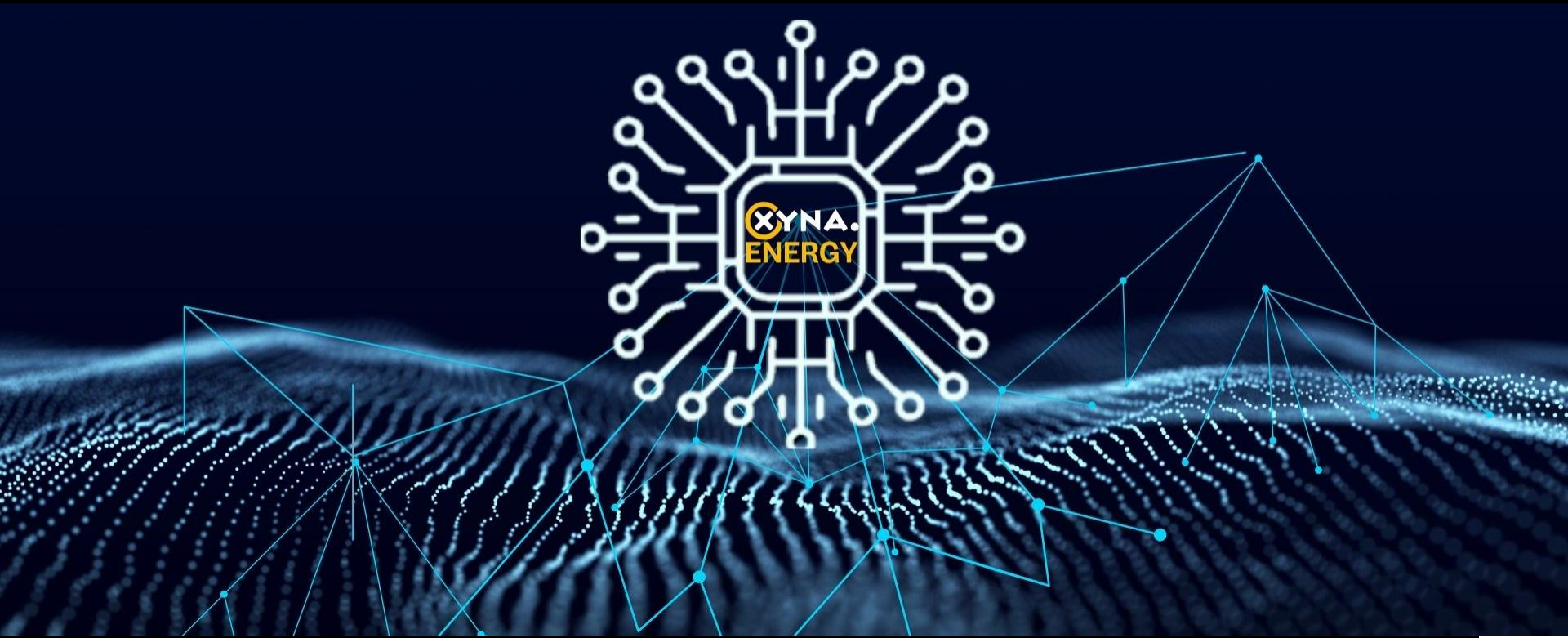
XYNA.ENERGY

AI-DRIVEN POWER PURCHASE HEDGING & POWER ROUTING



XYNA.ENERGY IN A NUTSHELL

- **Rising electricity demand** due to energy transition & climate change (expansion of air conditioning systems)
- **Increased volatility** - going green in electricity production & private PVA
- **Increased microclimatic influences** due to climate change e.g. urban temperature („*Höllentaleffekt*“)
- **Increased load on the distribution grid** - increasing power flows due to the expansion of heat pumps & wallboxes
- **Cost optimization and security of supply** - accurate generation & load forecasts required at the distribution level for residential buildings as well as for industry

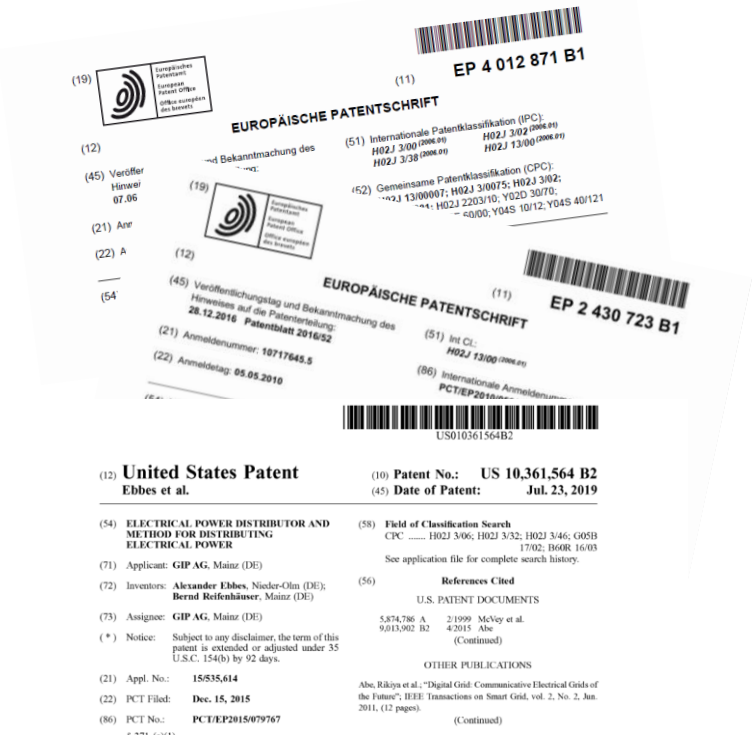
xyna.energy offers more accurate determination of electricity demand & grid capacity based on local generation, load, storage and capacity forecasts, taking into account the microclimate

➔ Optimization of electricity purchasing and hedging

➔ Smart City Demand Site Management to minimize §14a interventions

OUR XYNA.ENERGY BASIS

Quantum Grid 4.0 patents for an electricity grid like the Internet



(19) Europäisches Patentamt / European Patent Office / Office européen des brevets

(11) EP 4 012 871 B1

EUROPÄISCHE PATENTSCHRIFT

(12) ... Bekanntmachung des ...

