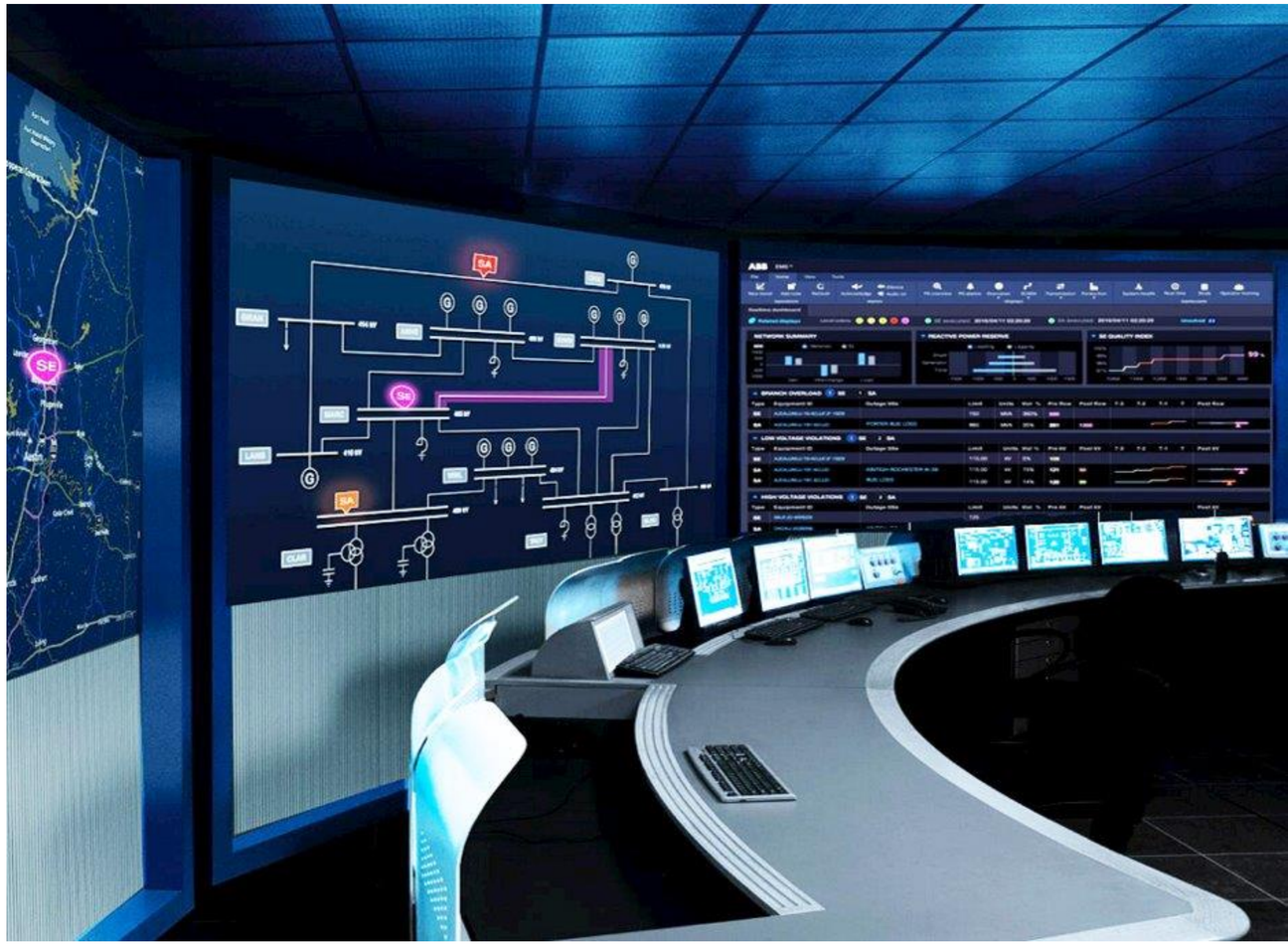
AI-assisted decision support for operational planning in distribution systems

AISOP

https://aisopproject.com



AI4Grids Symposium
HTWG Konstanz

29. September 2023

FH Zentralschweiz

Funding Partners

Smart Energy Systems ERA-Net

This initiative has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements no. 646039, no. 775970 and no. 883973.

