

# BUILDING A CASE FOR THE UNCERTAIN

>>> *stochastic agents and their decisions*

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# WHY?

>>> *let's not talk about disadvantages*

# STOCHASTIC & OPTIMIZING ACTORS

## Excerpt of possibilities

- Utilize **transparent** ("white-box") optimizers (e.g., max-profit / min-cost)
- Consider various forms of **uncertainty**
  - Forecasts
  - Market feedback (= noise from other actors)
- Depict **decision timing** across various markets
- Account for various **risk measures** (e.g., CVaR)
- Integrate **complex targets** (e.g., multi-objective optimization)

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## Good to know

- Works well even for **multi-actor systems**
- Allows deriving **price & volume of bids**
- Follows a familiar train/simulate approach
- Can be **combined** with existing fundamental **energy modeling frameworks**

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### Note:

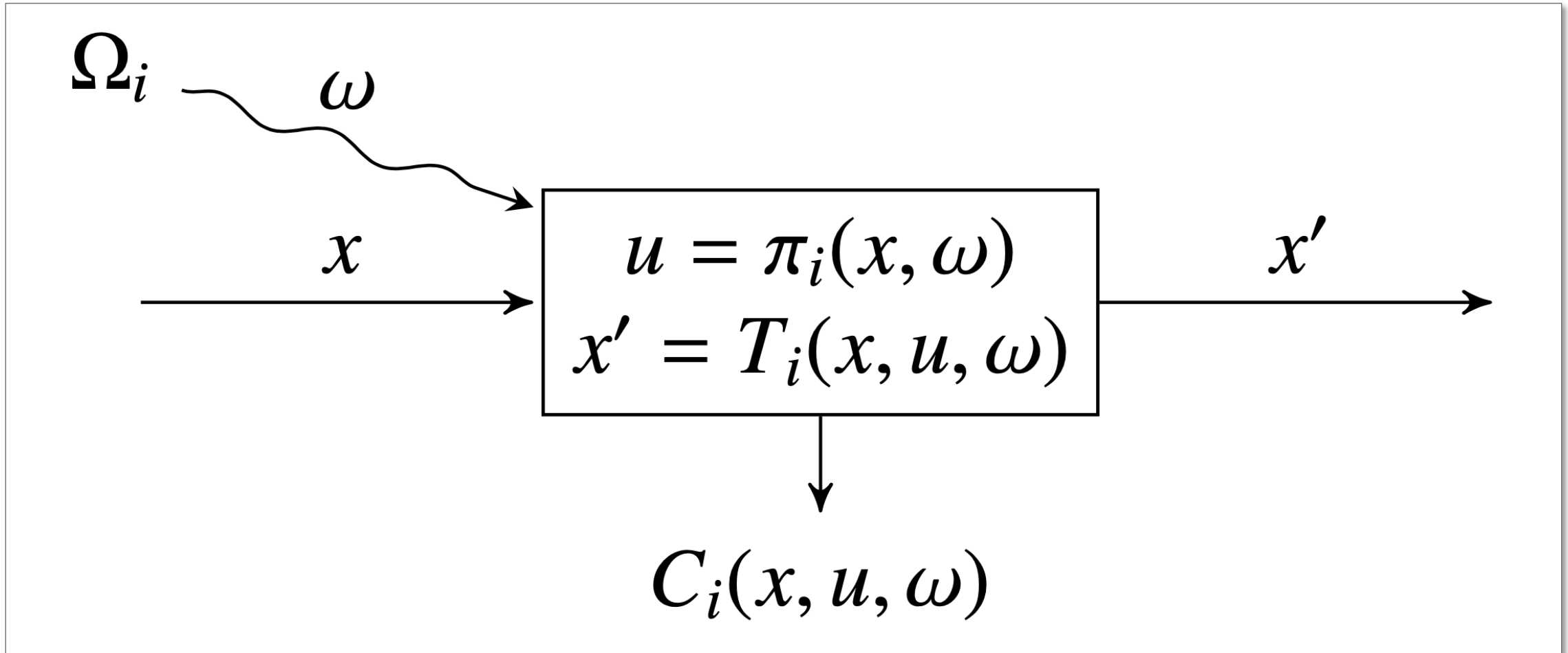
*This requires  
a certain  
type of  
algorithmic  
approach!*

