

# ***Data & AI in Energy Networks***

22.05.2025

***e-on***

# The new world of electricity – decentral, distributed and volatile



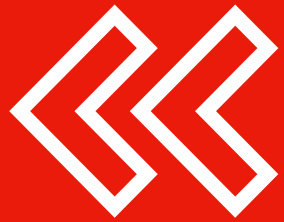
## ***The age of the dumb grid***

- Centralized production
- One-way electricity flow
- High share of non-renewable energies



## ***Moving towards smart grids***

- Growing share of volatile renewable generation
- New electricity consumers (e.g. e-mobility, heat pumps)
- More flexibility through new appliances (battery storage, heat pumps etc.)
- Two-way electricity flow



**Our Mission:  
Making the Energy  
Transition happen and  
boost efficiency using  
Data & AI.**

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# Data & AI for Energy Networks



***Use Case Deep-Dive  
Load Forecasting in the  
E.ON Lab***

## ***“Flexumer” – Driving the energy transition***

### **§14EnWG**

Emergency dimming of flexible households  
could lead to uncontrolled and  
**overdimensioned grid expansion**



Could we **proactively prevent**  
emergency dimming?

Until 2030, up to six  
million assets will be  
connected to E.ONs  
distribution grids



**+3 Mio.**

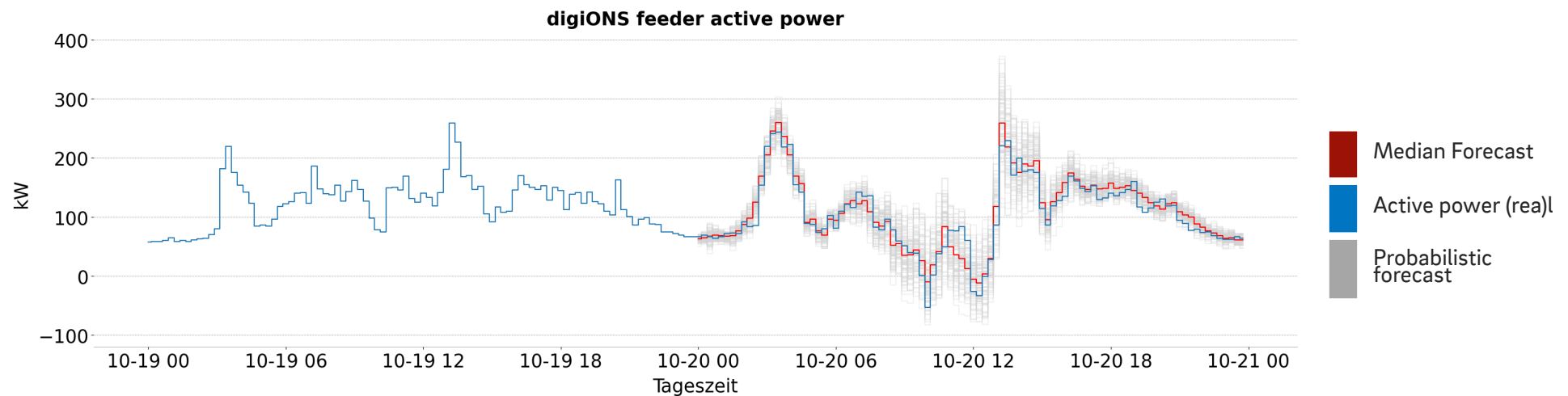


**+2 Mio.**



**+1 Mio.**

## *Data-Driven load forecast of substations*

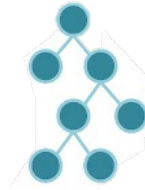


→ **Goal:** (Probabilistic) Forecast of 15 minute load intervalls of the next day (00:00 - 24:00) based on sensor and weather data

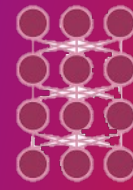
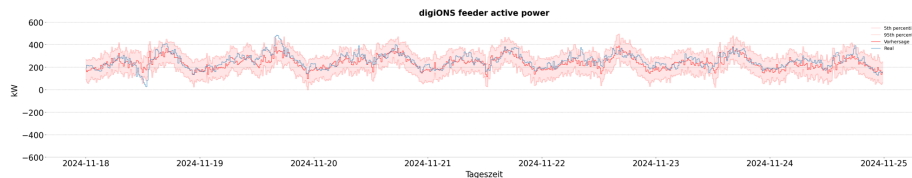