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(12) **United States Patent**
Ebbes et al.

(10) **Patent No.: US 10,361,564 B2**
(45) **Date of Patent: Jul. 23, 2019**

(54) **ELECTRICAL POWER DISTRIBUTOR AND METHOD FOR DISTRIBUTING ELECTRICAL POWER**

(71) Applicant: **GIP AG**, Mainz (DE)

(72) Inventors: **Alexander Ebbes**, Nieder-Olm (DE); **Bernd Reifenhäuser**, Mainz (DE)

(73) Assignee: **GIP AG**, Mainz (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 92 days.

(21) Appl. No.: **15/535,614**

(22) PCT Filed: **Dec. 15, 2015**

(86) PCT No.: **PCT/EP2015/079767**

(58) **Field of Classification Search**
CPC H02J 3/06; H02J 3/32; H02J 3/46; G05B 17/02; B60R 16/03
See application file for complete search history.

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(Continued)

For details see appendix: DEEP DIVE QUANTUM GRID 4.0

Long-standing partnerships with leading Tier-1 providers

"GIP Exyr GmbH provides competence and expertise at the demanding interface between network engineering, automation and software/IT.

Together, we are shaping the future of network automation at Vodafone - in line with our credo: Growing Together."

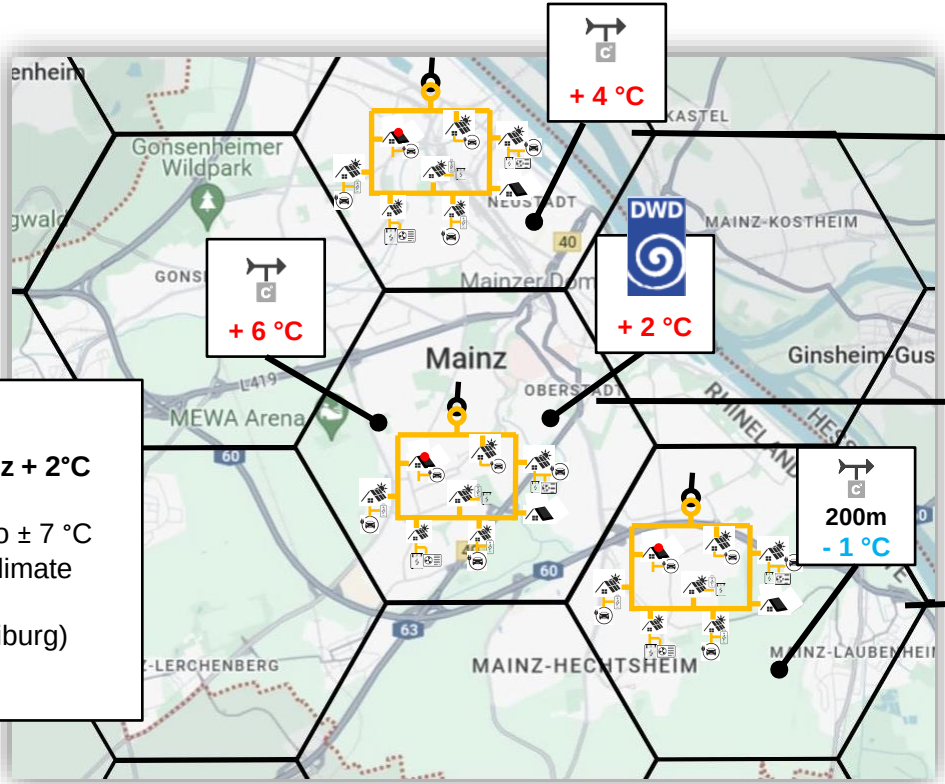
Steffen Krippner
Head of OSS Fulfilment
Vodafone GmbH

Core competencies

- In-depth network expertise for sophisticated provider networks
- Xyna - our own software solution for hyperautomation (www.xyna.com)
- XYNA.AI - our AI platform & pipeline with which, in addition to the models from OpenAI & Google, other cudtom open source Large Language Models (LLM) can be operated
- Novel multimodal neuro-symbolic AI approach to validate the errors of LLM
- Know-how power grids of the future https://www.gip.com/future-energy/

FORECAST INFLUENCES - MICROCLIMATE

LOCAL WEATHER PHENOMENA & URBAN MICROCLIMATE INFLUENCE ENERGY FORECASTS



DWD forecast for Mainz + 2°C

Urban deviations of up to ± 7 °C possible due to microclimate

- *Höllentaleffekt* (Freiburg)