# HOW?

>>> *SDDP – stochastic dual dynamic programming*

# THE BUILDING BLOCKS: NODES

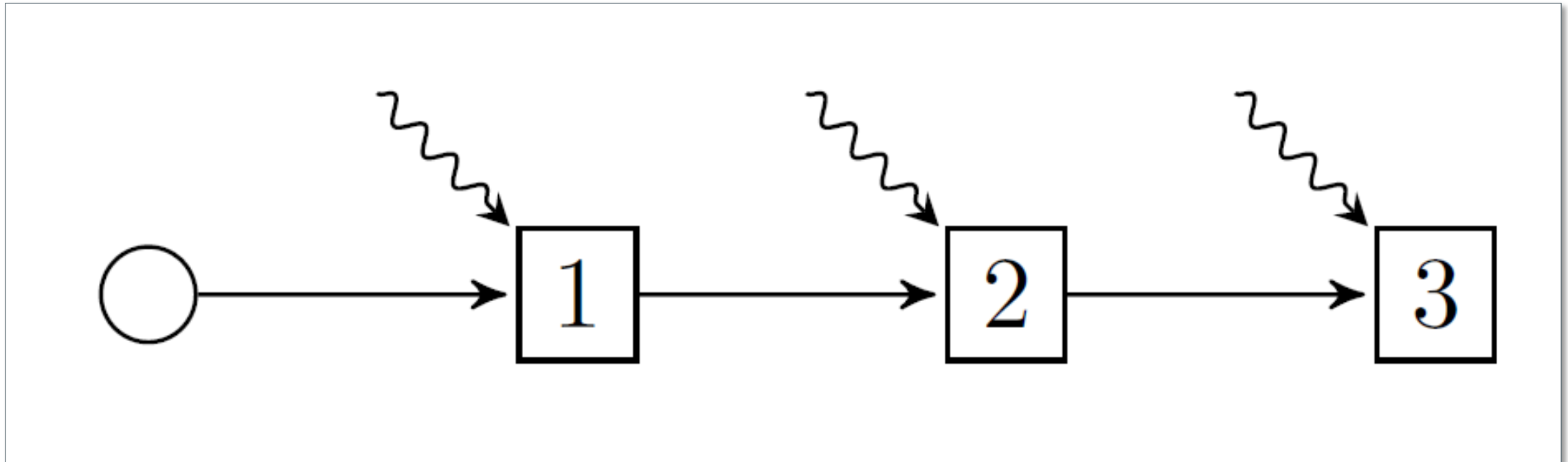
*It's time to make a decision ...*



source: sddp.dev (O. Dowson)

# POLICY GRAPHS

*Even harder than a hard choice: Many hard choices ...*



source: sddp.dev (O. Dowson)



# STOCHASTIC DYNAMIC PROGRAMMING

*Oh my ... Bellman's principle of optimality, value functions, and expected values!*

$$V_i(x, \omega) = \min_{\bar{x}, x', u} C_i(\bar{x}, u, \omega) + \mathbb{E}_{j \in i^+, \varphi \in \Omega_j} [V_j(x', \varphi)]$$

$$x' = T_i(\bar{x}, u, \omega)$$

$$u \in U_i(\bar{x}, \omega)$$

$$\bar{x} = x,$$

source: sddp.dev (O. Dowson)

# KELLEY'S CUTTING PLANE ALGORITHM

*Approximations from below ... imagine the Jaws theme song 🎵*

source: sddp.dev (O. Dowson)

$$f^K = \min_{\theta \in \mathbb{R}, x \in \mathbb{R}^N} \theta$$

$$\theta \geq f(x_k) + \frac{d}{dx} f(x_k)^\top (x - x_k), \quad k = 1, \dots, K$$

