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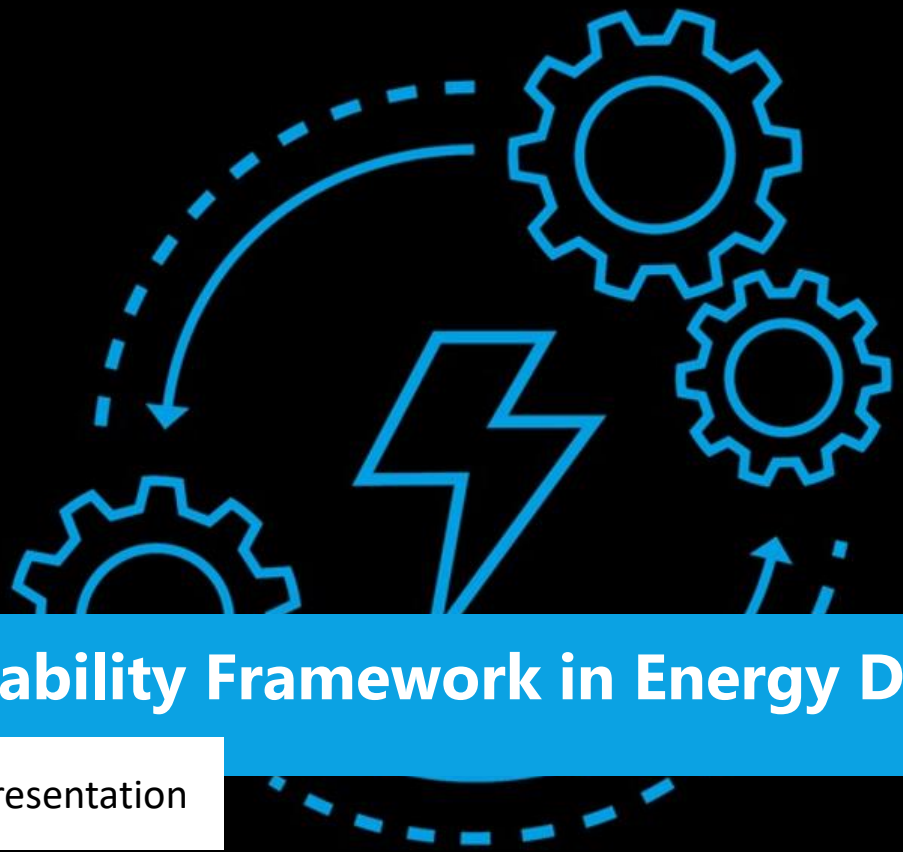

# Financing Eu Projects

*November 29, 2023*
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*Alberto Dognini*

# Interoperability Framework in Energy Data Spaces

Position paper presentation

# Overview

# Purpose of the paper

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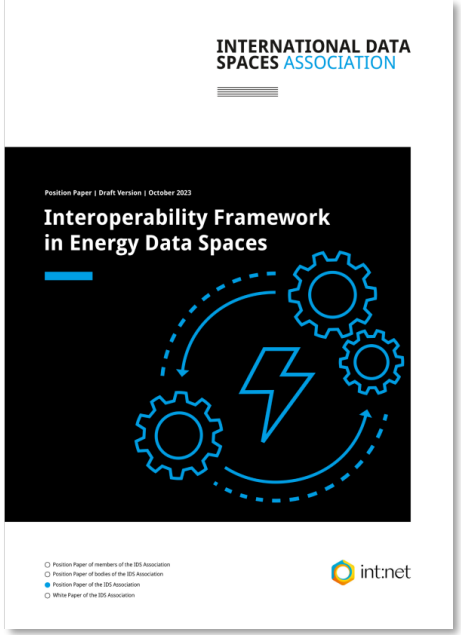
The purpose of this paper is to define a framework for achieving **technical and semantic interoperability** between data spaces in the energy domain. To accomplish this, it takes the work of the **HORIZON-CL5-2021-D3-01 projects** as its foundation, and describes the state of the art, and the challenges specific to this context.