Das AISOP Konsortium

Research partners

HSLU DEEP

TU Dortmund ZEDO

ETHZ FEN

Living Labs

CELL – COLLABORATIVE ENERGY LIVING LAB

NEED OWNERS

Romande Energie

Westfalen-Weser Netz

ASEW

Digital Platform Providers

logarithmo

HIVE POWER

Demo sites

Rolle, Chapelle-sur Mouton

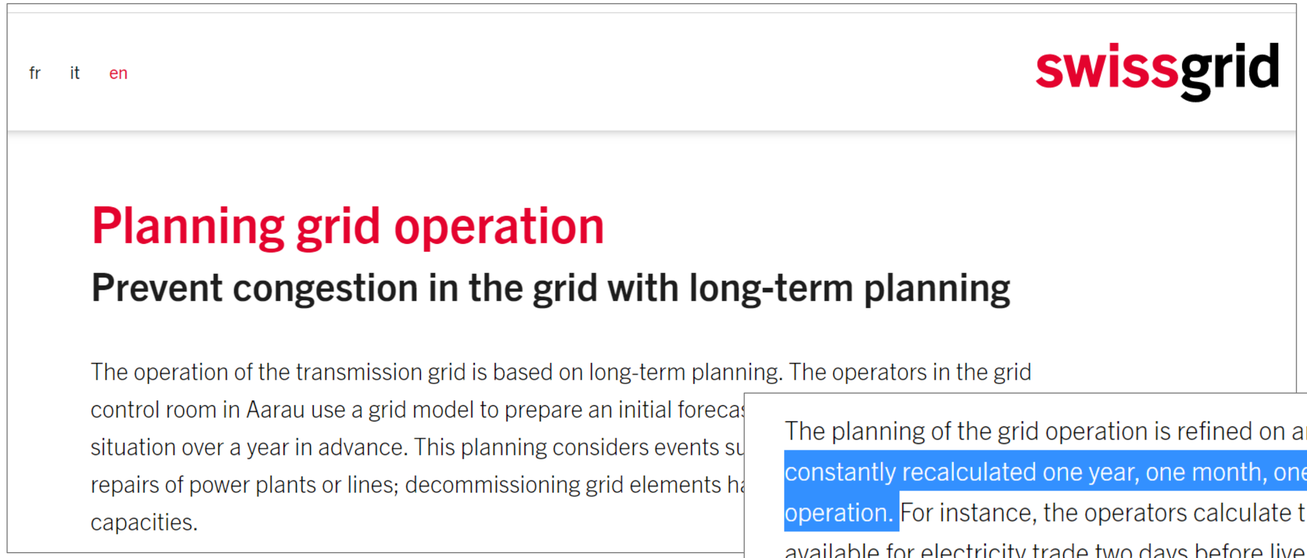
Westfalen-Weser Netz

Observers

LKW

Elia Grid International

Was heisst Betriebsplanung im Übertragungsnetz?



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swissgrid

Planning grid operation

Prevent congestion in the grid with long-term planning

The operation of the transmission grid is based on long-term planning. The operators in the grid control room in Aarau use a grid model to prepare an initial forecas situation over a year in advance. This planning considers events su repairs of power plants or lines; decommissioning grid elements ha capacities.

The planning of the grid operation is refined on an ongoing basis: the expected grid situation is constantly recalculated one year, one month, one week, two days and one day before real-time operation. For instance, the operators calculate the cross-border capacity that can be made available for electricity trade two days before live operation. One day before, the operators update their planning based on the schedules provided by power plants and electricity traders, which contain both domestic and international electricity trading transactions. The grid control room works together with the grid operators in neighbouring countries to check whether the grid and the international interconnection lines can transmit the produced and traded volume of energy, where congestion exists, and the action that needs to be taken.

Motivation

- ❖ Smart Meter Roll-out
- ❖ Neue Datenquellen
- ❖ Veränderungen oft und näher zu real-time
- ❖ Automatisierung in Betrieb

AISOP zielt darauf ab, ein **KI-gestütztes Entscheidungsunterstützungssystem für Verteilnetzbetreiber (DSO)** zu schaffen, um den Prozess der Betriebsplanung zu begleiten.