$$\theta \geq M,$$

# AND NOW?

>>> *an illustrative case study*

# THE SYSTEM

## Actors

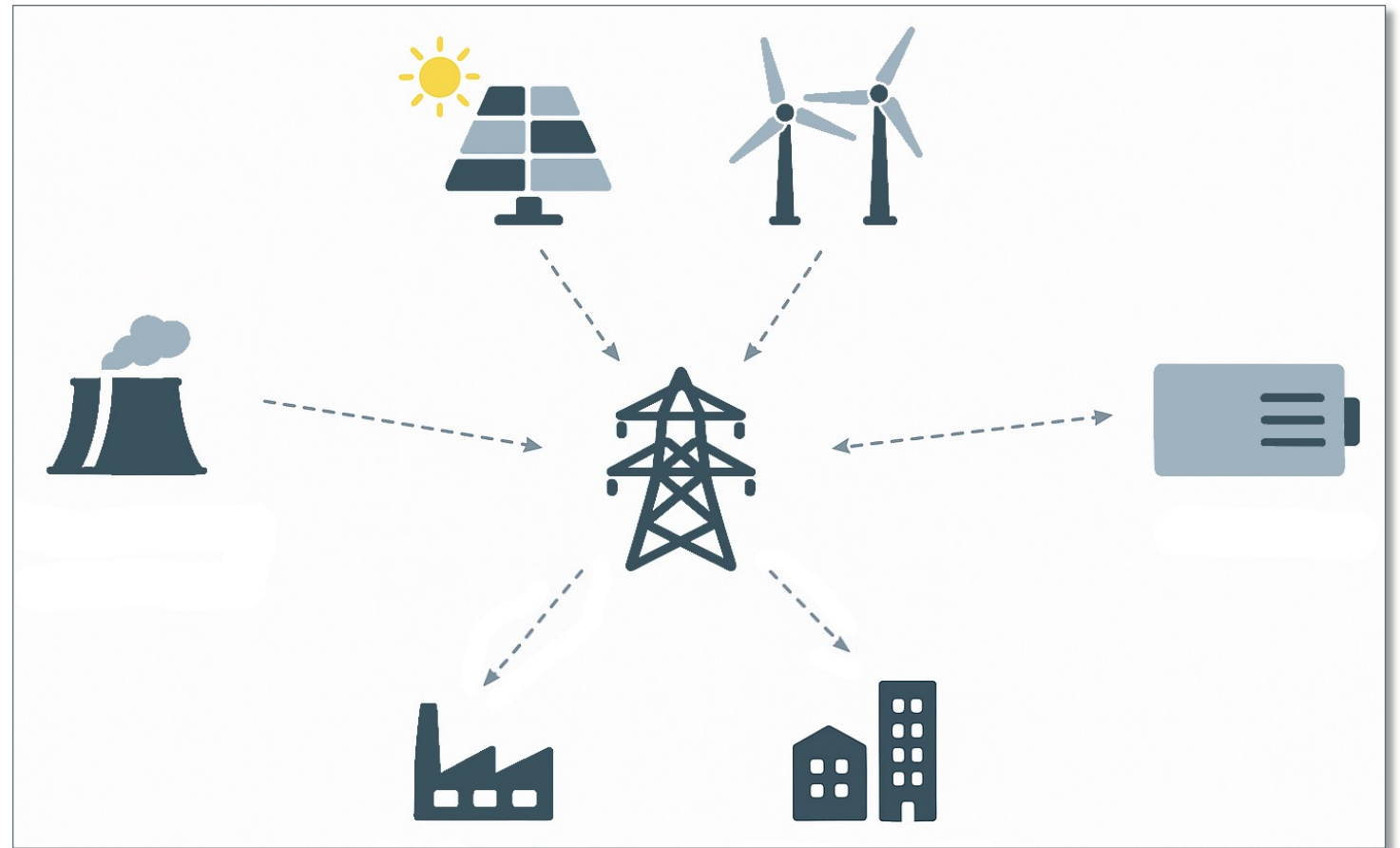
- Thermal
- Solar PV
- Wind
- Battery Storage