Interoperability Framework in Energy Data Spaces

# Paper Contributors

*Energy sister projects*

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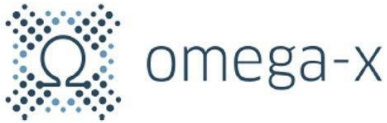
- Projects (technical) coordinators
- Semantic and technical interoperability tasks contributors from each project
- Standardization task leaders
- Pilots' coordinators





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# Relevant initiatives

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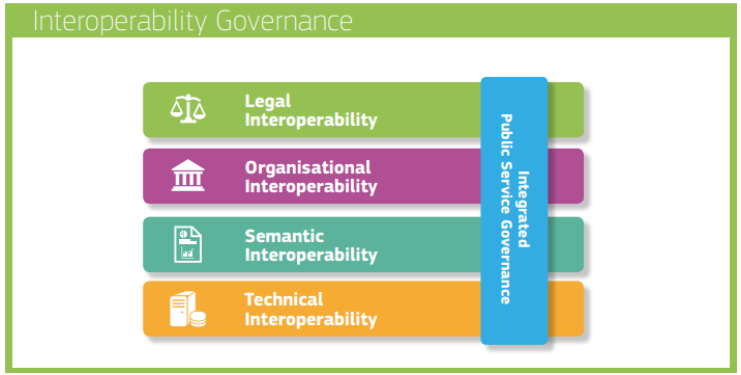
## New European Interoperability Framework

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FIWARE

gaia-x

DATA SPACES SUPPORT CENTRE

# Energy domain overview

*Requirements and challenges*

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- The energy sector is at the core of the twin **transition towards digitalization and renewable energies**
- **Fossil fuels** are increasingly being **replaced by electrification** in major sectors such as mobility, heat, and industrial processes.
- Energy is to a large extent a **regulated sector.** Non-discriminatory access to the grid and to markets is a key principle that needs to be maintained in a data space setting
- European and national regulatory bodies are imposing **rules and guidelines** that affect interactions and communications in the market. These will feed into the design and the **governance of energy data spaces.**
- Energy data spaces need to comply with a larger set of **domain-specific regulations**

# Key findings

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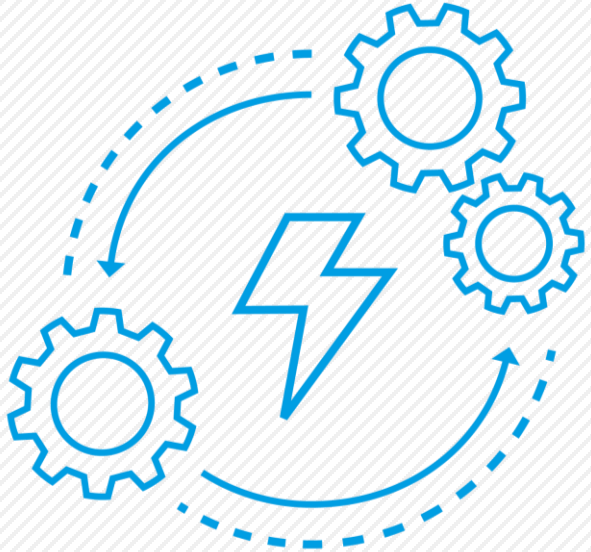
- **Standards** are fundamental to interoperate devices from different manufacturers while avoiding vendor lock-in, enhancing scalability, and ensuring data protection and cybersecurity.
- **Technical interoperability =>** for a successful federation of different data spaces, compatibility among different data connectors, services, and trust frameworks must have the highest priority.
- **Semantic interoperability =>** enormous variety of devices, assets, and applications require:
  - **Harmonization of ontologies and data models** (starting from well-established solutions as CIM).
  - **Common vocabularies and data models** can foster the benefits of federation services for cross-domain solutions.



# Five core technical standards

*To integrate systems in a smart grid of the future*

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1. **IEC 61850**: This standard defines the **communication protocols and data models** for the integration of intelligent electronic devices in substations and power systems. It enables seamless interoperability between various components of the grid.

2. **IEEE 2030.5**: Also known as the Smart Energy Profile (SEP), this standard focuses on the **interoperability of energy management systems**, smart meters, and other devices in the smart grid. It supports advanced energy management and demand response capabilities.

3. **OpenADR**: The Open Automated Demand Response standard provides a **common language and protocol** for demand response communication.

4. **IEC 62351**: It addresses the **security requirements** and measures for protecting communication networks and systems in the smart grid.

5. **IEC 61968/61970/62325**: Known as IEC CIM, this set of standards focuses on the **integration of information and communication technology** (ICT) systems in utility operations.

