



TREFOR Living Lab: Power Grid in the Triangle Area

ABOUT THE LIVING LAB:

The TREFOR living lab will incorporate load values for consumers in the Triangle Area.

The main focus of the living lab is how to reduce the load on the grid by introducing flexibility and analyze the future loading from EV and heat pumps.

Data is forwarded to Center Denmark, where the partners can access data.

Facts about the living lab:

TWO LIVING LABS	NR. BJERT	VESTER NEBEL
No. of customers	164	143
No. of LV feeders	5	6
Transformer size	400	200

RESULTS:

- ✓ DTU has developed a 6-hour temperature forecast for MV/LV transformers based on temperature and load measurements.
- ✓ SDU has developed a grid simulation, where the impact of different charging scenarios can be analyzed.
- ✓ The transformer model can be used for Dynamic Transformer Rating, and results have shown that monitored transformer stations can be overloaded with 20%.
- ✓ Transformers connected to wind farms can be overloaded with up to 60% without any problem.
- ✓ Using Linc data, new methods for estimating the hidden state of DSO networks have been developed.
- ✓ Coherent forecasting of load, PV and wind power production have shown improvements from 10 to 40 %.

PERSPECTIVES FOR THE FUTURE

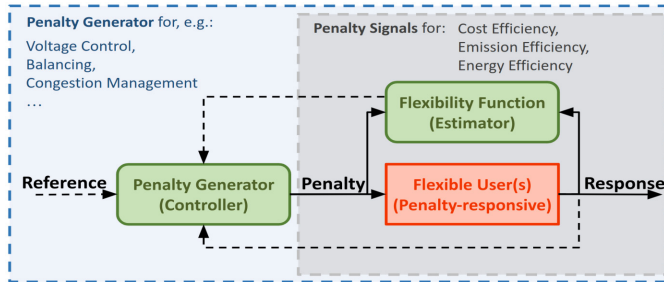
- ✓ Consumers' flexibility needs to be activated. Methods to do so need to be further investigated.
- ✓ DSO's need to know the existing capacity in the grid by activating dynamic rating based on consumption, weather etc.



TECHNICAL SETUP:

TREFOR delivers data from our remotely-read power meters to Center Denmark in hourly or quarterly resolutions. TREFOR also sends data from the 18 LINC devices to Center Denmark, where voltage and current are measured in 1-second resolutions.

MODELS:



The flexibility function is estimated for different categories of consumers in Nr. Bjert.

Pink radial

Description	August	September	October
Energy flexibility can change demand by up to:	13%	12%	10%
Total energy flexible capacity is estimated to be:	78.3 kWh	193.6 kWh	121.9 kWh
Parameter estimate for C :	3.76	10.33	6.21

Table 5.9: Results from estimating energy flexibility in houses of the Pink radial when using energy consumption and price data from August, September and October 2022.

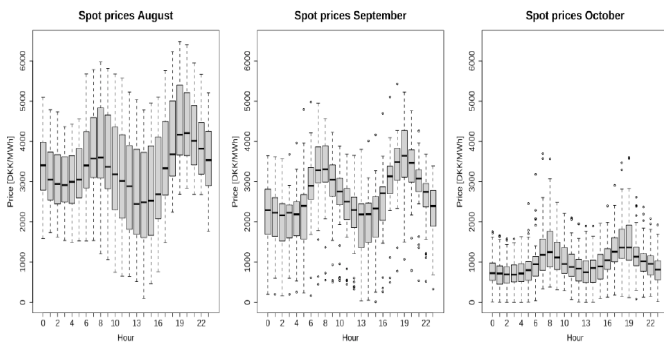


Figure 5.8: Spot prices based on hourly trends for August, September and October 2022.

A data-driven digital twin model for transformer stations has been developed.

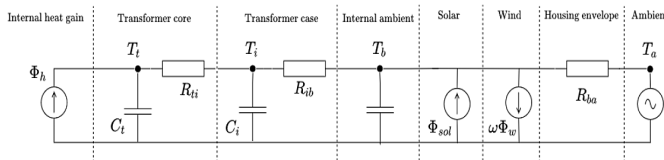


Figure 7: RC circuit of the three state model $TtTtTb$.

FED is a Danish digitization project, funded by Innovation Fund Denmark, aimed at turning Danish power consumption flexible to enable utilization of excess power from wind turbines and solar cells.

The project brings together Denmark's foremost researchers, organizations, supply companies, software companies and a number of living labs that provide data for the project.

FED FLEXIBLE ENERGY DENMARK

Innovation Fund Denmark