## Data & Forecasts

- Eight different weeks
- Austria, 03/2024 to 03/2025
- Techno-economic: DEA

## Scaling

- 100 MW peak demand



# RESULTS



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3000 €/MWh

artificial auction price limit

500 €/MWh

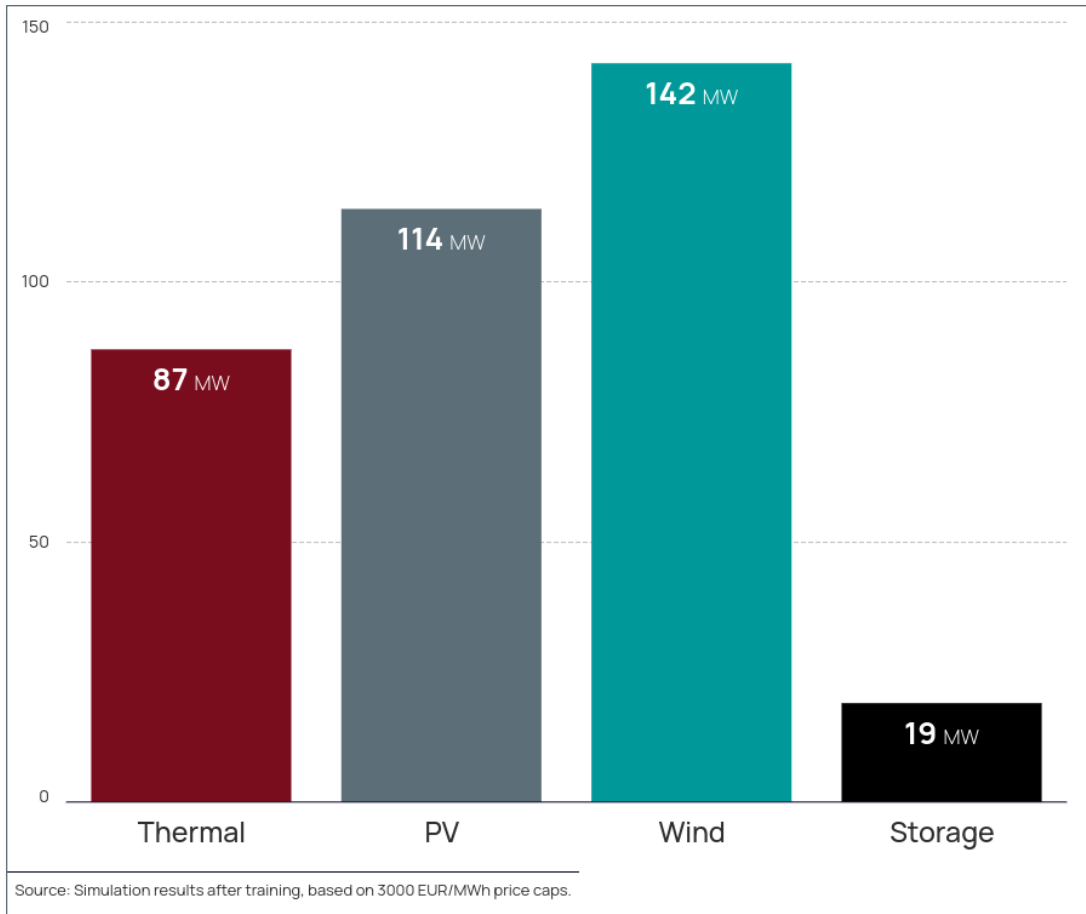


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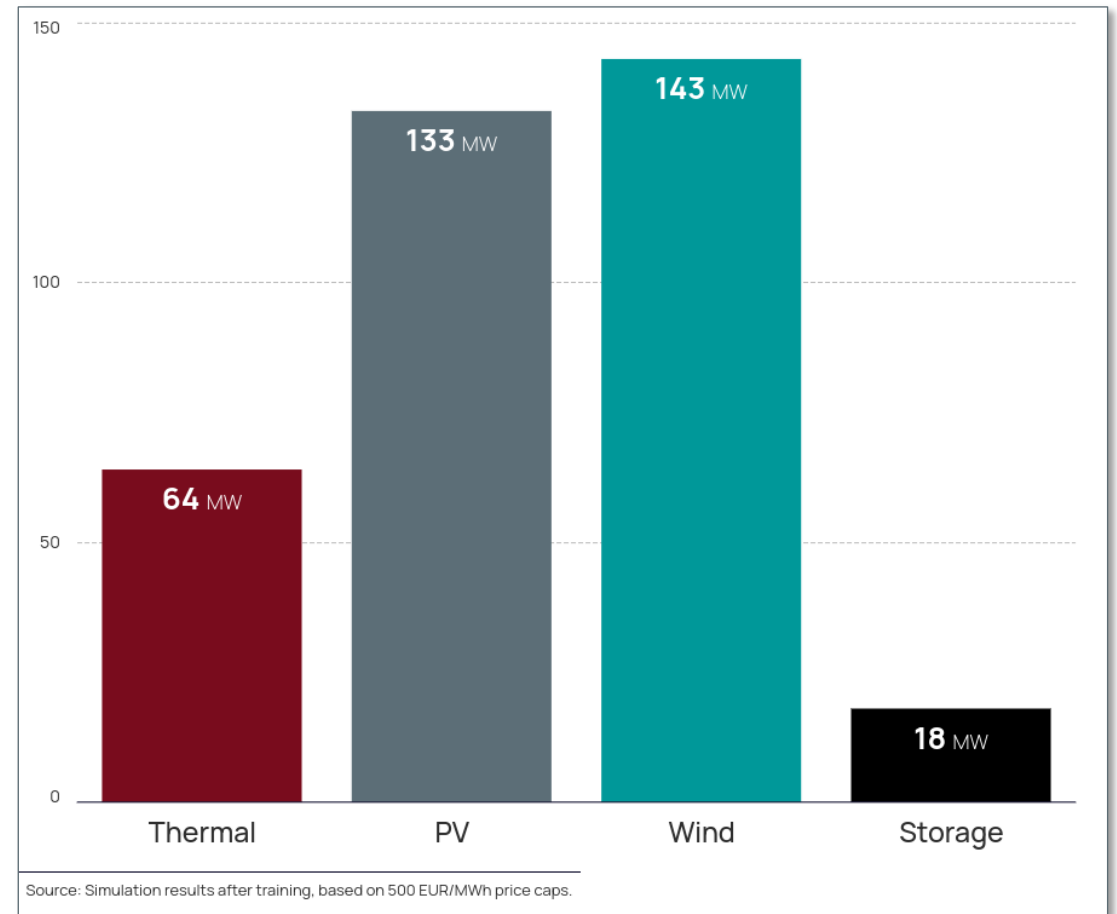
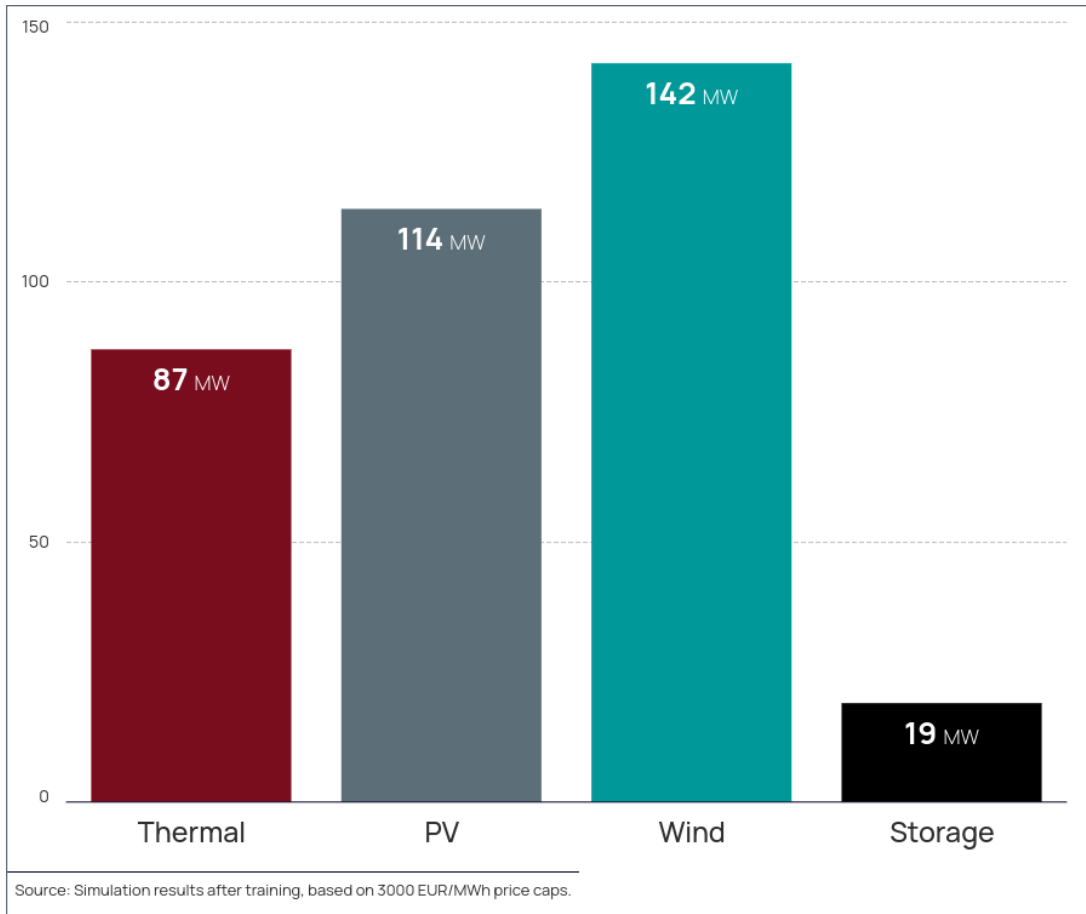