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# Technical & Semantic interoperability

Building Blocks & challenges

# Building Blocks Overview

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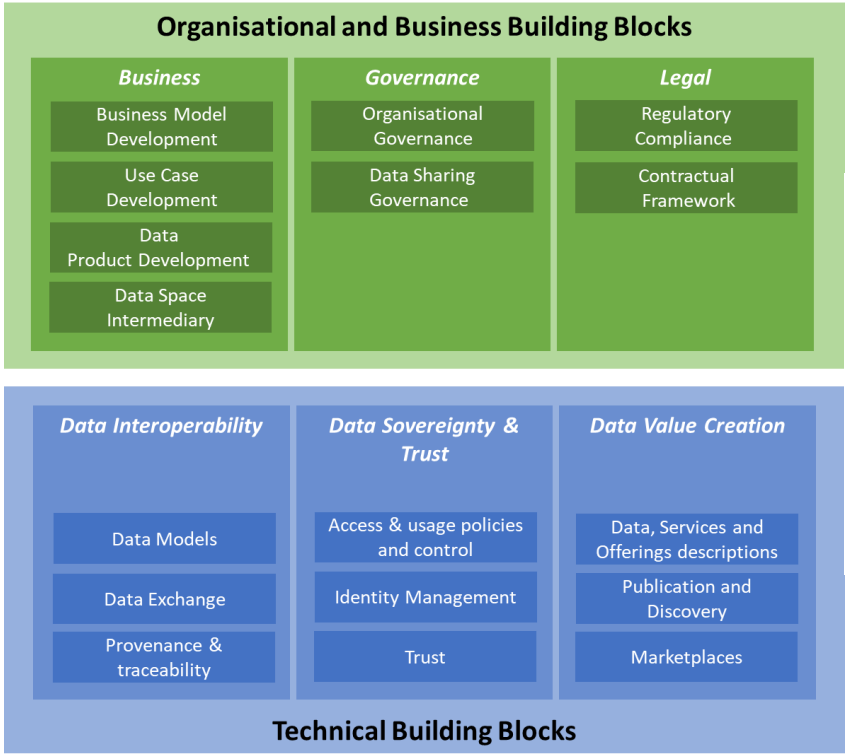
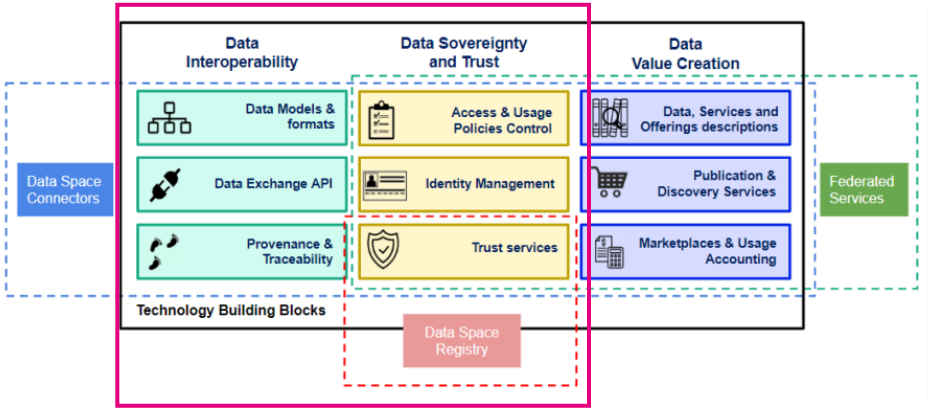
*DSSC Blueprint v0.5 & OPEN DEI*




In Scope



# Technical Interoperability

*Summary*

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- **Building blocks**
  - Data Interoperability (Data Exchange APIs)
  - Data Sovereignty and Trust (Access & Usage Policies Control and Identity Management)
- **Actors**
  - Data Space Governance Authority
  - Data Space
  - Participant
  - Participant Agent
  - Data Space Registry
  - Credential Issuer
  - Identity Provider
- **Data formats**
  - JSON-LD
  - NGSI-LD
- **Data transmission protocols**
  - Dataspace protocol

## Challenges

- Interoperability among **connectors** used by projects
- Interoperability among different implementations of **Federation Services** (e.g., for the Catalogue there is the Metadata Broker from IDS and the Federated Catalogue from Gaia-X)
- Interoperability of the **Trust Framework**. Trust certificates from one project should be interoperable with those from another.
- Are data connectors ready to accommodate existing infrastructure?
- Sister projects' reference architectures and identification of gaps to enable interoperability should be analysed.

