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Optimal microgrid sizing: impact of ✦anticipative✦ operation?

(i.e. perfect foresight)

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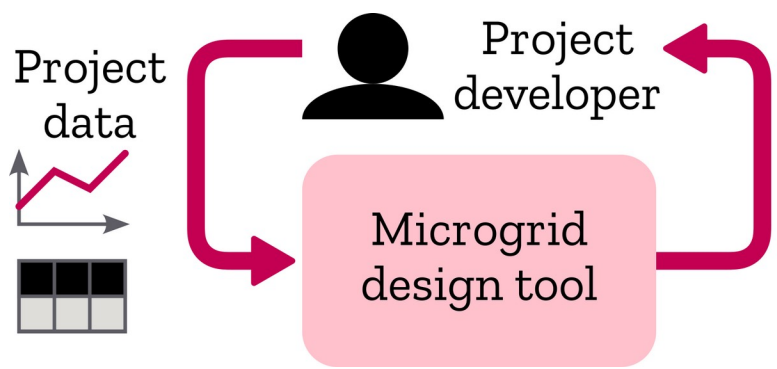
Open Energy Modelling initiative (openmod) – Grenoble workshop 2024
March 25th–28th, 2024

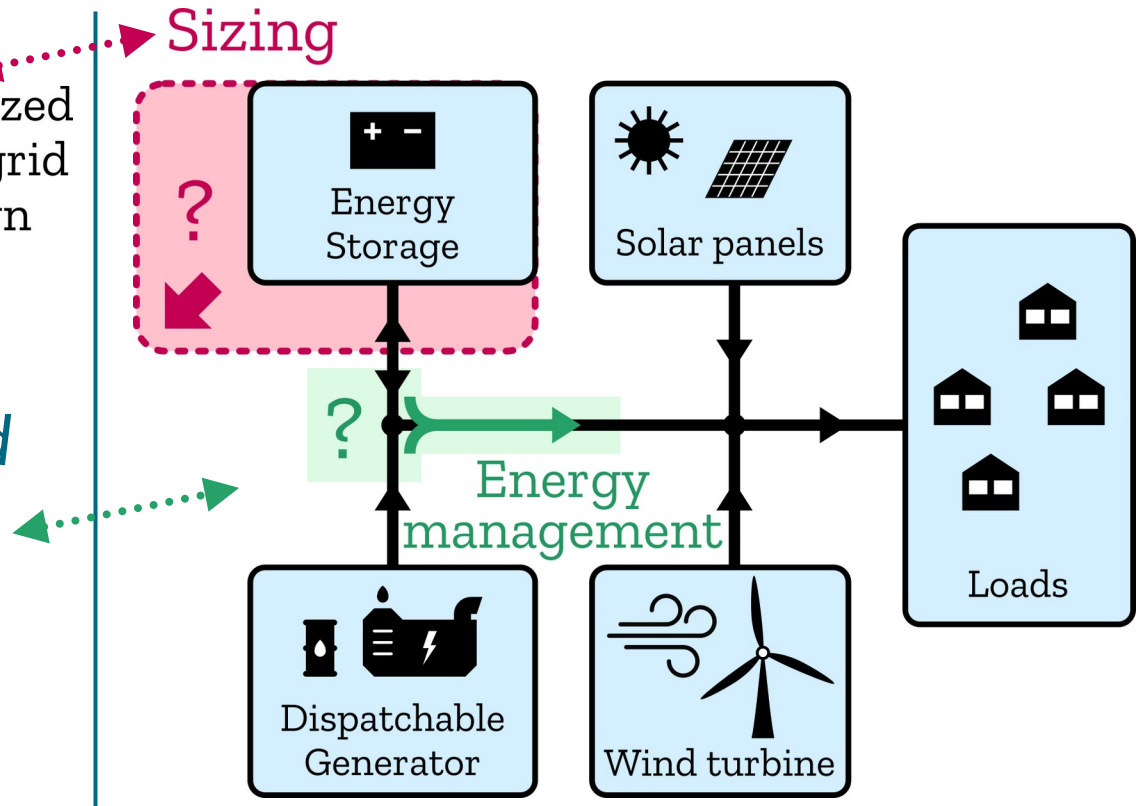
Microgrid design is a joint *sizing & operation* optimization



