Chronological time-period clustering for optimal capacity expansion planning with storage

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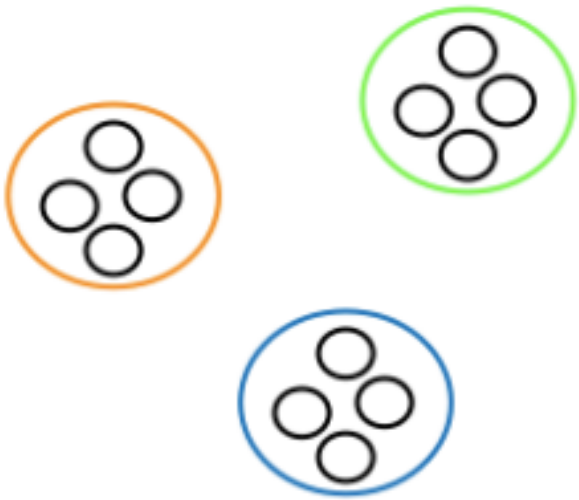
Capacity expansion planning

Capacity expansion problem	
Horizon	1 year
Obj	Min prod+inv cost
Var	Generation capacities Line capacities
Con	Generation = Demand Unit technical limits Line technical limits

Clustering

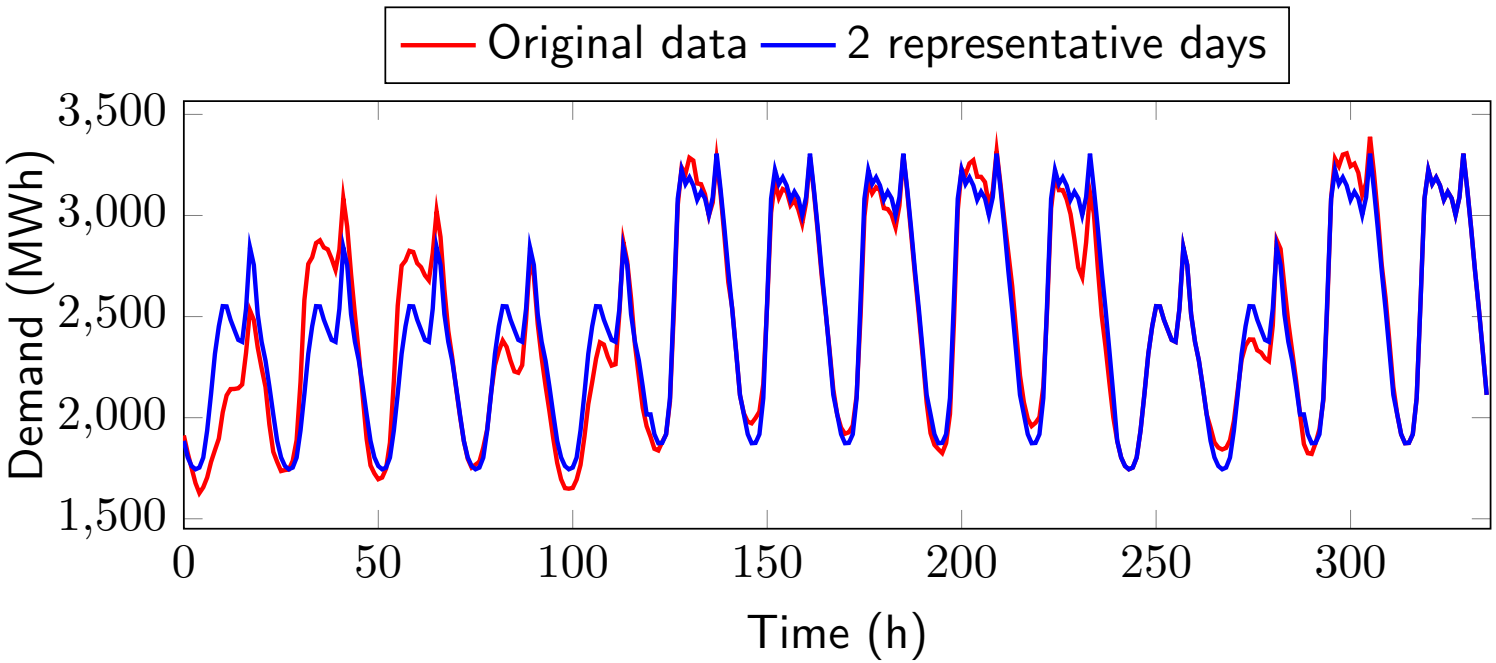


AIM

Reduce the computational burden of capacity planning problems with renewables and storage

Representative days for demand ☺☺☺☺

- Electrical demand shows strong daily, weekly and annual patterns and therefore, using representative days works quite well