# Semantic Interoperability

*Summary*

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## Key findings

- **Harmonization frameworks** simplify data exchange and interpretation in the smart grid ecosystem by creating common vocabularies, data models, and ontologies.
- **System Adaptation** is essential for aligning data formats with established models.
- **Well-known standards** like IEC CIM ensure consistent interpretation, adapting to changing relationships.
- **Automated data model consultation** streamlines data access and reduces errors.
- **Linked data**, such as RDF, eliminates silos and enhances interoperability.
- **Common ontologies** foster shared understanding, integration, and innovation among stakeholders.
- **Vocabulary Hubs** link semantics to data/service marketplaces, promoting data discovery and exchange in the smart grid ecosystem.

## Challenges

- Energy systems involve **heterogeneous components and devices.**
- **Sector-specific Common Information Models**, like in H2020-SYNERGY, are necessary for the decentralized and distributed energy system.
- Organizations like CEN-CENELEC/ETSI and standards such as IEC 62325 work on **common semantic models** for smart energy systems
- **Effective lifecycle management** is essential for handling new components like Distributed Energy Resources (DERs).

03

# Projects´ Reference Architectures

# OMEGA-X

*Reference Architecture*

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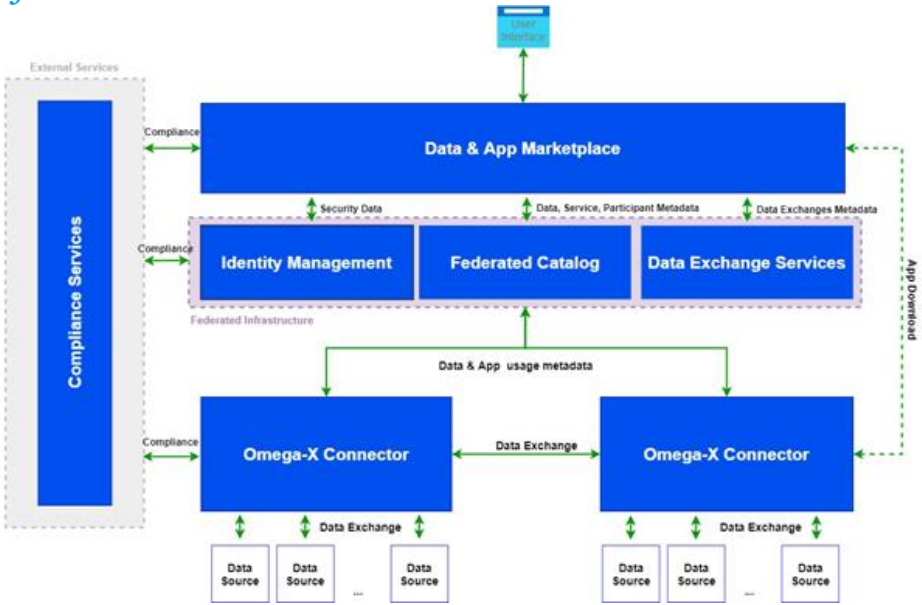


- The Data & App Marketplace, which acts as the main "entry" point for end-users in the Data Space, through its graphical user interface, enabling operations such as participant registration, management of data/service offering and participants, searching and contracting of offerings;
- Federated Infrastructure, providing the mechanisms for secure and sovereign data exchange and service provisioning, providing operations related to Identity Management, Catalog of data/services and Data Exchanges services;
- Connectors enabling the actual flow of data exchanges and the provision of services enabled by data;
- Compliance Services enabling Trust and Interoperability, validating the shape, content and credentials of self-descriptions and the compliance with the rules of Gaia-X Trust Framework and IDSA specifications.
- CSDM (Common Semantic Data Model