Riverside
Heat storage capacity of water masses

City center
Low vegetation, population density, traffic

Altitude
200m above sea level

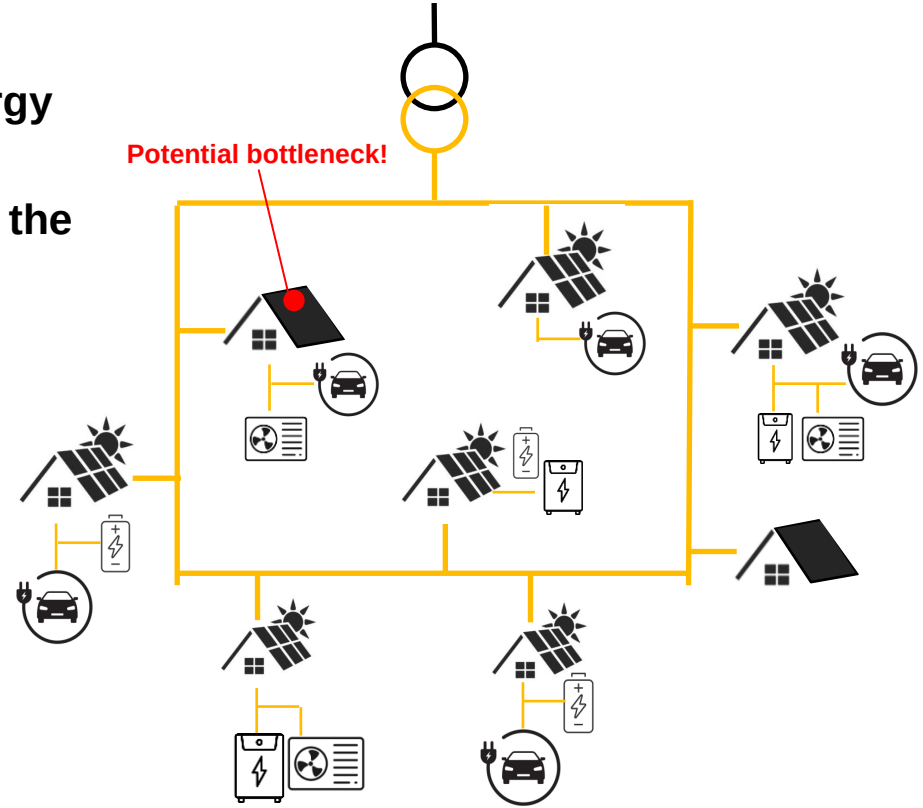
XYNA.ENERGY: AI-ENABLED CYBER-PHYSICAL DIGITAL TWIN

The neuro-symbolic XYNA.AI of **xyna.energy** knows & adapts:

generation, storage & load models to map the physical behavior

Mapping the generation and load behavior under the influence of the microclimate, in particular the local temperature at the location of the building, as well as the capacity of the distribution grid and the residual capacity available to the location.

Here, existing data and systems are utilized.



XYNA.ENERGY: INSPIRED BY OUR PATENTS TO CREATE A POWER GRID LIKE THE INTERNET

Digitization of demand & generation through energy packages consisting of integer elementary energy packages

- Simplified forecasts and reduced calculation effort
- Simplified purchasing, schedules and control

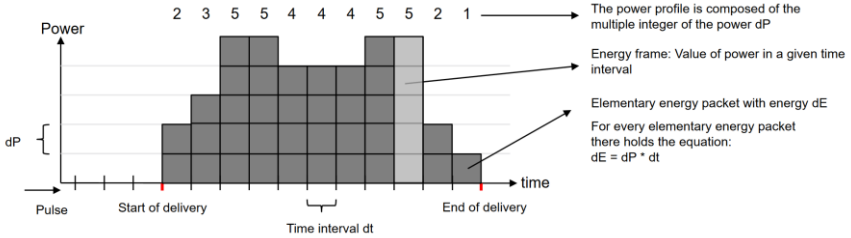
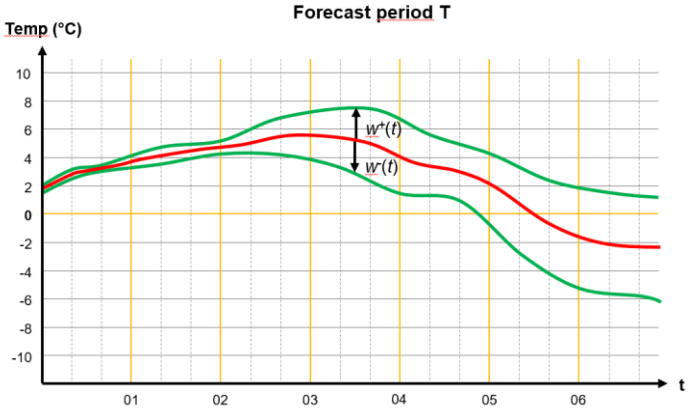


Fig. 3 Power profile: Quantization of power and time that gives rise to the energy packet

Ensemble weather forecasts for volatility forecasts

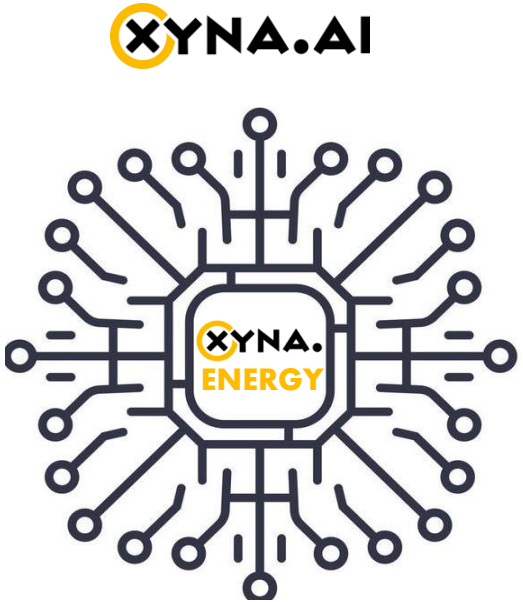
- Basis for hedging
- Risk assessment of overload points in the distribution grid