Optimized Microgrid design

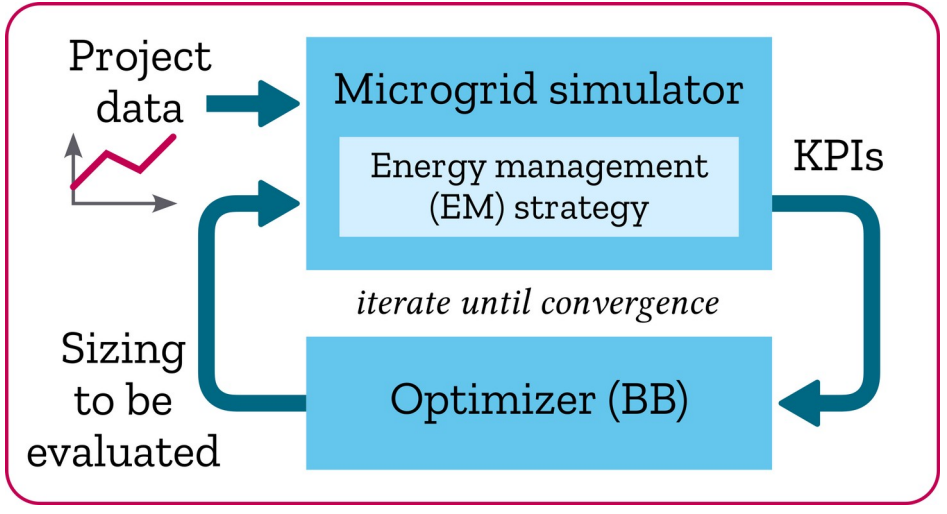
Ex.: min *Cost* s.t. *load is satisfied*

- "Imaginary" operation model needed for lifecycle performance evaluation
- based on representative data → uncertainty to real-life



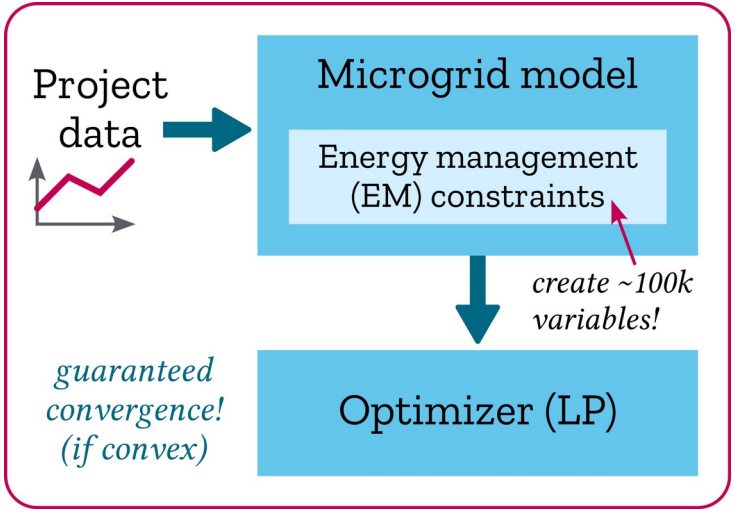
The two classical formulations are different in nature and hypotheses

Blackbox optimizer + Operation simulator



- Non anticipative
- Suboptimal (if using rule-based operation)

All-in-one Math. Program with Algebraic model



- Anticipative (Perfect foresight)
- (Over)-optimal

*models often **not** comparable!*

From same data, two different designs and real-life load satisfactions

1) Design methods

min *Cost* such that *load shedding* = 0.0 %

Rule-based oper. + Blackbox optim

All-in-one Linear Program

Generator	Battery	Solar PV	Wind
1577 kW	**4767** kWh	1970 kW_p	1250 kW
1154 kW	**5131** kWh	2037 kW_p	1240 kW

Data: PVGIS + Ouessant island load (peak **1707** kW) for 365 days @ 1h timestep + PVGIS

2) Real-life performance eval.

Load shedding	LCOE
0.00 %	172.3 €/kWh
0.23 %	171.3 €/kWh

→ *anticipative All-in-one model yields **subpar** performance!*

See also posters!

Tools: Microgrids.X

Microgrids.jl

- Julia based
- Simulation model with rule-based operation
- **Blackbox** optimization

open source MIT license

https://pierreh.eu/Microgrids-X/
https://github.com/Microgrids-X/Microgrids.jl

Microgrids.JuMP

- Julia/JuMP based
- **Algebraic** (linear) model
  - with usage-dependent lifetime effect on annualized cost for battery and generator

to be released