# ENERSHARE

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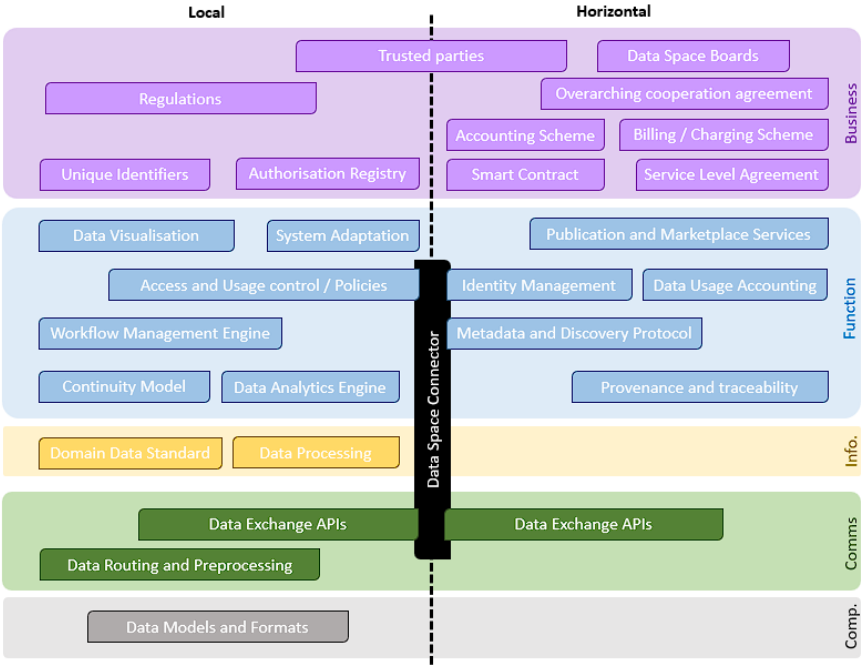
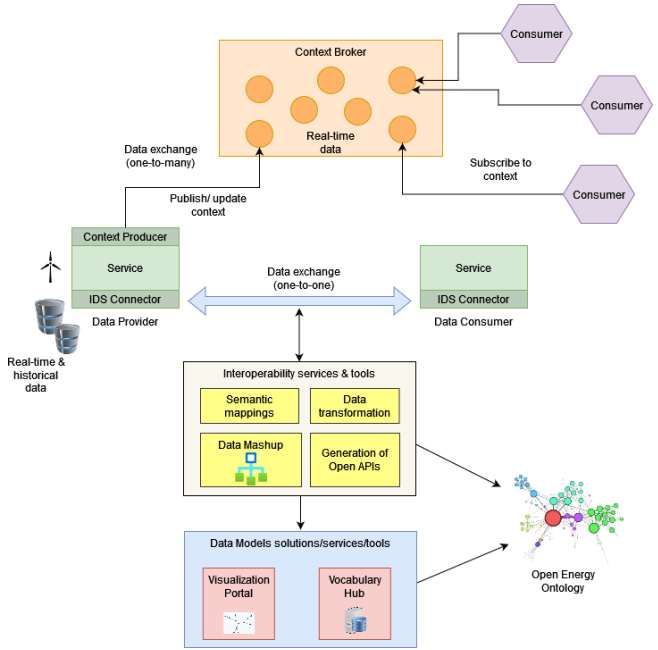
## *Reference Architecture (I/II)*



# ENERSHARE

*Reference Architecture (II/II)*

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- Data models: The **Open Energy Ontology (OEO)** is the set of interconnected ontologies to semantically model the energy data landscape (renewables, energy communities, flexibility and electromobility).
- Tools: A **Vocabulary Hub** or web-based vocabulary registry to host the data vocabularies and a **Visualization Portal** or web-based GUI for the interactive visualization and querying of ontologies.
- Data exchange: one-to-one, secure and trusted data exchange is guaranteed between provider and consumer using **IDS connectors.** One-to-many data exchange following a publish/subscribe paradigm is proposed using the **Context Broker**.
- **Interoperability services and tools** to facilitate data exchange including data transformations, semantic mappings, the generation of Open APIs and a data mashup editor to combine data from different data sources.