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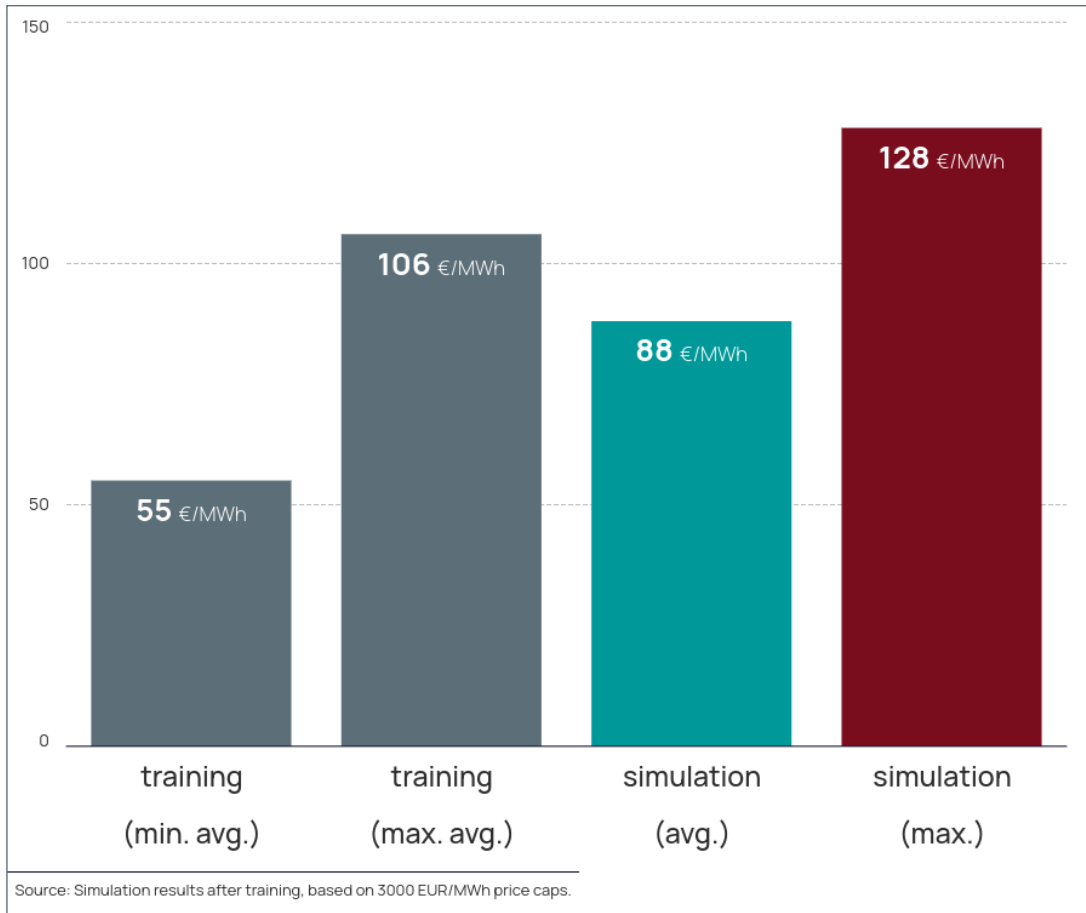