AISOP	Operational planning for active distribution systems
Outcomes	Curative or proactive congestion management Day-ahead (or x-hour-ahead) preparation for probable events – based on forecasts: weather, solar generation Feeder reconfiguration: emulating (n-1) redundancy Voltage management (distributed or decentralised) Online security assessment
Value	Investment deferral Fault location isolation and system restoration Identification and forecasting new loads (i.e., HP, EV charging) and solar generation Coordinating, designing (or helping to design) market or tariff mechanisms Providing services (e.g., Redispatch 2.0 in Germany: DSO contributing to redispatch) Coordination of utilization of resources in distribution Component monitoring and predictive maintenance Sustaining scarcity / autarky
Tasks	Assimilating data from smart meters and grid sensors Managing information security Assessment of available flexibility and load flexibility controls: ripple control, load shifting Assessment of network configuration changes (switches, tap changer-equipped substation) DSO-DSO-TSO interactions
www.aisopproject.com	

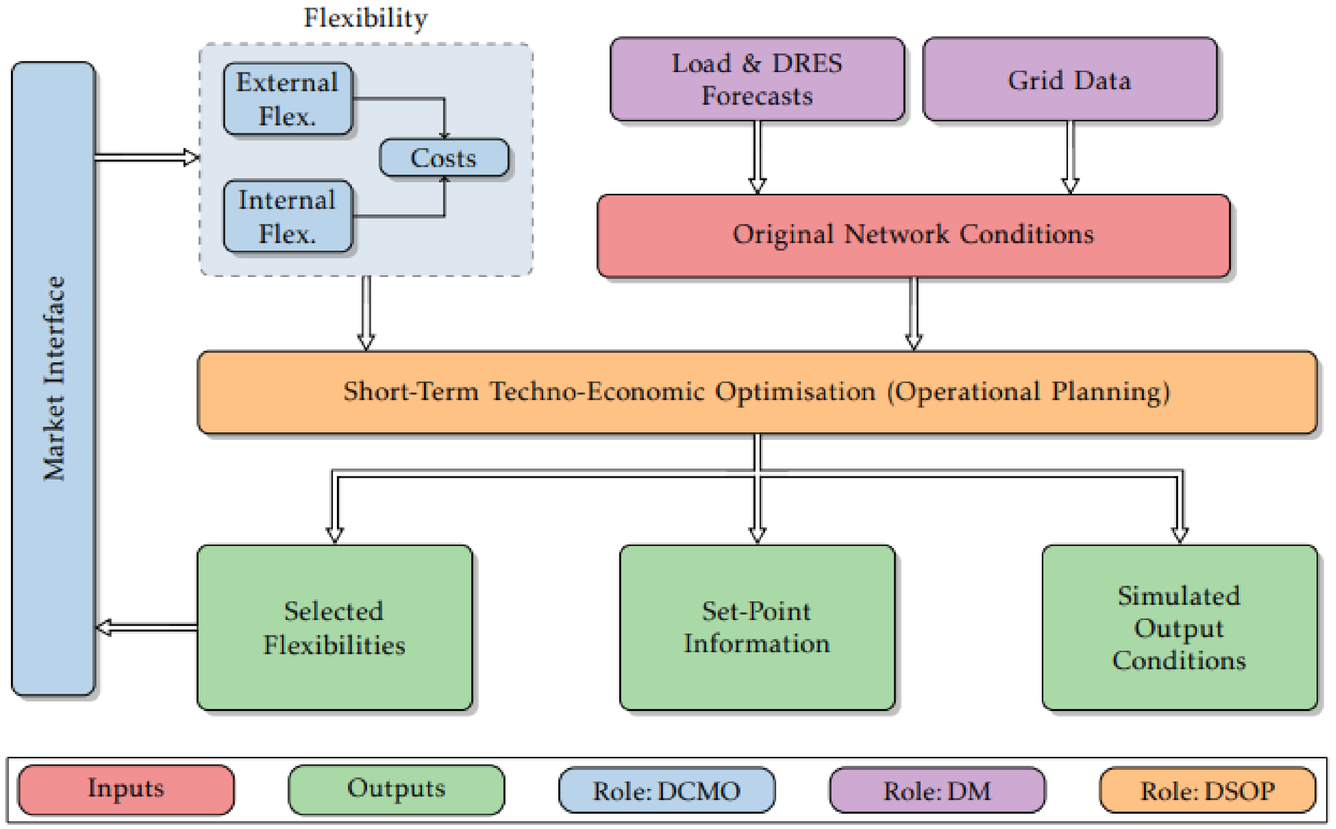
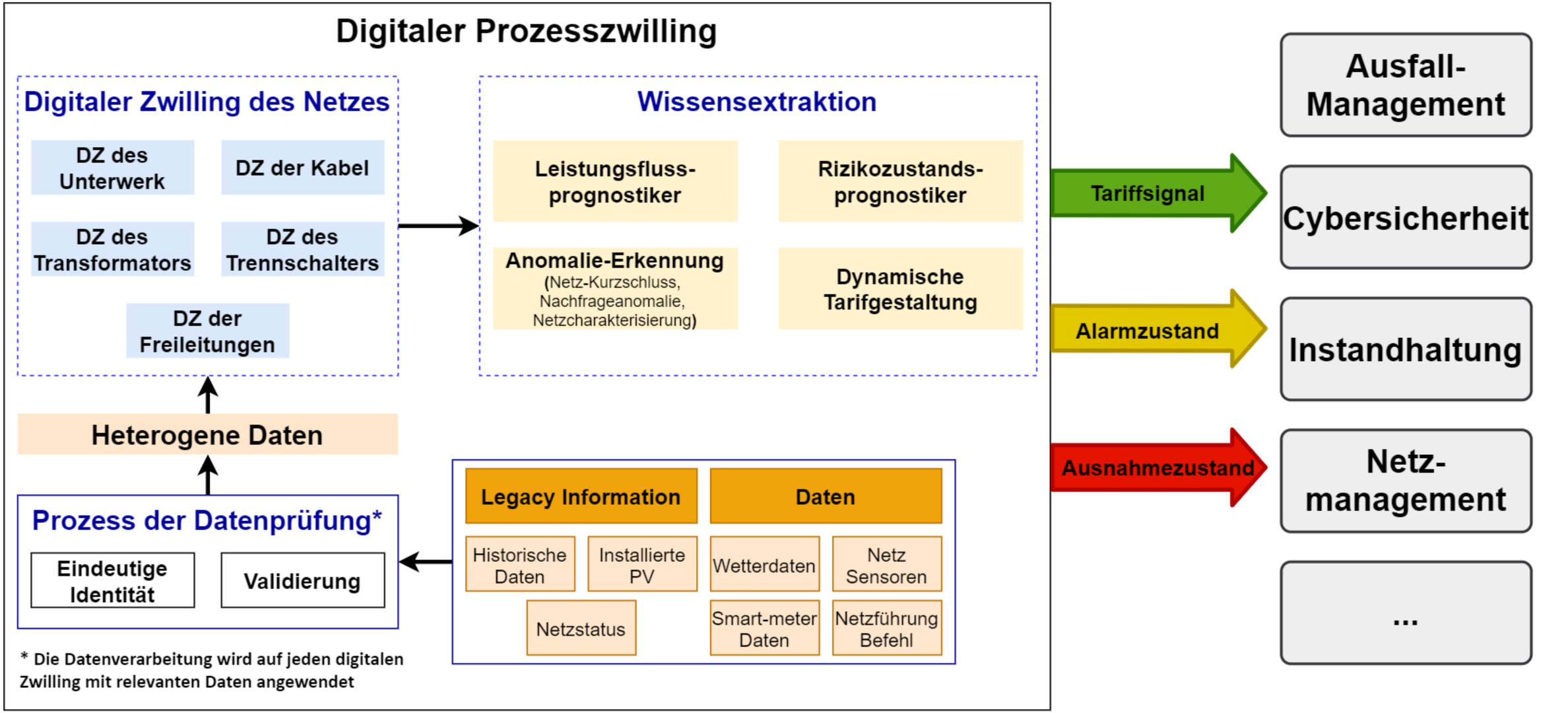