XYNA.ENERGY: FORECASTS & DECISION SUPPORT FOR TRADING & §14A POWER ROUTING

XYNA.AI INSIDE - AN EU DATA ACT COMPLIANT AI FOR CRITICAL INFRASTRUCTURE

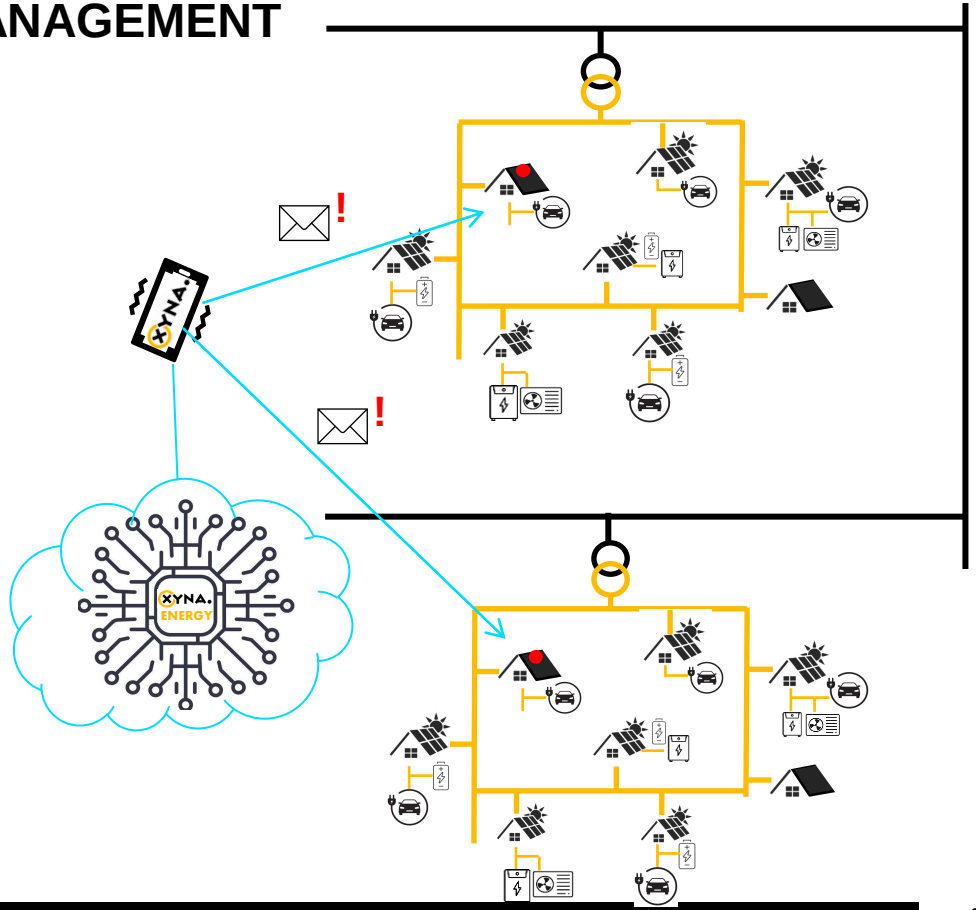
- The multimodal neuro-symbolic xyna.ai creates generation, load and volatility forecasts in accordance with the EU-AI Act.
- These forecasts
  - determine the net energy packages for the location that must be made available for the forecast period
  - are carried out as a sequence in a recurring order at fixed intervals so that the forecast accuracy increases
- The forecast sequence provides the data on which energy packages are relevant for buy and sell decisions, as well as data for hedging trading options on the spot market in Paris or on the long-term trading market in Leipzig
- Power routing (§14a): based on cyber-physical twins and forecasts, critical locations are determined, that can create critical grid situations.