## Tested AI models

### XGBoost with Bootstrap of the Residuals

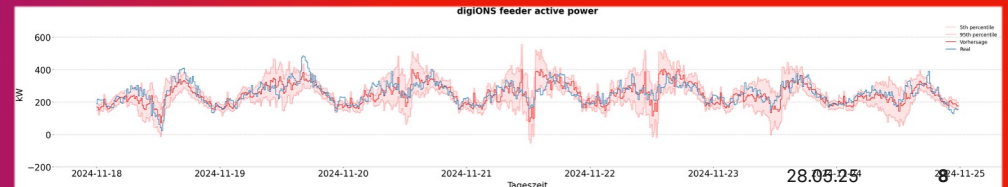


- Training of a regular XGBoost model
- Calculation of the residuals for each training example
- Bootstrapping of the residuals to obtain a distribution function
  - Random sampling of a model error (“disturbance factor”)
  - Generation of a “disturbed” prediction
  - Result: Empirical distribution of the prediction



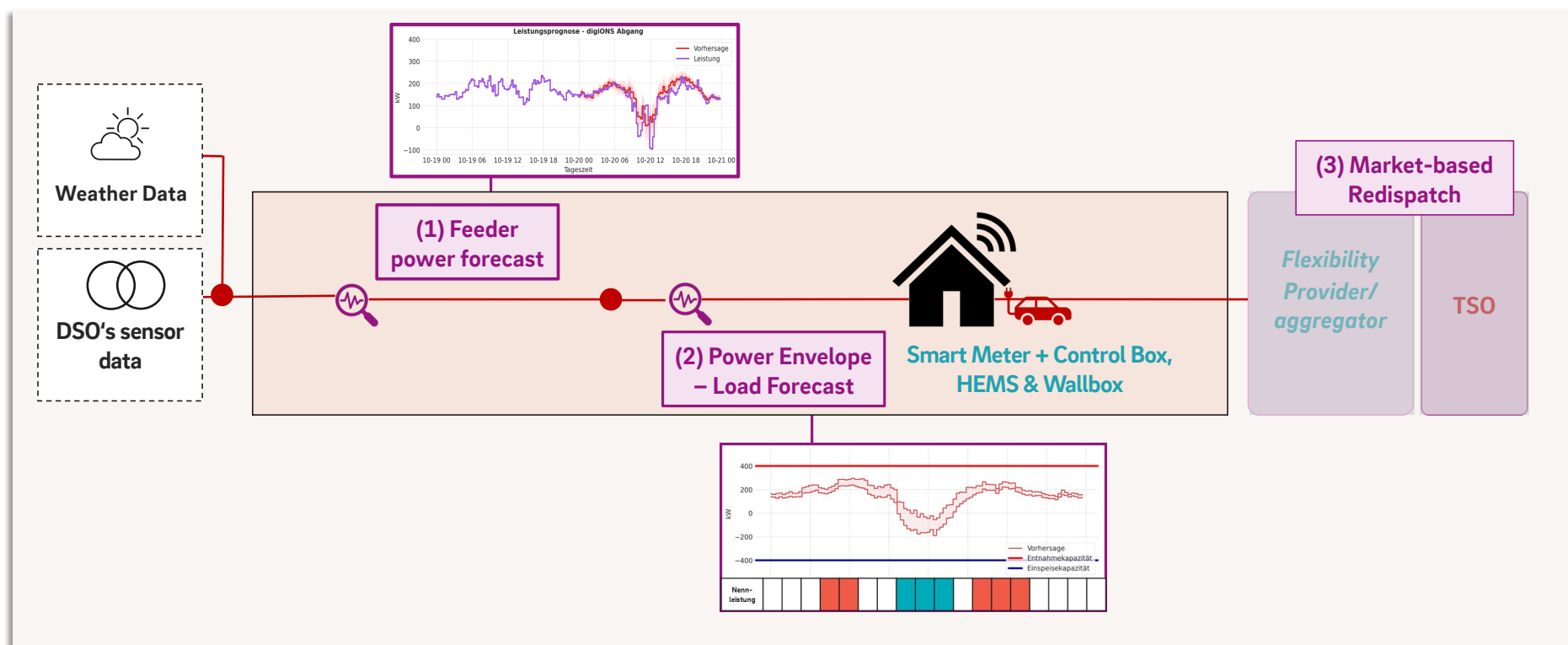
### Neural network with Monte-Carlo dropout

- Classical NNs provide deterministic predictions
- Modeling uncertainty using Monte Carlo dropout
- Through multiple runs in the inference phase (with active dropout layer) we obtain a distribution of predictions





# Power Envelope – The first step towards proactive congestion management



## *Open questions*

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What is a sensible forecast interval?

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How do we want to evaluate the forecasts?

- Best forecast in critical time windows?
- Best forecast in individual feeder or across all feeders?

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How much smart meter data do we need for an acceptable forecast quality?

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Which of our grid sections need a forecast?

# From PoC to Smart Grid

## Challenges



Harmonized data  
landscape is the basis



Installation of  
measurement  
hardware



Be ready to scale  
your solution



Think about  
technology  
adaption

***Thank you!***

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