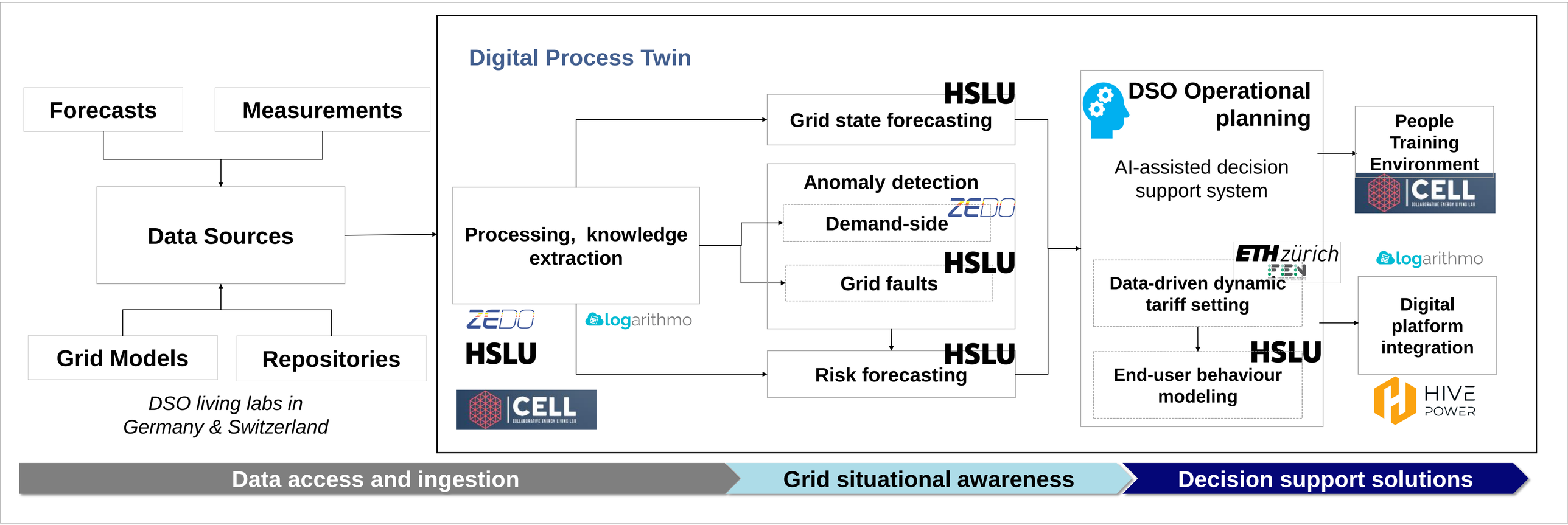
Figure 2.19: Typical Framework for Operational Planning in ADN