XYNA.ENERGY §14A POWER ROUTING & SMART BUILDING DEMAND SITE MANAGEMENT

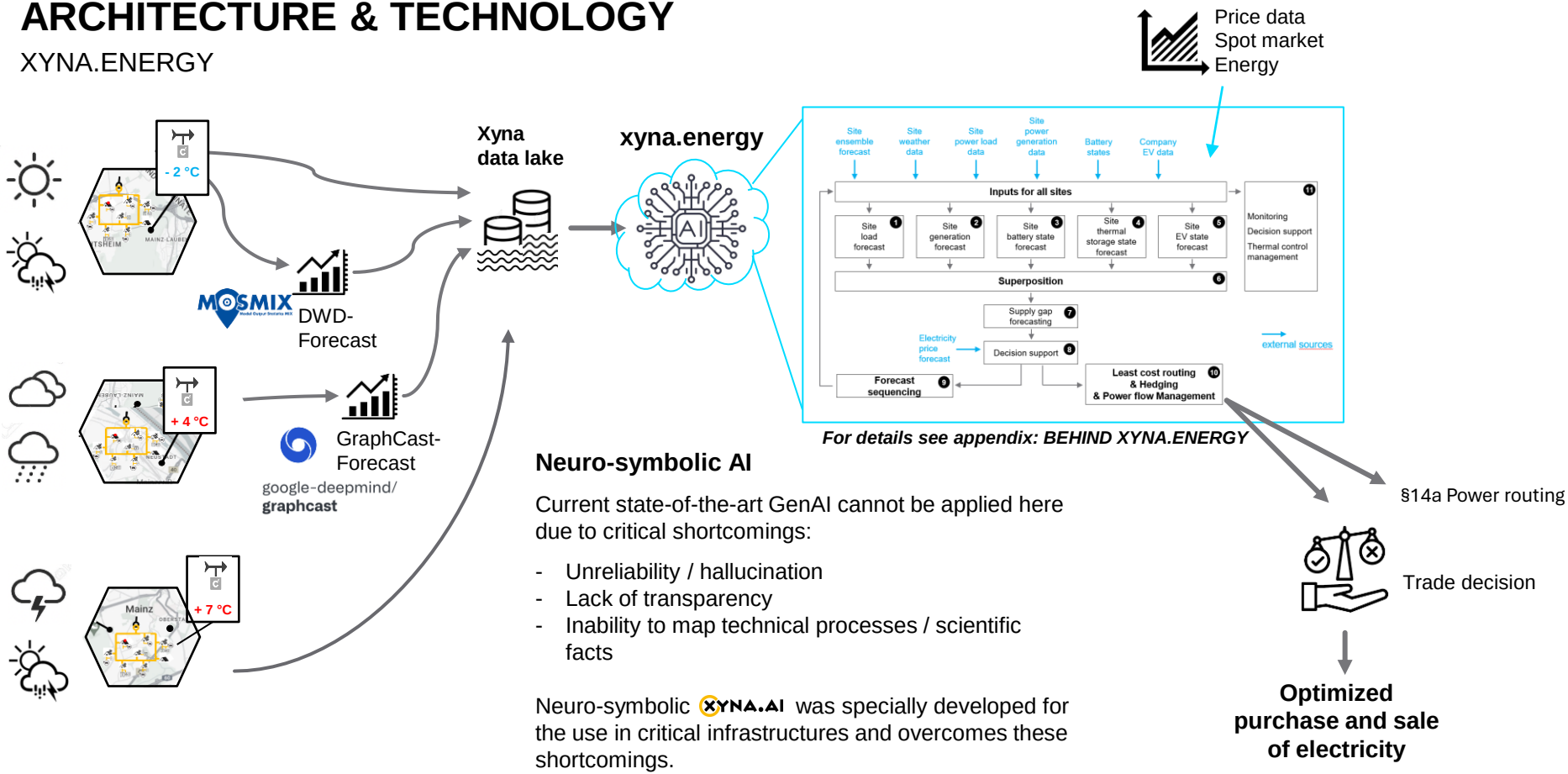
xyna.energy …

- provides the power to be transmitted via the corresponding access network based on the net demand forecast of smart buildings
- creates status forecasts for distribution grid sections using data from the digital twin or by obtaining data on the available / freely available transmission capacity in the grid section from third-party systems
- identifies smart buildings whose demand leads to a potential "bottleneck" and thus a risk to grid stability
- proposes power reduction measures for the potential smart buildings, such as postponing the charging time of the electric car or reducing the room temperature to avoid the §14a intervention
- creates a power routing schedule for the event that §14a has to be applied



ARCHITECTURE & TECHNOLOGY

XYNA.ENERGY



For details see appendix: BEHIND XYNA.ENERGY

Neuro-symbolic AI

Current state-of-the-art GenAI cannot be applied here due to critical shortcomings:

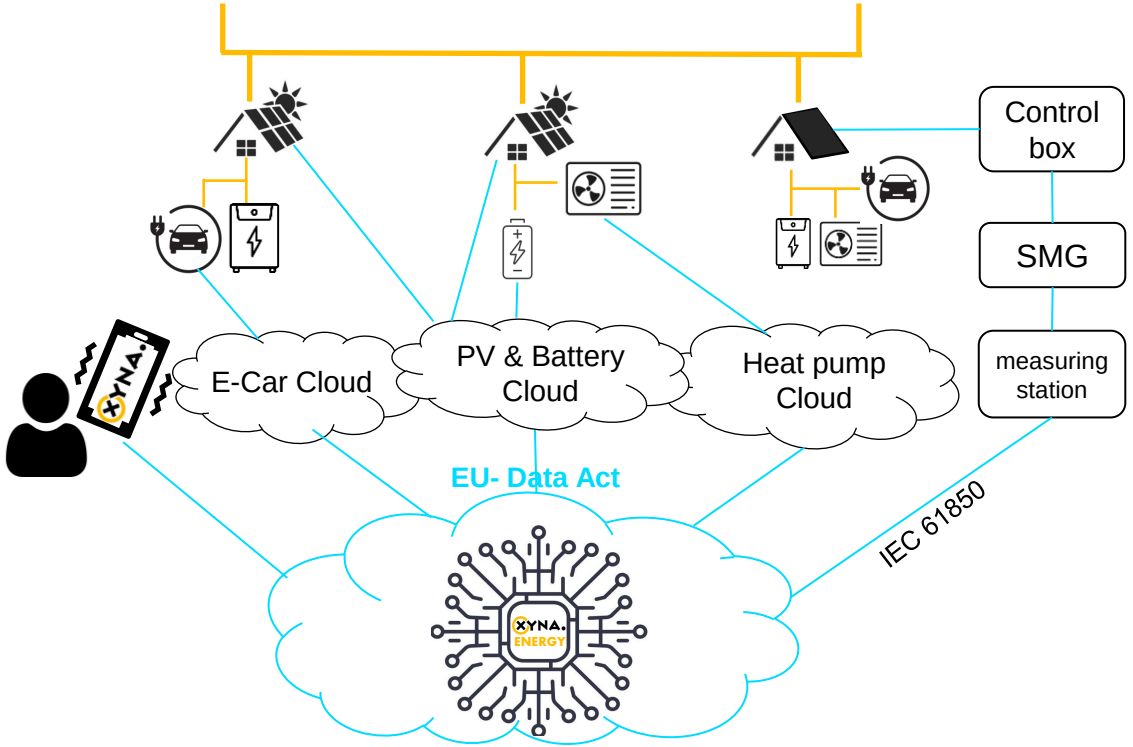
- Unreliability / hallucination
- Lack of transparency
- Inability to map technical processes / scientific facts

Neuro-symbolic XYNA.AI was specially developed for the use in critical infrastructures and overcomes these shortcomings.