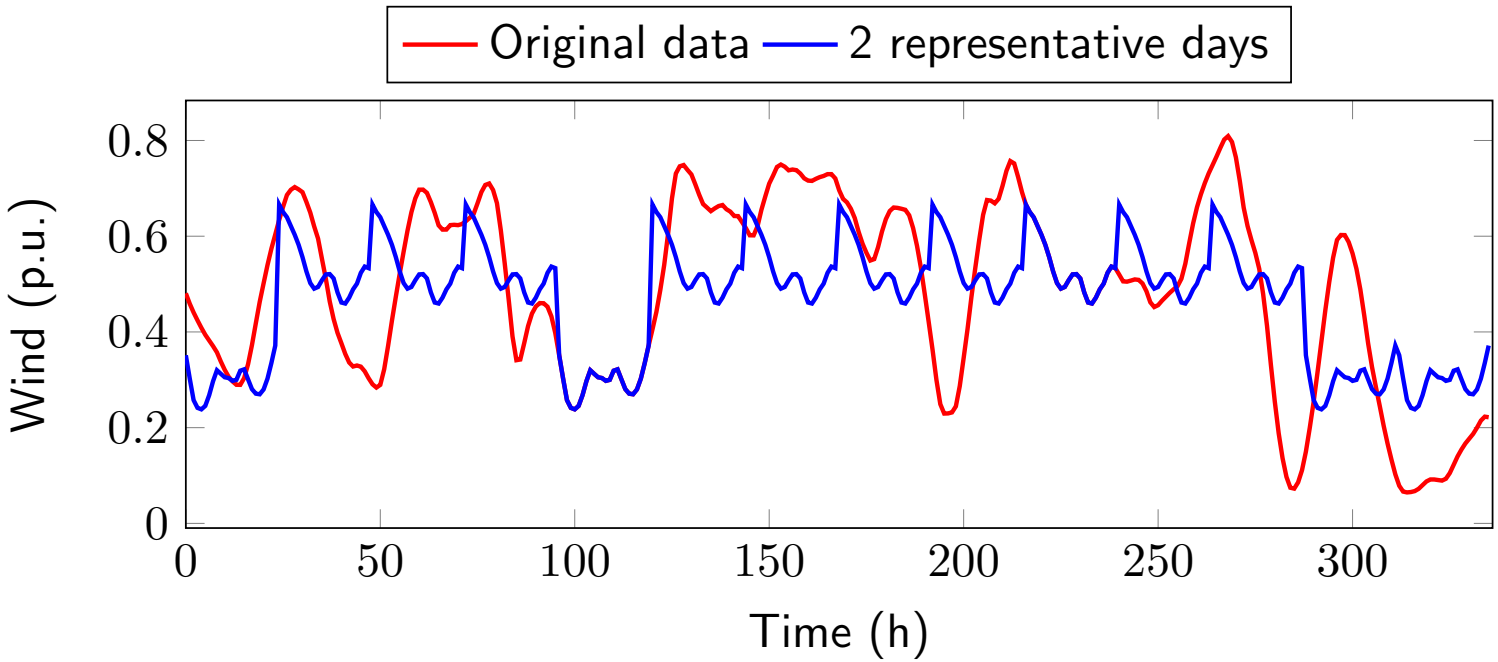
- Instead of 14 days (336 h), we use 2 representative days (48 h)

