Energy data-X
Sovereign data exchange in the German energy sector

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Motivation

Digital transformation within the energy sector has become a critical necessity. Advancing information and communication technologies is essential for managing the increasing complexity and decentralization spurred by renewable energy sources. Specifically, decentralized data management could become a key enabler for a more adaptive energy grid that empowers consumers with greater control over their data. The need for data to better control the energy system coincides with the build-up of data infrastructures for research an industry in initiatives like NFDI4energy, GAIA-X or the International Data Spaces Association. The project energy data-X is a research project driven by German grid operators and Fraunhofer to establish an Energy Data Space for the energy sector in Germany.

Data Space

Data spaces are digital architectures that facilitate secure and sovereign exchange and sharing of data across different organizations and sectors. They enable entities to maintain control over their data while participating in a broader ecosystem, promoting collaboration and innovation. By leveraging standardized protocols and governance models, Data spaces support interoperability and trust among diverse stakeholders, driving efficiencies and unlocking new value from data assets across industries.

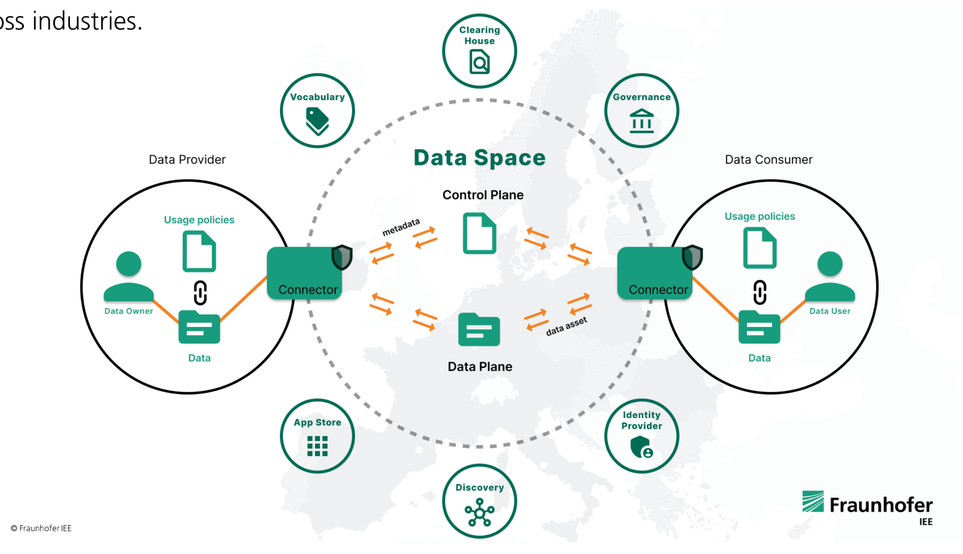

Figure 1: Overview about roles and components in a data space

A Data Space comprises several key components to ensure secure, efficient data exchange (see Figure 1). The Connector acts as the interface for data exchange, enforcing data usage policies and ensuring secure communication. A Metadata Broker facilitates discovery and integration of data across the ecosystem by cataloging available data services and datasets. An Identity Provider manages digital identities, ensuring that only authorized users and systems can access and share data in the Data Space, thus maintaining trust and security within the ecosystem.

Project and Consortia

The project energy data-X is led by TenneT TSO GmbH and funded under the 7th energy research programme. It is a three-year project that has started in October 2023. The consortia is distinguished by the inclusion of all four TSOs in Germany, showcasing a unified effort across the national grid. Alongside these key network players, the project engages metering OEMs, energy suppliers, research institutes and many more (see Figure 2), creating a multidisciplinary team focused on exploring the potential of Data Space technology for the energy sector.

Figure 2: Project consortium of energy data-X

Use Cases

In the project, we explore two use cases. The first use case facilitates the transmission of smart meter readings through meter data administrators to further applications. The focus will be on the rapid assessment of balancing group management, allowing for more immediate responses by balancing group managers to deviations. This approach not only enhances the efficiency and reliability of energy distribution but also underscores the potential for real-time data management in optimizing energy supply and demand dynamics.
In the second use case decentral sources of flexibility are to be made visible via the Data Space. This will be the prerequisite to tap the flexibility potential for trading and system services.

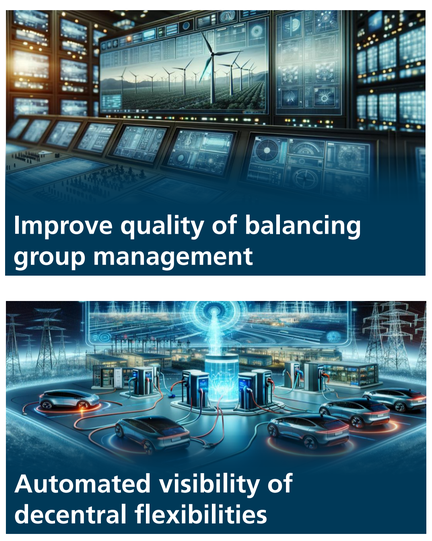

Figure 3: Visualisations of use cases in energy data-X

Research Roadmap

Looking forward to advancing this field of study, the research roadmap encompasses several key areas, each aimed at deepening the understanding and application of data spaces in the energy sector.

- **Comparative Performance Analysis.** To objectively assess the efficiency of the approach, comparative analysis using measurable metrics are needed. Parameters like overall process time and message throughput will be critically examined against existing technical alternatives. This will provide a quantifiable basis for evaluating the advantages and potential limitations of the system.
- **Scalability Assessment.** A crucial aspect of future work will be exploring the scalability of the system, particularly when thousands of parties are interacting. This will include examining the system's behavior in the face of network interruptions and varying network latency configurations, providing insights into its robustness and efficiency at scale.
- **Comprehensive Security Analysis**. Given the importance of cybersecurity, a detailed analysis of the security implications of the decentralized approach will be conducted. Identifying potentially new attack vectors and assessing whether a decentralized system contributes to overall system robustness will be required.
- **Practical Application Considerations**. Multiple practical aspects of a data space solution, including maintainability and the ease of updating source code needs to be considered. This will help in understanding the real-world applicability of the system, ensuring that the research results are not only theoretically sound but also practically viable.
- **Regulatory and Policy Implications.** Existing policies and regulations may have to be adapted to allow for data space based decentralized data management in the German energy market. This approach will identify which energy market processes can benefit from transitioning to a decentralized setup and which should remain centralized, while complying with regulatory rules.
- **Business Model.** A significant area that remains to be explored is the development of a viable business model for the federation services of a Data Space. Future research should focus on evaluating potential business models, addressing the challenges of sustaining the service financially while maintaining its effectiveness and integrity.

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