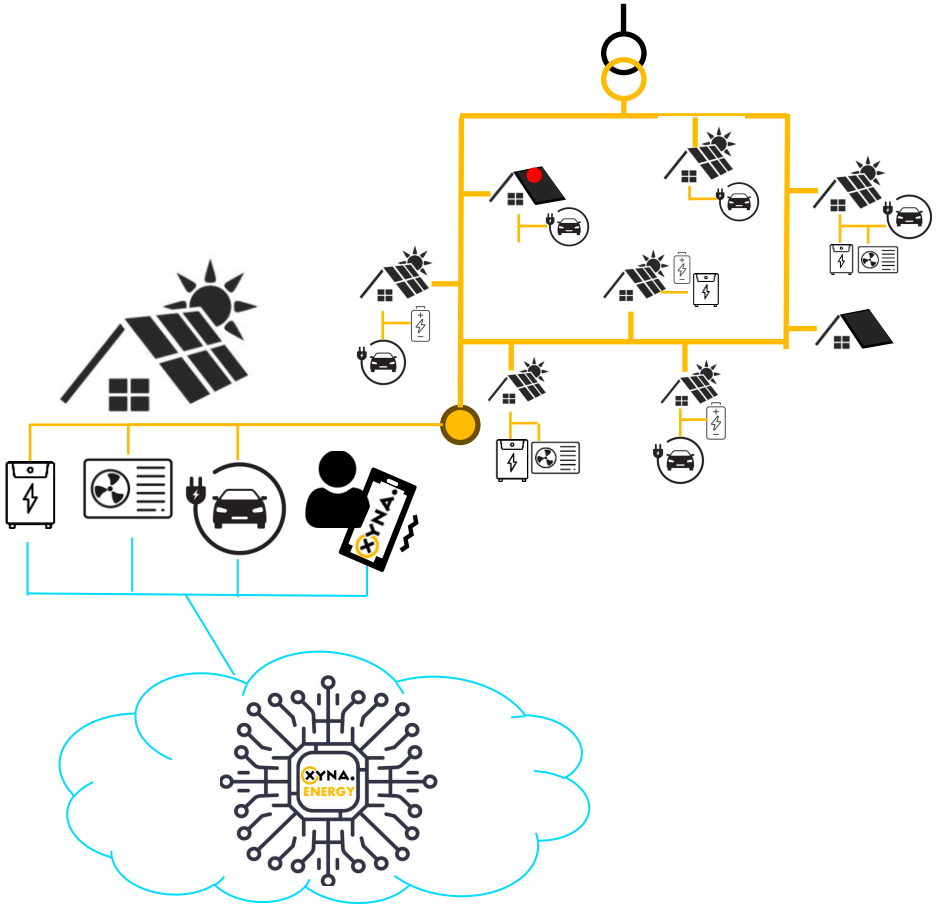
XYNA.ENERGY: AI NEEDS DATA

DATA ACQUISITION

- Construction of **urban weather stations**, primarily temperature sensors to record microclimatic deviations from DWD data
- **EU-Data-Act**
- **Metering point operators** via smart meter gateway & FNN control box
- **Xyna.energy App**:
- Industry: Expansion of energy management through dedicated energy measurement, AI analyses & forecasts for production plan-dependent loads



XYNA.ENERGY @ SMART HOME



EU Data Act enables access to the most comprehensive measured values from September 2025, including:

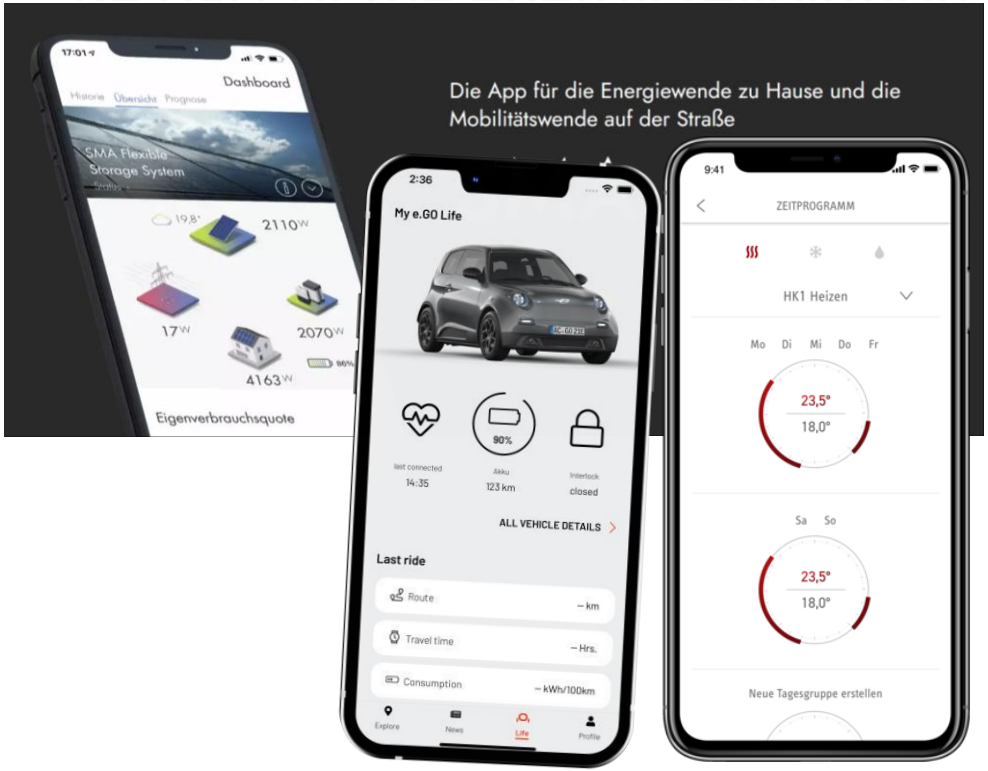
- PV generation capacity
- Storage status of the stationary storage system
- Heat pump power consumption
- Temperature & flow rate of hot water storage tank
- Balcony power plant
- Outdoor temperature to control the heat pump
- Electric Car
    - Battery charge status
    - Outdoor temperature
    - Load for battery temperature control
    - Load car
    - Charging current
    - Location coordinates
    - Battery & drive status data
    - Data from an air conditioning system for cooling, if applicable