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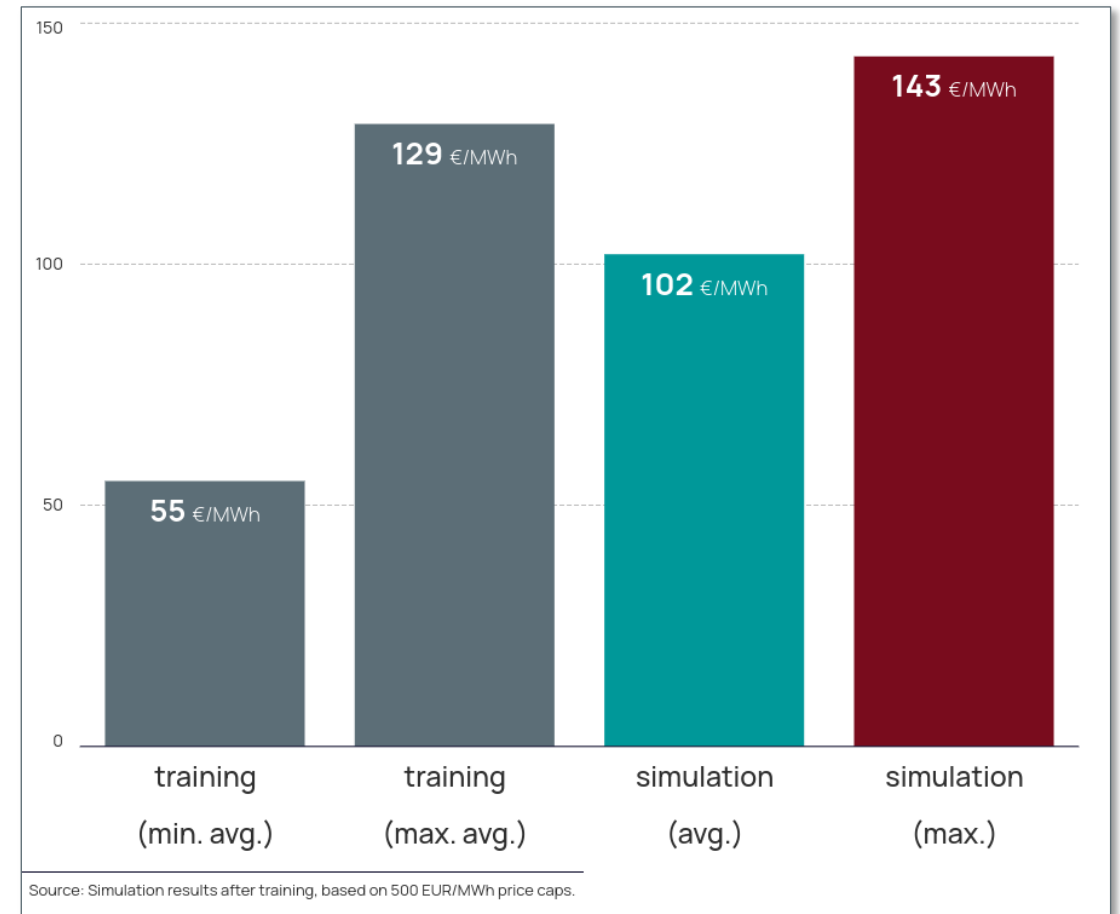
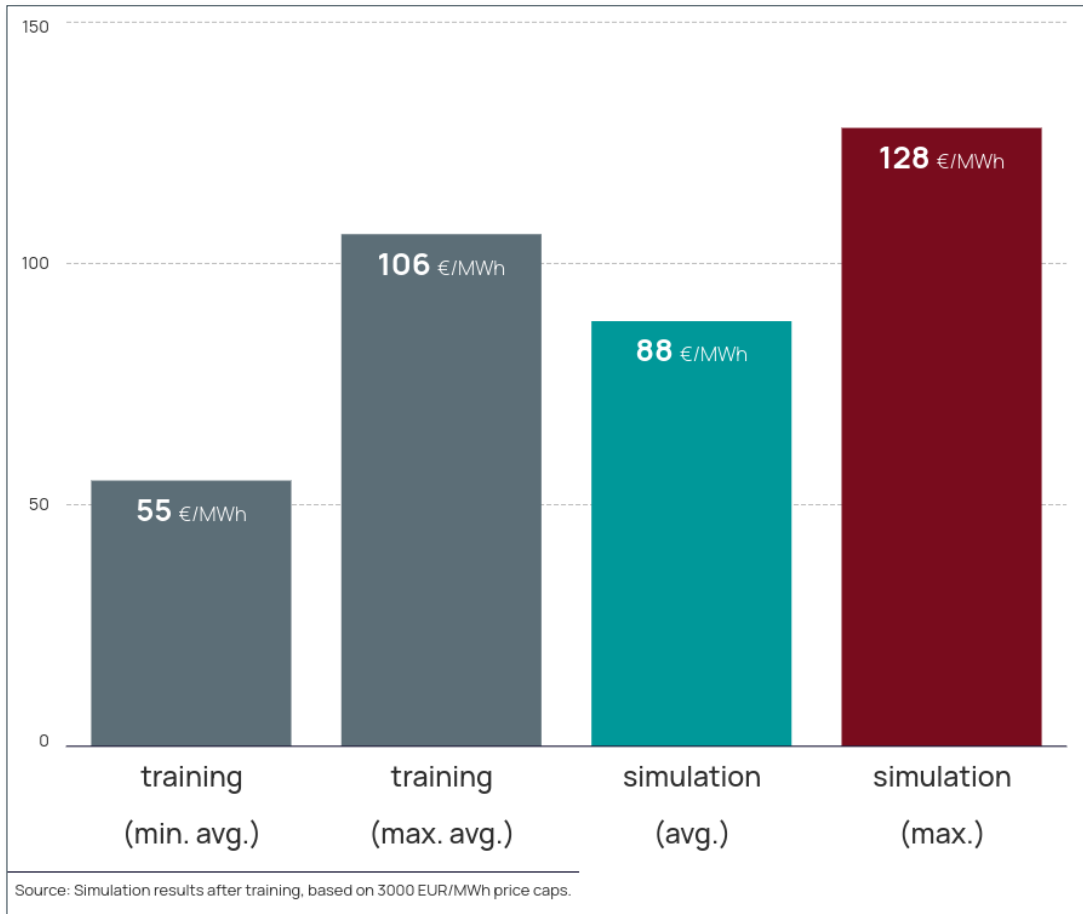