# DATA CELLAR

*Reference Architecture*

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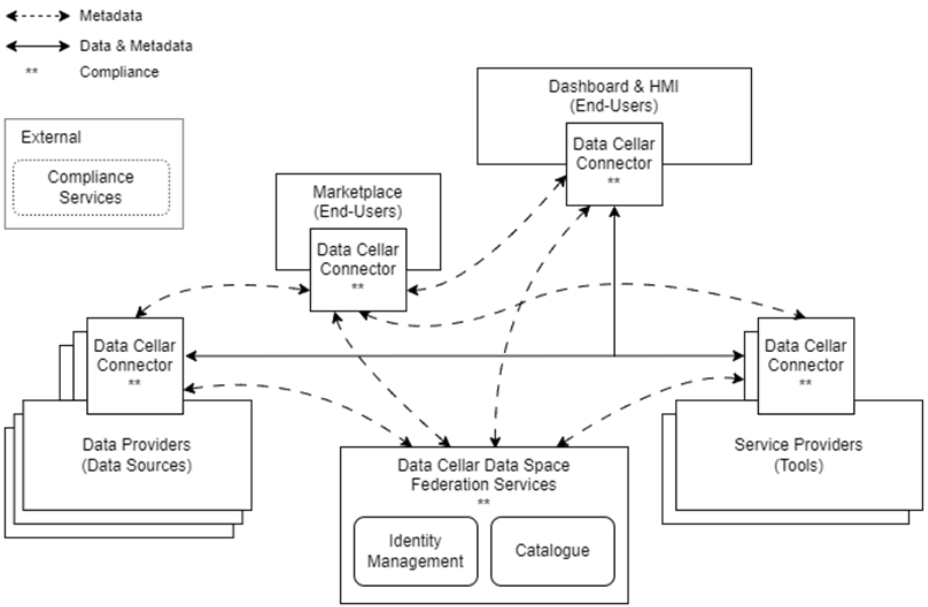
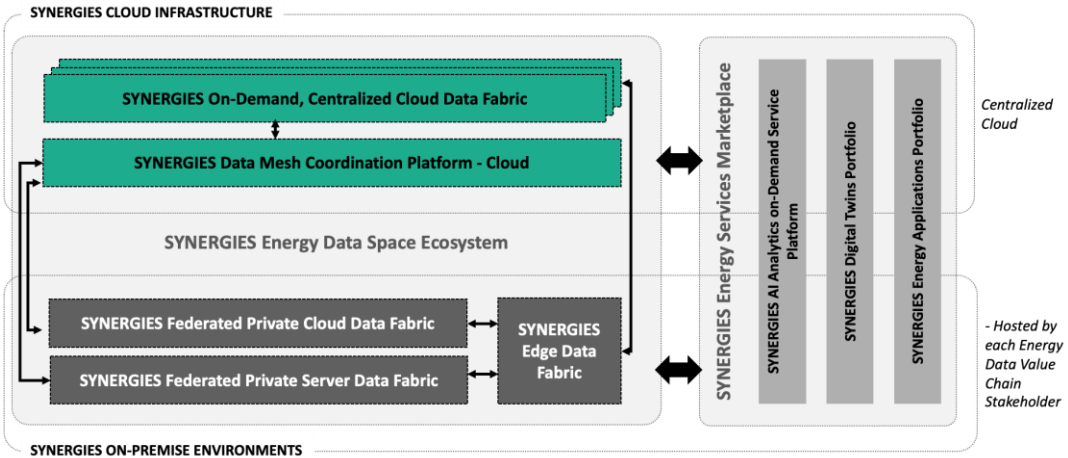



- **Data Cellar Connectors** – all data cellar data space participants operate and maintain a connector. Via the use of connectors, data sources and tools can be integrated into the ecosystem and comply with the requirements of the data space.
- **Data Cellar Data Space Federation Services** – namely Federated Identity Management and Federated Catalogue services which are necessary for the operation of the data space and allow secure and sovereign exchange of data and services between data space participants.
- **Marketplace (End-Users)** – Via the marketplace, end-users can offer their data, and acquire data and services.
- **Dashboard & HMI (End-Users)** – The Dashboard & HMI, as a data space participant, provides end-users a graphical interface to interact and access all services available on the Data Cellar data space.
- **Compliance Services – external to Data Cellar**. Interactions with compliance services are necessary to achieve compliance with Gaia-X and IDSA specifications (validation of Self Descriptions), and to support the onboarding process of data space participants.

# SYNERGIES

*Reference Architecture*






The **SYNERGIES Energy Data Space Ecosystem** that leverages the data mesh architecture patterns to effectively integrate real-time, batch and streaming data. It relies on the seamless communication and cooperation among:

- The **Cloud Infrastructure:** responsible for coordinating all data governance, interoperability, sharing and value accrual functionalities across all modalities of the Stakeholders' Energy Data Spaces. Such an infrastructure is the so-called the SYNERGIES Data Mesh Coordination Platform – Cloud (a.k.a Cloud (Coordination) Platform).
- The **Data Fabric Environments** that essentially represent the **Stakeholders' Energy Data Spaces** in which the energy data value chain stakeholders are able to integrate, host, analyse and serve/share their data assets in an easily consumable manner.