Selfprofiling via xyna.energy App (Photo, Speech, Text)

SELFPROFILING VIA XYNA.ENERGY APP: STARTS NOW

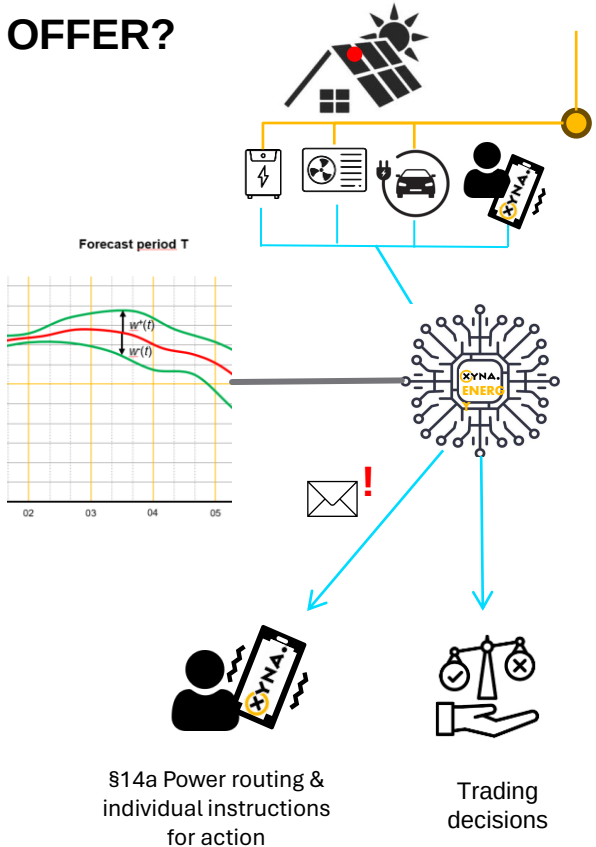
USERS COLLECT DATA INDEPENDENTLY

Be part of the energy revolution.

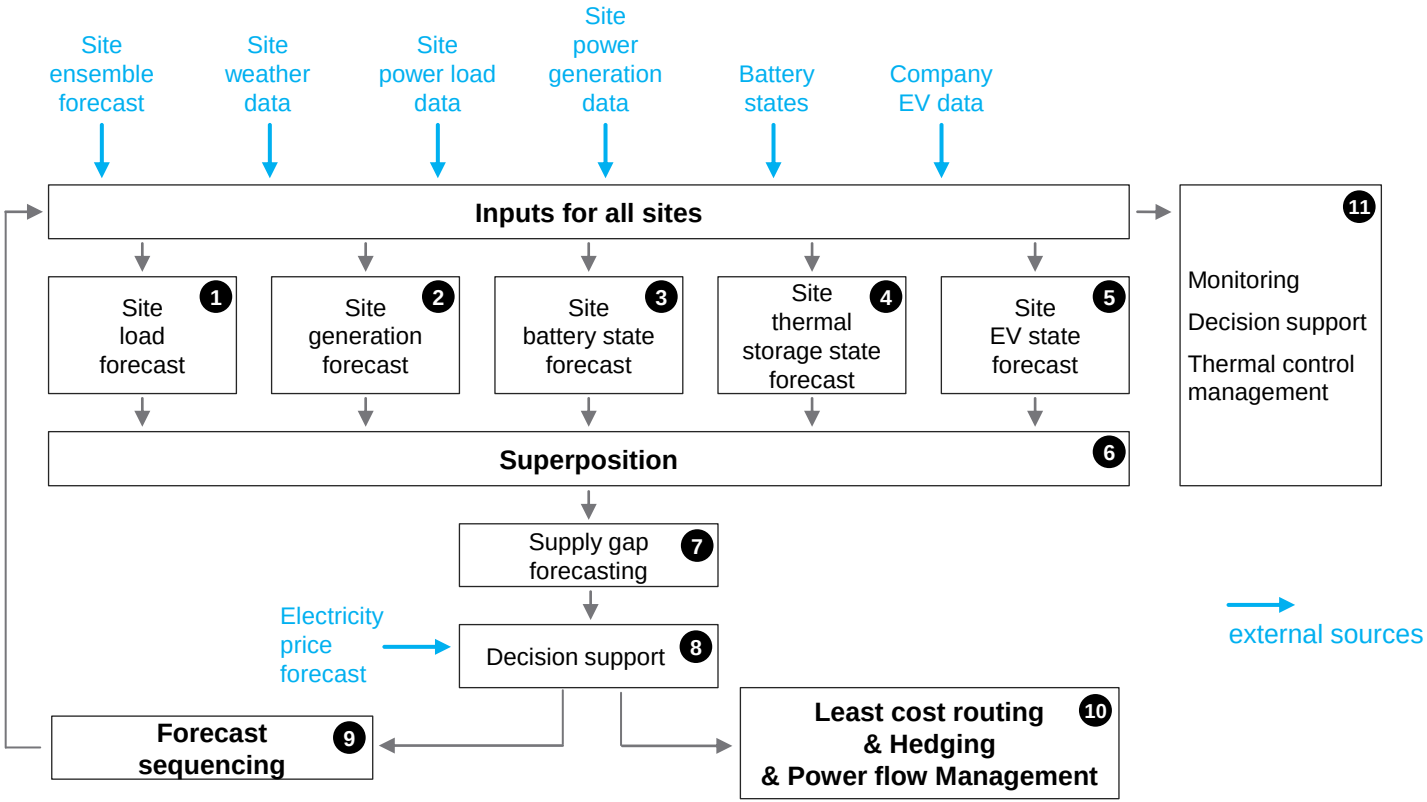


CONCLUSION: WHAT ADVANTAGES DOES XYNA.ENERGY OFFER?