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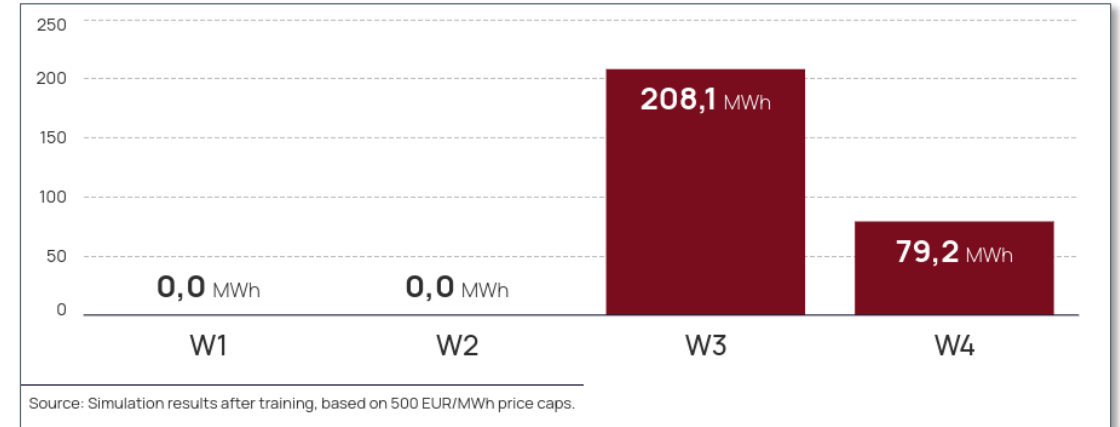
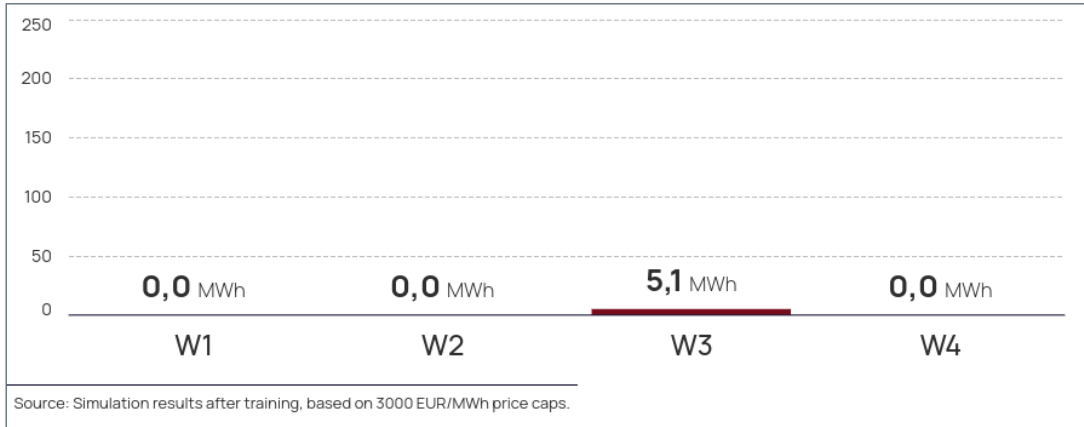
# SECURITY OF SUPPLY

