gaia-x Hub Germany

Applying Data Spaces

Use Cases in Health, Industry and Energy

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About the series

This paper contains the content of the free online course "Applying Data Spaces: Use Cases in Health, Industry and Energy" offered by Gaia-X Hub Germany. It provides interested parties with a basic understanding of the data economy and promotes discourse and the exchange of ideas.

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3. Project Energy Data-X and the Use Case "FleX"

3.1 Introducing the energy data-X project

A stable and sustainable energy supply forms the foundation of our modern society. However, the energy transition is fundamentally changing the energy sector. More and more decentralized systems such as photovoltaic and wind power plants, electric vehicles, storage facilities, and heat pumps are shaping the energy sector. This presents energy suppliers with new challenges: they must coordinate power generation and consumption more flexibly, as renewable energies are not constantly available. In order to manage bottlenecks or surpluses in a sensible way, all parties involved need to work together intelligently – especially at the municipal level in the areas of energy, industry, real estate, and mobility. This requires cross-sector, standardized data exchange, which enables efficient and reliable control. Energy data-X serves as a lighthouse-project within Gaia-X, the European initiative for a secure and sovereign data infrastructure. It aims to standardize the exchange of energy industry data across sectors, thereby promoting flexible, sustainable, and efficient energy use. As a pioneer, energy data-X shows how trustworthy data spaces can create innovative solutions for the energy transition – with a particular focus on municipalities, industry, mobility, and real estate.

What does this mean in practice?

The energy transition and the increasing sector coupling of electricity, transport, and heating are increasing the complexity of the energy system, leading to fluctuating loads and increasing storage requirements. At the same time, new demands are being placed on grid stability, flexibility, and regulatory control. Efficient data exchange between many decentralized players is necessary to meet these requirements and ensure a stable supply. However, there is currently a lack of standardized, secure procedures for the sovereign and data protection-compliant exchange of energy data. In addition, billing and grid optimization are often significantly delayed, resulting in expensive compensation measures.

What are the challenges for this project?

To meet these challenges, Energy data-X is developing a decentralized data space in which energy data can be exchanged securely and according to clear rules. The data remains with the owner and is only passed on via protected connectors when necessary and with the owner's consent. Identity and trust mechanisms as well as federated services guarantee secure use. The data space will be available to all market participants on a prototype basis, enabling data-centric business models, accelerating energy industry processes, and supporting climate and energy goals. The effectiveness of this approach is evident in the following use cases:

Use case 1: Optimization of balancing group management

The balancing group management controls the energy flows within a virtual account (balancing group) to bring injections and consumptions into equilibrium. This central task of the energy industry ensures that the energy flow in the electricity or gas grid remains stable.

In real-time, balancing group management data from renewable energy plants and consumers is transmitted to balancing group managers in near real time with the help of smart meter gateways. This allows deviations between planned and actual feed-in or withdrawal to be detected immediately and compensatory measures to be initiated in good time. In contrast, allocation in previous systems often takes weeks, resulting in unnecessarily high stand-by energy consumption.

To better understand the terminology, a smart meter gateway is a central, secure communication module of an intelligent metering system (iMSys). It encrypts digital consumption data from meters for electricity, gas, or water and automatically transmits it to authorized recipients such as grid operators. Control energy, also called balancing power, serves as a reserve to compensate for fluctuations in the power grid—more precisely, in the grid frequency. When control energy is used, electricity can be both fed into and drawn from the grid.

Use Case 2: Decentralized cross-sectoral flexibility development

This use case addresses how small, distributed systems such as charging stations, battery storage systems, or heat pumps can be efficiently integrated into grid control. These systems can flexibly adjust their power consumption or feed-in. The data space allows this flexibility to be recorded and controlled in real time. Surplus renewable energy can thus be stored or used in a targeted manner, while bottlenecks in the grid are automatically balanced. This makes the grid more stable, weather-dependent energies are better integrated, and automated flexibility services create sustainable solutions for energy supply.

Both use cases show how energy data-X can advance the energy industry: through faster, more efficient grid processes and the use of decentralized flexibilities for the energy supply of the future.

3.2 Use Case "FleX"

A central component of the project is the "flexibilitiy development" (FleX) use case. It aims to optimally integrate central, controllable systems such as photovoltaic systems, battery storage, charging stations, heat pumps, and electric vehicles into grid control. This use case is examined in more detail below – from the underlying problem to the solution and the resulting benefits.

Description of the problem

The growing expansion of renewable energies is leading to a decline in the number of large central power plants, while more and more decentralized generation and consumption units

are being connected to the grid. In 2024, these included around 3.1 million photovoltaic and wind power plants and around 7 million electric vehicles, storage facilities, and heat pumps. This development is making control and balancing in the energy system significantly more complex. Although systems such as batteries, charging stations, and heat pumps have considerable flexibility potential, this potential has only been exploited to a limited extent so far. This is particularly problematic because renewable energies are significantly more volatile than conventional power plants and therefore require the targeted use of flexibility to balance energy surpluses and shortages. This requires cross-sector data provision, as individual flexibility offerings can hardly be coordinated and used for grid stability without uniform and reliable data flows.

Solution approach and components

energy data-X enables these uniform and reliable data flows by connecting flexibility units[1] securely and in a standardized manner to the data ecosystem via their respective energy management systems. Automated machine-to-machine data exchange allows data on reserves and consumption to be transferred efficiently. Common standards ensure that players and plants can be integrated across sector boundaries.