- **More accurate forecasts** by taking microclimatic influences into account
  - *In winter, these can amount to deviations of up to 50% in electricity requirements for heat pumps*
- **Reduced incorrect purchases** thanks to the location-accurate forecast of buildings and prosumers, leading to more accurate forecasts of the total amount of electricity to be purchased
- **Optimized trading & hedging through volatility management**: In ensemble weather forecasts, the building at the location x , the required energy packages $E_{nom}(x,T)$ for the considered periods, and the associated volatility packages, $[\![E]\!]$^+ (x,T) are determined for a fluctuation-related increase and decrease in demand E^- (x,T).
  - *The total amount of electricity that needs to be purchased on the exchange, for example, and the volatility packages as a hedging basis are derived from this. Depending on the prices and price forecasts on the exchanges, this enables optimized purchasing and hedging*
- **§14a: Minimization of intervention points and times:** Advance information of possible affected entities with instructions for action serves to avoid an intervention, reduces the effort of complaint management and leads to higher customer satisfaction.

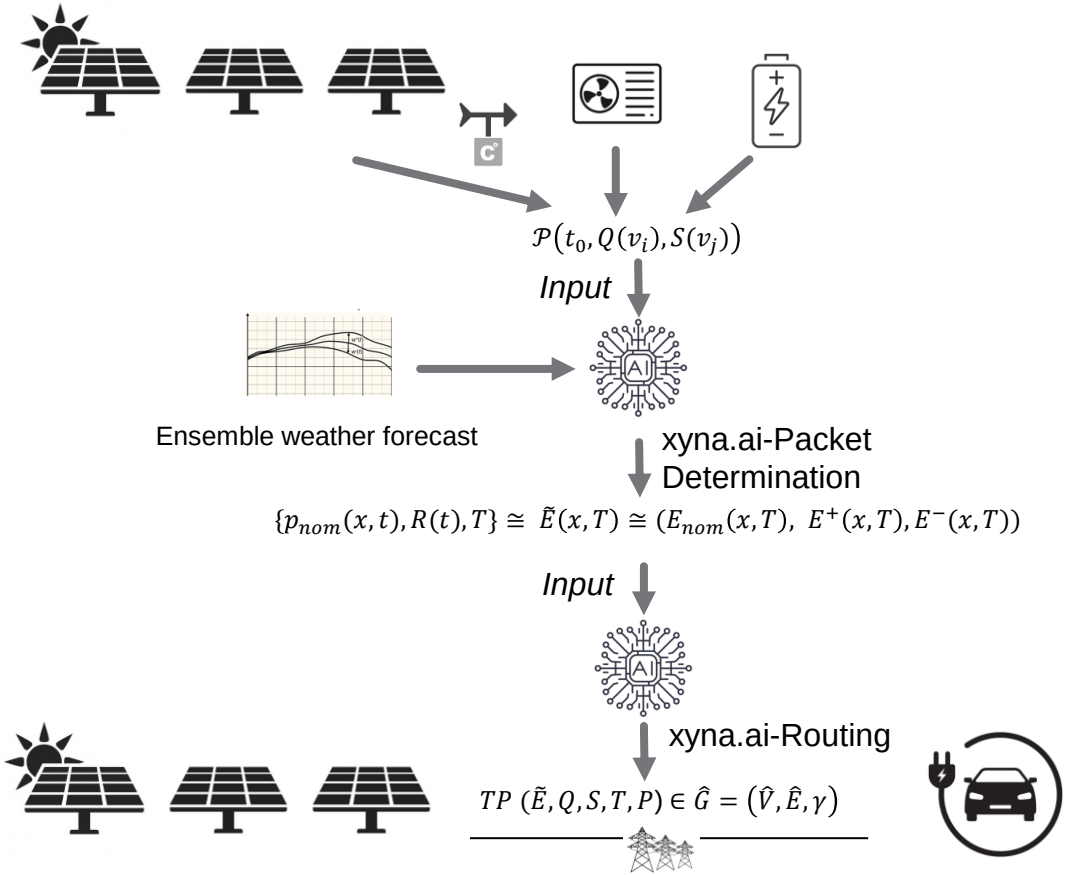


APPENDIX: BEHIND XYNA.ENERGY



More: https://www.gip.com/media/xynaenergy_paper_2024.pdf, page 3-4

APPENDIX: DEEP DIVE QUANTUM GRID 4.0



- An equivalence class $\{p_{nom}(x,t), R(t), T\}$ with the assigned data packet determines an ensemble energy packet $\tilde{E}(x,t)$. The following applies $\tilde{E}(x,T) \cong (E_{nom}(x,T),\ E^+(x,T), E^-(x,T))$
- The power grid under consideration with its generators, consumers and storage units is described by the graph $\hat{G} = (\hat{V}, \hat{E}, \gamma)$, $e(v_i, v_j) \in \hat{V}$ Edge between the vertices $v_i, v_j \in \hat{V}$
- The transmission of an energy packet $\tilde{E}(v_i)$ from the generator $Q(v_i)$ to the consumer $S(v_j)$ takes place via a transport path previously determined by the xyna.ai routing via the transport path $TP\ (\tilde{E}, Q, S, T, P)$ as a subgraph of $\hat{G}$
- $\mathcal{P}(t_0, Q(v_i), S(v_j))$ are the measured values of the perimeter network for all considered sources $Q(v_i)$ and sinks $S(v_j)$. Xyna.ai determines the ensemble packages of the generators $Q(v_i)$ and consumers $S(v_j)$. Autonomous & self-organized, xyna.ai routing determines the sources required to optimally cover the demand of a consumer and the optimal transport graph for power transmission through the energy packages.