https://tel.archives-ouvertes.fr/tel-01690509/document

Digitaler Zwilling in der Netz- und Elektrizitätswirtschaft*

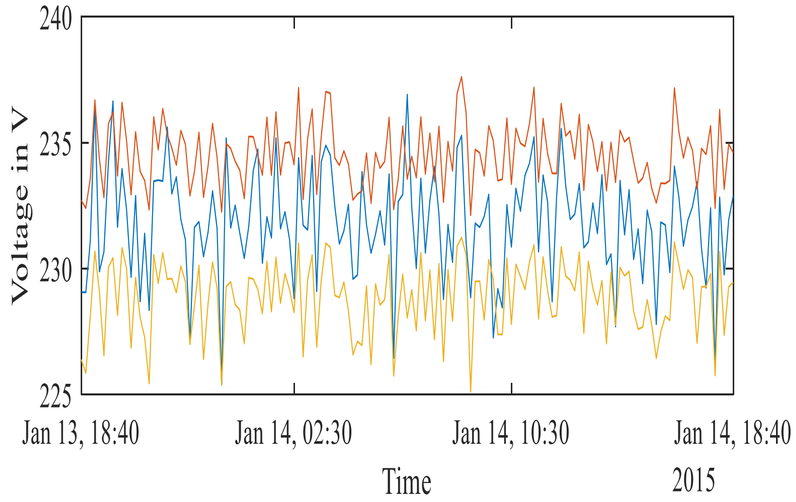


Ansatz AISOP

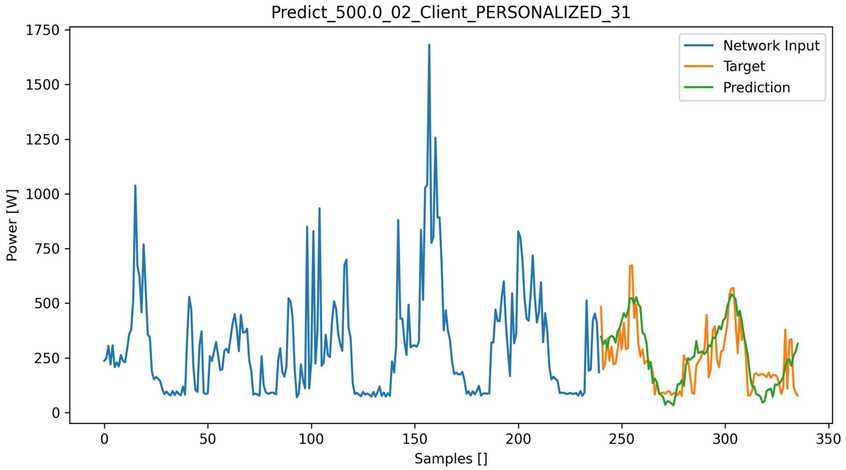


Laufende Arbeiten

Spannungsprognose



Lastprognose



F. Widmer, S. Nowak, B. Bowler, P. Huber, A. Papaemmanouil, **Data-driven comparison of federated learning and model personalization for electric load forecasting**, Energy and AI, Volume 14, Elsevier, 2023

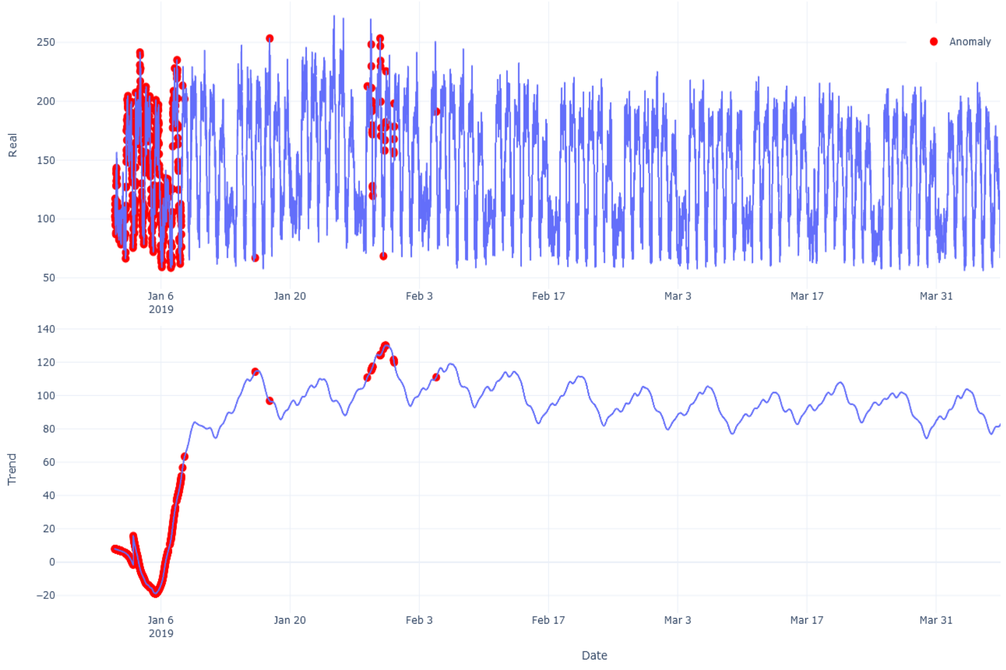
Fehlererkennung

Model	Fault detection			
	Radial		Mesh	
	Accuracy	Error	Accuracy	Error
Linear regression	0.019	0.16	0.016	0.165
Logistic regression	0.788	0.21	0.788	0.212
Multilayer perceptron	0.827	0.17	0.867	0.133
Naive bayes	0.812	0.19	0.823	0.177
Decision-tree	0.901	0.10	0.921	0.079
k-nearest neighbors	0.944	0.06	0.939	0.061
Random forest	0.825	0.18	0.844	0.157
Gradient boosting	0.947	0.05	0.949	0.051

