QUANTUM GRID
a grid like the internet

thinking beyond computing

Our solution

for the challenges of 100% green energy:

Quantum Grid

Green energy is **renewable**.

Renewable energy is **volatile** and **decentralized**.

And thereby **unreliable**.

Climate-neutral energy generation of the future will consist of distributed renewable generation from wind, tidal, hydro, solar, new forms of deterministic power plants, and future generation facilities based on synthetic biology technologies.

- Future climate-neutral energy generation will be highly volatile
- All exploitable potentials of generation have to be exploited
- The requirements for dynamics and flexibility in power transmission will be additionally increased by growing electrification, replacement of fossil fuels, decentralization of production, electromobility, and changed consumption behavior
- The challenges of bridging the gap between demand and generation will increase
- Blackout prevention is becoming increasingly important

Only one technology has ever solved these problems.

Quantum Grid is a power grid like the **internet**.

It offers **reliability** for volatile and distributed energy.

Only one technology has ever coped with a comparable challenge of reliability and decentralization: the internet. Billons of devices, connected by wireline and wireless links. Spanning the whole planet. Each of them unreliable in itself. But offering a reliable service of the only other resource, comparable in its relevance to electrical power: information.

- This is possible because of the unique architecture of the internet
- Xyna Factory is an automation platform that builds the internet and accesses to it for leading carriers since more than a decade
- Quantum Grid carries the DNA of the internet and its unique architecture: packet-based power transmission and distribution
- The Quantum Grid is backed-up by patents worldwide
- It has a pole position in the new eco system of smart energy similar to the internet eco system

Quantum Grid (QG): In a nutshell

Packet-based and software-defined power transmission for a flexible & resilient

Climate Neutral Energy Supply

- Paradigm shift: from power on demand to **power on order**

- **QG** is a hybrid of a transmission & communication network

- Packets are defined by the time course of the electric power, called power flow, to be transmitted via a software-defined route for a fixed transmission period

- The software builds a **QG** Routing Plane that is decentralized, self-organized and automatic

- To transmit the packets, the Routing Plane controls the **Quantum Flow Controller (QFC)** nodes of the grid, formed by Inverters & Double Active Bridges (DAB)

- These **QFC** nodes shape the packets on the transmission path by controlling the physical power flow

Quantum Grid: Advantages Part I

<u>Far Beyond Smart Grid</u>
Offering a flexibility and resilience that by far exceeds the possibilities of the smart grid, which is limited by the physics of the classical grid due to the centralized and rigid controlling of the power transmission only through the grid frequency.

- <u>A Grid like the Internet</u>
  Decentralized, autonomous, automated, self-organized, flexible and resilient (Blackout Prevention) with integration of forecasts for production, demand and storage capacities

- <u>Backbone for Future Energy Supply</u>
  Integrating gas networks and electrical grids enabling medium- and long-term bridging of power gaps as well as the compensation of the decrease of rotating masses for grid stabilization

- <u>Innovative Energy Storage</u>
  Highly dynamical flexible hybrid energy storage solutions driven by **QG** technologies

Quantum Grid: Advantages Part II

- <u>Utilization & Optimization</u>
  - overproduction capacities
  - power to gas
  - transmission capacities

- <u>Enabling new potentials</u>
  of next generation Power Electronics, Inverter, Double Active Bridge Technologies
  and DC- & hybrid DC/AC Grids

- <u>Packet approach better than Smart Grid</u>
  - Software is less complex,
  - offers increased cyber-attack prevention through decentralization
  - enables AI perfectly because of digital nature of QG

- <u>New data & AI-driven business models</u>
  by the packet-based power on order technology

Quantum Grid: The Time is now to start

Worldwide huge market potential, especially in the USA

- large investments in grid infrastructure
- increase in the share of renewables
- growing electromobility & electrification

- Current developments in Power Electronics (PE), Inverters, Double Active Bridges, DC technologies & Electronic Substations, supporting the establishment of the **QG**

- Current software-defined communication technologies, e.g. 5G radio, which are tightly coupled with the **QG** technology are ready to be used in the **QG**

- Patented **QG** technology enables to integrate packed-based power transmission into in the existing grid

- Actual AI technologies can be used for the **QG**

Quantum Grid: Applications

- **QG** can be built in two ways:
  - green field approach or
  - as an extension to the legacy grid via a Quantum Grid Gateway

- Firewalling the grid against blackout by a QG-based segmentation

- Packet-based virtual power transmission Overlay Network
  - for large companies, especially Hyperscalers and Cloud Data Centers
  - with own remote green power generation, e.g. Offshore Wind Parks, for clean energy supply without local pollution using partial capacities of HVDC-Links

- Future batteries by **QG Cross Bar** technology enabling highly dynamical, flexible and long-lasting electrical storages with individual controlled Li-Cells, combined with Super Caps, ceramic based batteries, ammonia fuel cells to compensate the missing rotation energy of classical fuel driven generators

- Next Generation inhouse distribution of power in plants or campuses by the **QG Cross Bar** technology

More **Quantum Grid** Applications

- The **QG** solves the many problems of large **ships** driven by **ammonia fuel cells**

- **QG Cross Bar** for Vehicle-to-Grid, enabling simultaneous, parallel, flexible & intelligent charging & feeding of electric cars while protecting substations

- AI & data-driven business models enabled by the **QG**´s packet-on-order and the transmission by packets, e.g. for autonomous electric mobility

- Hybrid **QG** with Double Active Bridge technology based **QG** substations connected by e.g. 10 kV DC links forming a **QG** and connected standard analog 0,4 kV AC access lines to connect residential prosumers

- **Quantum Grid out of the Box**: Plug & Play power supply for houses and buildings, island grids which can be federated to area covering grids for rural areas

- And more …

Our offer: Quantum Grid & Thinking beyond Computing

- Know-how: GIP is leading in the upcoming innovation of packet-based power transmission, which is also promoted in Japan, China, the US, and EU

- Know-how: Software-defined networking, software for automation & management of huge data networks

- Patented **QG** technology
  - Quantum Grid: Fundamental EU (EP 2 430 723 B1), US (US 9337655 B2), and China (CN102439812B) patent for packet-based power transmission enabling blackout prevention, flexibility, resiliency and new data driven business models
  - QG Cross Bar: Corner stone US patent (US 10,361,564 B2) for packet-based energy storage, distribution & grid virtualization
  - QG 4.0: Patent pending: New Energy Packet & Routing Concept enabling intelligent and adaptive end to end processing from integrated forecasting to final transmission for advanced Power to X, volatility & Energy Storage Management Solutions

- Advanced software technology for the self-organized and software-defined **QG** with integrated software-defined data networking based on Xyna Technologies

Xyna software is the successful product of GIP Exyr GmbH, a 100% affiliate of GIP, for management of large packet-based data networks used by leading carriers like Deutsche Telekom, Vodafone, and more.

We are looking for cooperations

Inspired by the successful cooperation of BioNTech [Mainz] and Pfizer [US] against the COVID pandemic, we are looking for a cooperation partner for the

- development of **QG** technology into market-ready solutions
- marketing & sales of **Quantum Grid Technologies** based products

More information:

- Quantum Grid: https://www.gip.com/future-energy/
  or in the book "**The Energy Internet**" Ed. Wengcong Su, Axel Q. Huang, ISBN (Online) 978-0-08-102215-3
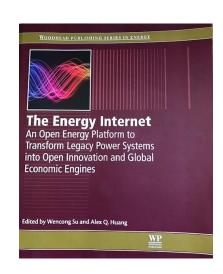- Xyna technology: xyna.com

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