👍 Computational burden is reduced

👎 Day-to-day chronology information is lost

Representative days for wind ☹☹☹☹

- 👎 Some renewables do not present a strong daily pattern

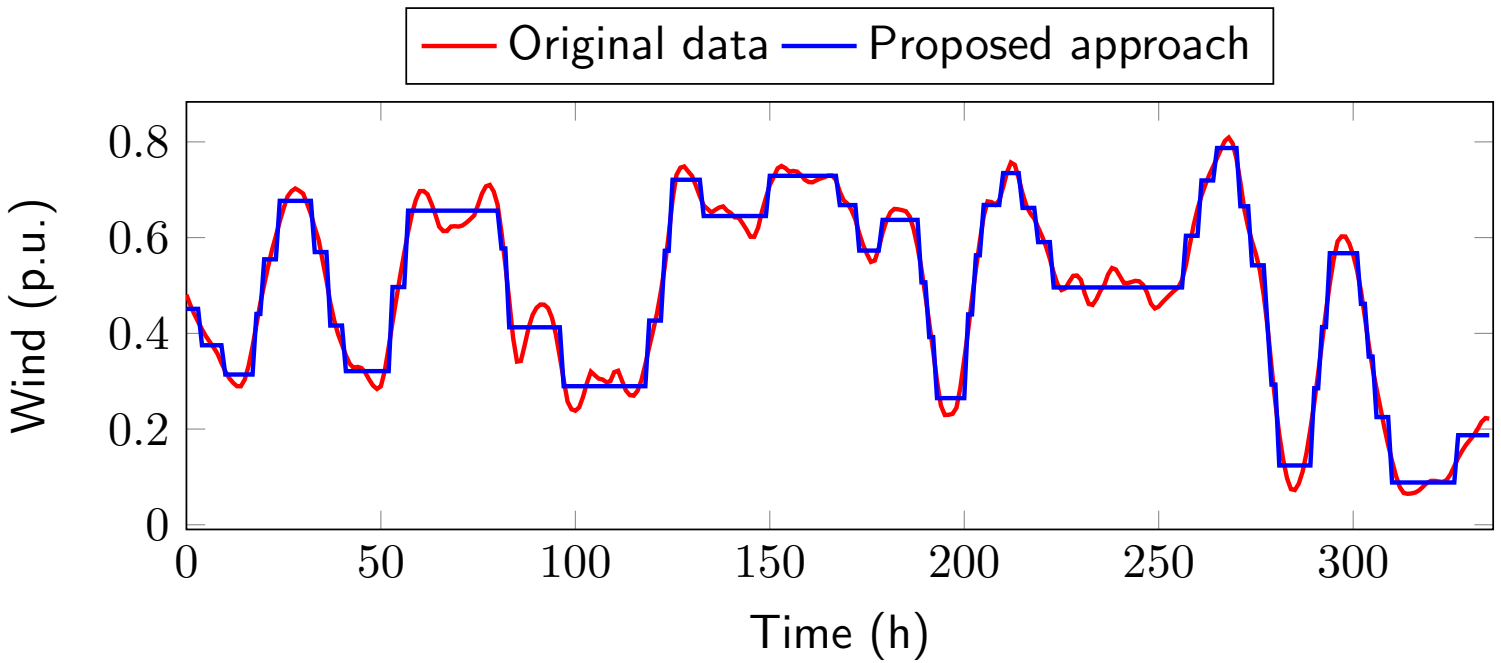


- Energy stored can be used several days later (**seasonal storage**)
- Crucial to overcome the "dark calm cold" periods in central Europe
- 👎 Seasonal storage cannot be modeled using representative days

Chronological clustering of time periods

- We propose a new clustering methodology to group **consecutive hours** and maintain chronology

👍 Wind is approximated more accurately



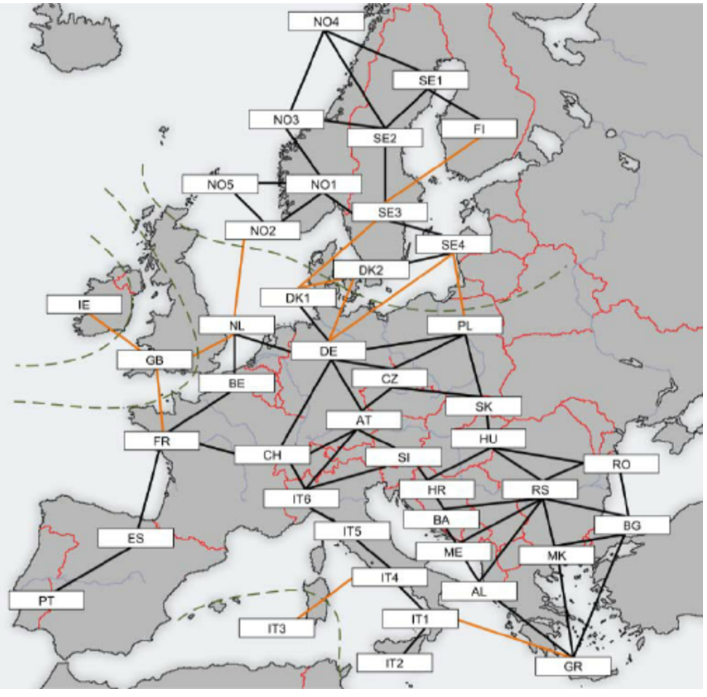
👍 Seasonal storage can be properly modeled

👍 Computational burden is reduced

👍 Day-to-day chronology information is kept

Case study: European electricity network

- Electric power system (28 countries) for 2030 (single target year)
- Investments in conventional and renewable generation, transmission lines and two storage technologies (intraday and interday)



Approach	Error	Time
F (8760)	0 %	$\sim$ 10 h
D-28 (672)	13.1 %	$\sim$ 100 s
W-4 (672)	48.1 %	$\sim$ 100 s
C-672 (672)	6.1 %	$\sim$ 100 s

Thanks for the attention!! Questions??

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