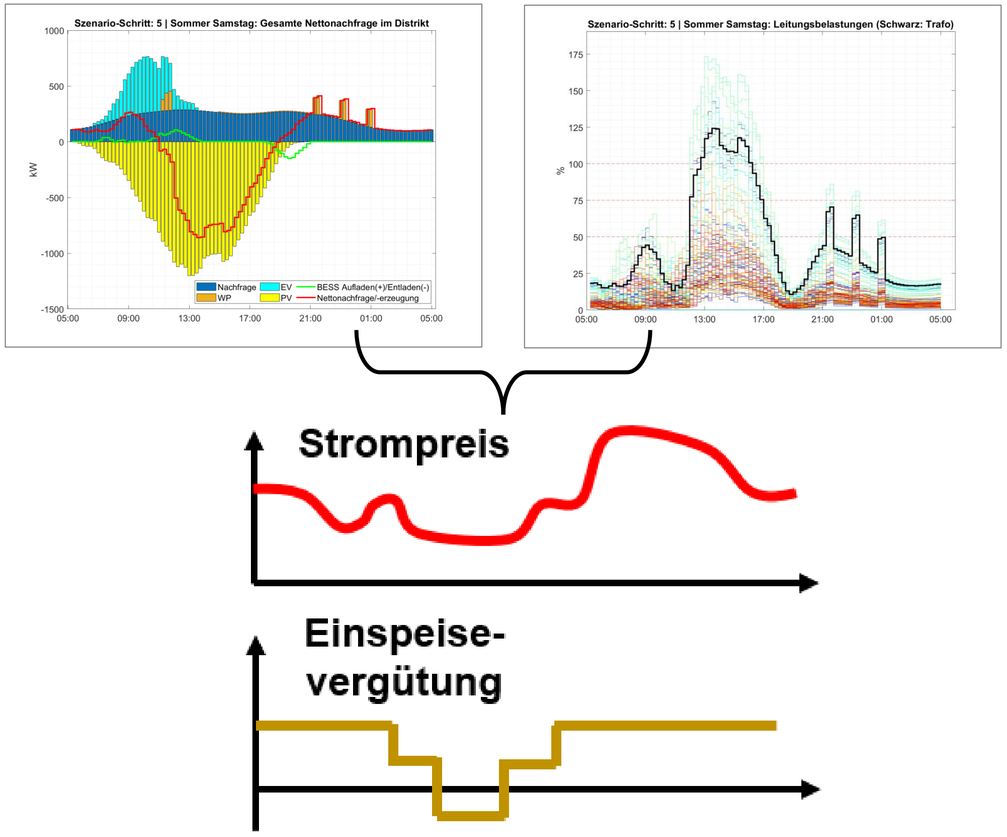
* M. Hojabri, S. Nowak, A. Papaemmanouil, "**ML-Based Intermittent Fault Detection, Classification, and Branch Identification in a Distribution Network**", MDPI Energies, 2023

