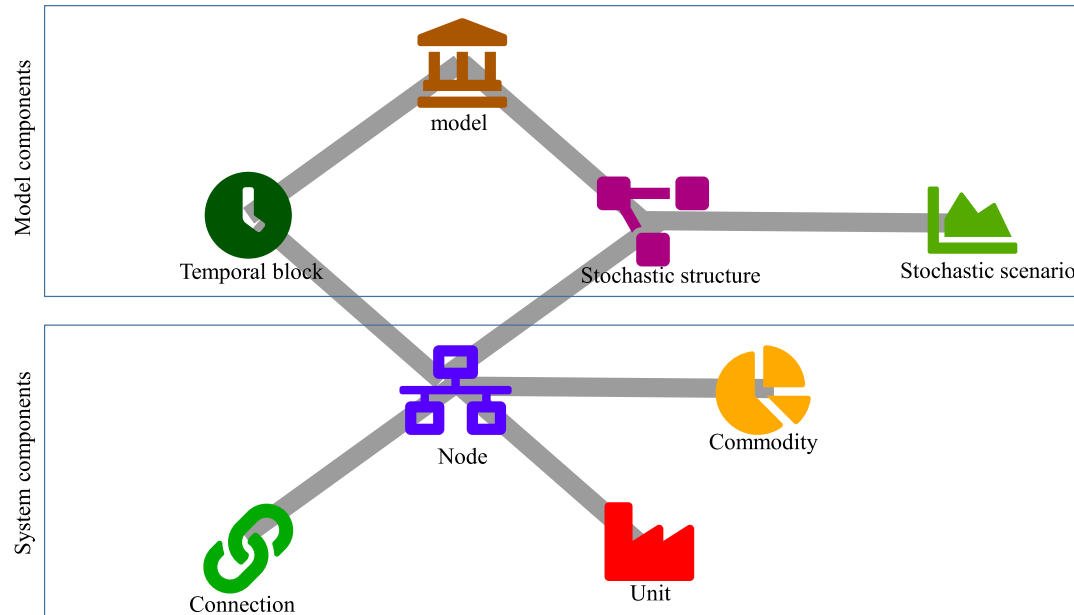
- Exception:
- Nordics
- Some bilateral
reserve sharing
(e.g., BE-FR)

- **Day-ahead** market with joint energy & balancing capacity market clearing
- Scope: **2030** scenario for **CWE** with 5 countries (BE, DE, FR, LU, NL)



Realization in SpineOpt.jl

SpineOpt is a generic open-source energy system model generator



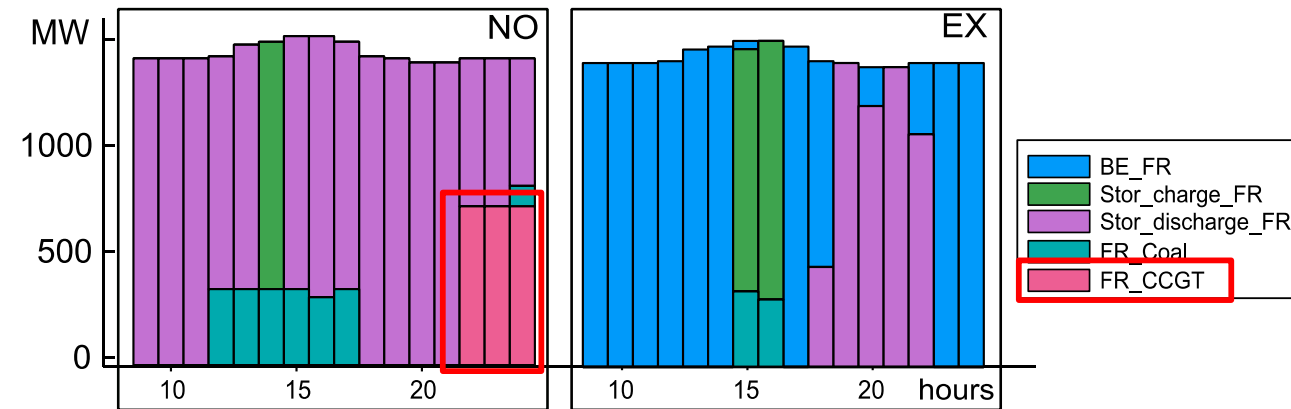
<https://github.com/Spine-project/SpineOpt.jl>

- High level of technical detail required
 - Clustered unit commitment formulation
 - Ramping and reserve constraints
- 1-year optimization (MILP)
 - Rolling horizon optimization
- Different market scenarios for coordination
 - Realized through SpineOpt's generic constraints
 - Database-driven differentiation between market designs

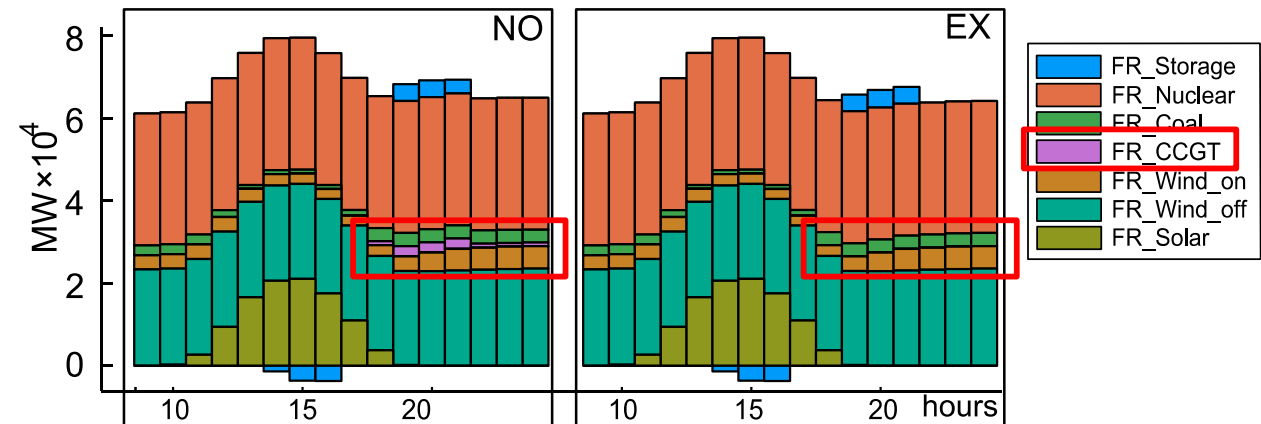
Balancing Capacity Exchange $\times \leftrightarrow \rightleftarrows$

- Exchange impacts “must-run” constraints
 - Spinning reserves imported (aFRR!)
 - Relaxation of “must-run” requirements
- Allows more efficient DA scheduling
 - Low-flexibility, low-OPEX units operate closer to maximum output
 - Avoiding start-ups of high-flexibility, high-OPEX units
- Results in moderate cost savings
 - Order of magnitude ~25 M€/year

Spinning reserves in France



Energy production in France



Balancing Capacity Sharing

- Sharing reduces balancing capacity need
 - Benefits of joint sizing exercise
 - Further relaxation of technical constraints
- Allows even more efficient DA scheduling
 - Schedule even closer to cost-optimal DA electricity schedule
- Results in moderate cost savings
 - Order of magnitude ~155 M€/year
 - Biggest benefits not yet captured?
 - *Results suggest that the total amount of high-flex capacity could be reduced*

