Next Generation Challenges in Energy-Climate Modelling Workshop 2022

Break Out Group - Forecasting and predictability: planning and managing variable renewables

Perfect foresight and typical weather. Too good to be meaningful?

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Part A. Perfect and myopic foresight. Which one to assume?



The context. Energy system

Energy system optimisation models



Victoria et al. doi.org/ghpp93 Perfect foresight: knowing in advance how things will unfold in the future

Perfect foresight. Why is it problematic?



Myopic foresight. Much better? Myopic foresight: knowing how things will unfold only up to a point

From an *operational* perspective:

- Better reflects real-world electricity market mechanisms
- But what about months-ahead gas storage?
- What about future **long-term** (seasonal) **storage** of renewables?

From an *investment planning* perspective:

- Should better reflect real-world short-term investments rationale
- But in reality some things are known in advance (e.g. carbon price trends)



• Both perfect and myopic foresight have limitations

Any foresight. Conclusions

• What is best to assume depends on the **research question**

• **Reality** is possibly closer to **a mix of both** types of foresight

• In either case, model parameters (e.g. weather) remain fixed!

Part B. I love this weather, it's the perfect storm

Weather year. The largest source of uncertainty



Weather year. The largest source of uncertainty



Things seem to improve with a fully sector-coupled system, but...

And weather-related uncertainty it's not getting any better

euobserver

Weather year.

The largest source

of uncertainty

Germany expects coal supply problems this winter



The New York Times

Europe's Scorching Summer Puts Unexpected Strain on Energy Supply

The dry summer has reduced hydropower in Norway, threatened nuclear reactors in France and crimped coal transport in Germany. And that's on top of Russian gas cuts.

Heatwaves pushing up demand for air conditioning in UK

Cooling could increase country's <u>power consumption by 15%</u> during summer by end of century





Handling uncertainty. Thoughts on the way forward

There are ways to **integrate parametric uncertainty** into the optimisation:

- Imposing **reserve margins**
- Robust optimisation
- Stochastic optimisation
- Out-of-sample testing

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• Intersecting near-optimal option spaces

Handling uncertainty. Intersecting option spaces



Thank you. Let's discuss

1. Perfect foresight and parametric uncertainty are **different issues**

2. Parametric (especially weather-related) **uncertainty** is more impactful and **more urgent**

3. There are methods to make **good use of uncertainty**

4. But data about possible future weather conditions are needed

The slides and links to references are available at <u>flombardi.org</u>