3000 €/MWh

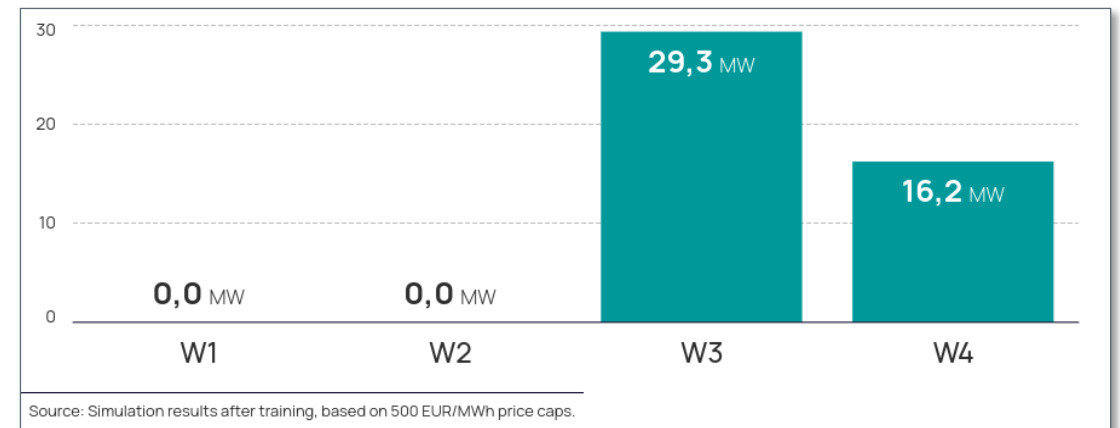
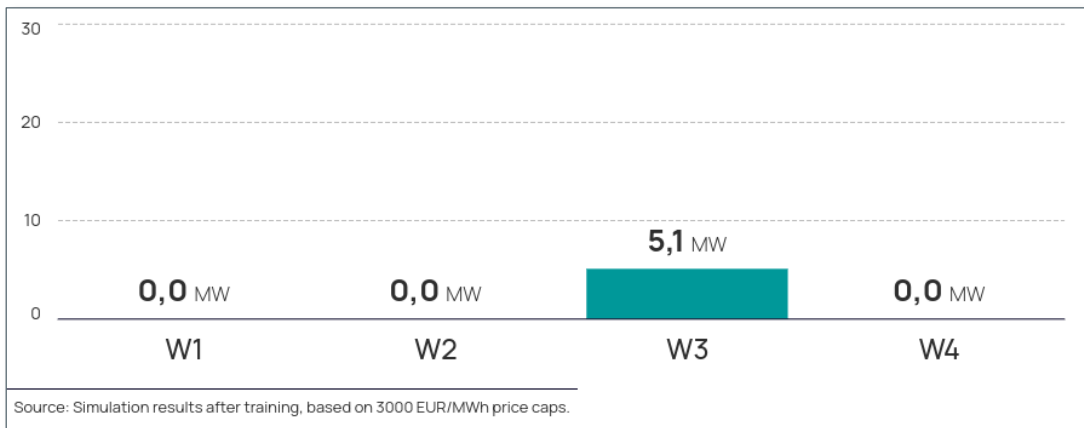
artificial auction price limit

500 €/MWh

missing energy



missing capacity





**THANK YOU!**

Stefan Strömer – 31.03.2025

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