Laufende Arbeiten

Anomalienerkennung

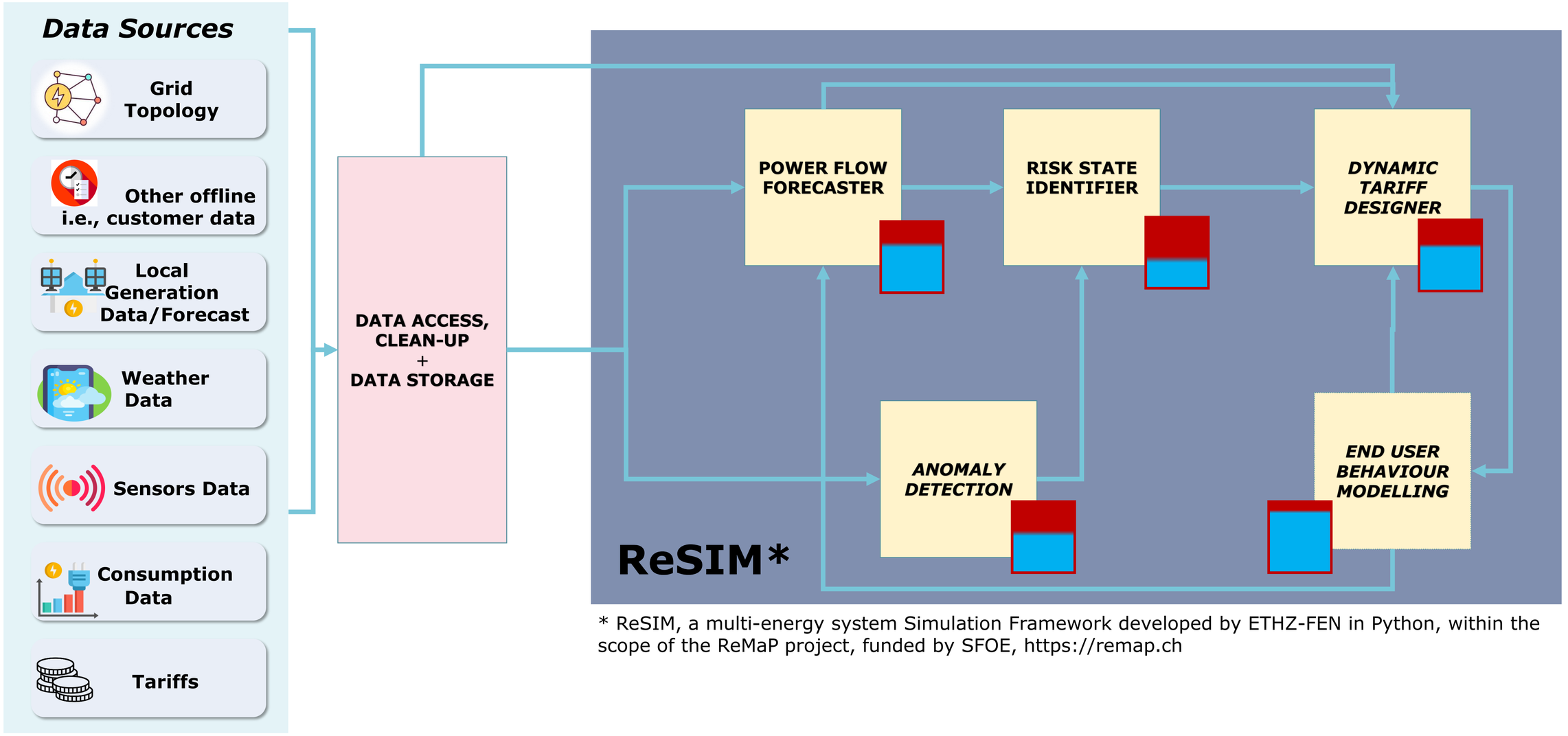


Dynamischer Tarif



Wie geht es weiter?

Progress



* ReSIM, a multi-energy system Simulation Framework developed by ETHZ-FEN in Python, within the scope of the ReMaP project, funded by SFOE, https://remap.ch

Vision: Open Source Plattform

Chancen und Opportunitäten

- Steigerung der Netztransparenz/Beobachtbarkeit
- Ermöglichung einer hohen Durchdringung von dezentrale Energieerzeugungsanlage (DEA)
- Reduzierung der Energiekosten (durch faire Preisgestaltung) durch Vermeidung von Investitionen in die Infrastruktur
- Erhöhter Zugang von Prosumern zum Energiemarkt sowie Kapitalisierung von DEA-Investitionen
- Stärkung der Kundenbefähigung
- Erhöhte Unabhängigkeit der Gesellschaft von importierten Energiequellen

HSLU Hochschule Luzern

Vielen Dank für die Aufmerksamkeit!

AISOP

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