In this way, aggregators can market bundled flexibility, balance group managers and grid operators have a technical basis for calling up flexibility in a targeted and secure manner for grid stabilization, and end consumers or prosumers[2] can use their plants both on the energy market and for local grid optimization and generate additional income. This increases security of supply, reduces long-term grid expansion costs, and promotes the integration of renewable energies.

Presentation of the consortium partners and their roles in the use case

The energy data-X project involves 14 partners from the energy industry, information and communication technology, science, and standardization. As consortium leader, *TenneT* assumes the role of the orchestrator and coordinates the processes in the data space. *Fraunhofer IOSB-AST* acts as technical federator. As such, it provides federated services and ensures secure, interoperable operation in accordance with Gaia-X standards. Together, they ensure trustworthy, sovereign, and smooth data exchange. The consortium is complemented by partners such as *Amprion, PPC, Spherity, DKE, Fraunhofer IEE*, and others, while associated partners such as *50Hertz, TransnetBW, E.ON, EWE Netz, ARGE Netz, Eviden Germany, Microsoft*, and the *International Data Spaces Association* contribute additional expertise and

[1] Flexibility means that the electricity demand – for example from a company or a plant – can be adapted to the electricity supply to a certain degree and in a flexible manner, without violating production requirements. This is particularly relevant for electricity from renewable energy sources, as fluctuations due to weather, time of day, or season are possible.

[2] Prosumers in the energy industry: They generate electricity with their own systems, e.g., with a photovoltaic system on the roof, consume it themselves, and feed surplus electricity into the grid.

sector connections. The project thus combines expertise from network operation, digitalization, standardization, and research to build a sustainable, sovereign data ecosystem for the energy industry.

Benefits for SMEs

All market players benefit from standardized and secure data exchange, which enables new business models and makes processes more efficient. While large companies can handle complex data exchange more quickly, the data space gives small and medium-sized enterprises (SMEs) low-threshold access to relevant energy data. Intermediaries take on technical and regulatory tasks, significantly lowering barriers to entry, especially for SMEs. On this basis, they can develop their own innovations—such as data-based services for energy efficiency, for marketing flexibility, or for new data products.

Users also benefit from the data space

They can develop data-centric business models and design and market their own data products – for example, for forecasts, flexibility services, or the optimization of energy consumption. At the same time, they retain control over their data, determine how it is used, and comply with data protection requirements. The data space also enables networking with other sectors, for example via platforms such as Catena-X[3], which allow cross-sector applications such as forecasting services with automotive data. Real-time data and automated processes also enable efficiency gains and cost reductions.

In this way, energy data-X makes the digitalization of the energy industry accessible, strengthens the innovative power of SMEs, and offers all users secure, scalable access to valuable energy and process data.

3.3 Outlook

After the end of the project period in October 2026, the plan is to establish energy data-X as a new standard and open ecosystem for the energy industry and to scale it further.

Once the project is complete, the developed data space will be open to all players in the energy industry and related sectors and will be ready for productive use. The focus will be on integrating further use cases and cross-sector networking with other Gaia-X data ecosystems such as Catena-X (automotive industry) and Manufacturing-X (manufacturing industry). The provision of the data space is to be financed by the transmission system operators' network charges, thereby leveraging network-related effects and avoiding costly billing processes. The use cases are generally developed and operated by commercial providers.

In the long term, Europe-wide and international interoperability is planned so that business models and innovations can be implemented across borders. Artificial intelligence and advanced data analysis are to further automate processes in real time, for example for

[3] https://catena-x.net/

forecasts or flexibility services. energy data-X will thus accelerate digitalization and sector coupling and contribute to the climate and innovation goals of Germany and Europe.

Requirements and challenges

For this to succeed, regulatory decisions and further support from politicians and the market are necessary for the nationwide and European rollout. Data protection, data sovereignty, and cyber resilience remain key prerequisites for acceptance and integration into practice. energy data-X will thus become the core of the digitalization of the energy industry and create the basis for joint, data-centric innovations by companies, science, and society.

How can I get involved?

Participation in energy data-X is possible because the project explicitly aims to create an open and interoperable data ecosystem for all market partners in the energy industry. Participation as an external party is therefore possible and welcome, but requires registration and technical and organizational compliance with the data ecosystem specifications. Contact details and further information are available on the official project website.

Where can I find further information?

Energy data-X integrates various players, including companies outside the consortium, to enable data-centric innovation and data-sovereign exchange in the energy sector. External interested parties usually need a digital identity and must establish secure access to the data room, for example via a so-called connector. Compliance with the governance and data protection requirements of the Energy Data Space is also a prerequisite. For identification and assignment in the data room, there is a central identity and trust procedure that ensures that only known and trustworthy actors are allowed to participate. Direct registration as an external participant is possible via the project website https://www.energydata-x.eu. There you will find current information, contact persons, and details on pilot projects and open calls in which municipalities, companies, and other external market players are specifically invited to contribute their expertise, data, or use cases. Fraunhofer Institutes also provide information on contact points for external partners. These can participate as associated partners, data providers, or use case providers. Integration usually takes place via specific application projects or pilot measures, with particular emphasis on interoperability with other European initiatives such as Gaia-X. The exact design depends on the respective use case, the data provided, and the technical infrastructure.

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