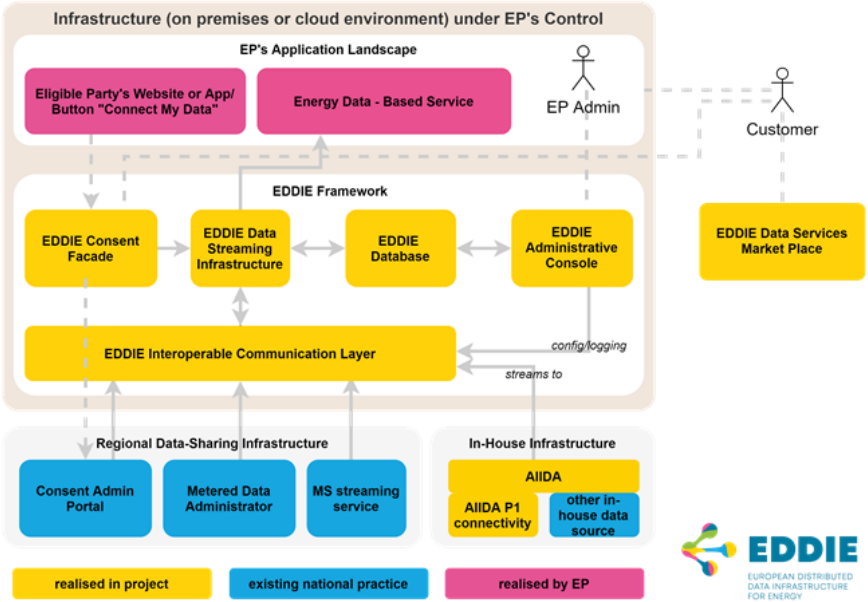
The **SYNERGIES Energy Services Marketplace:**

(a) a range of analytics solutions configured in the SYNERGIES AI Analytics on-Demand Service Platform;
(b) different types of Digital Twins that are configured and offered as- a-service;
(c) a bundle of Energy-as-a-Service Applications towards consumers, local communities and network operators that will facilitate human interpretation and contextualization of energy system-wide insights and optimization strategies delivered through the pre-trained AI analytics and Digital Twins

# EDDIE

*Reference Architecture*






The online parts of the EDDIE Framework communicating with external systems are (yellow boxes):

- **EDDIE Administrative Console**, providing the administrative interface of the EDDIE Framework
- **EDDIE Consent Façade**, providing the user flow and the proper routing of the customer to the appropriate Consent Administrator (CA)
- **EDDIE Interoperable Communication Layer**, flexible software applications providing the integration and communication with MS (I/O) CAs and Metered Data Administrators (MDAs)

The three components above share a common database (EDDIE Database) to manage authentication information, process states, mapping/reference data, etc. and a common data streaming environment (EDDIE Data Streaming Infrastructure). The latter will also provide the Application Programming Interface (API) for Energy Data – Based Service.

Project EDDIE will provide connectors to other Data Spaces

# Reference Architectures Mapping

*WIP*

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| OMEGA-X | ENERSHARE | DATA CELLAR | SYNERGIES | EDDIE |
|---|---|---|---|---|
| Omega-X connector | TSG Connector | Data Cellar Connector | | Connectors? |
| Identity Management | Identity Management (DAPS+CA) | Federated Identity Management | | |
| Data & App Marketplace | Marketplace | Marketplace | Energy services Marketplace | Data Services Marketplace |
| Federated Catalog | Metadata Broker | Federated Catalog Services | | |
| Data Exchange Services | Interoperability services and tools | | | |
| Compliance Services | | Compliance Services (external) | | |
| Common Semantic Data Model | Vocabulary Hub | | Federated Private Cloud Data Fabric | Data Streaming Infrastructure |
| | Context Broker | | Federated Private Server Data Fabric | Database |
| User Interface | App Store | Dashboard & HMI | Edge Data Fabric | Interoperable Communication Layer |
| | Blockchain | | Data Mesh Coordination Platform - cloud | |
| MVP | | | On-Demand, centralized cloud Data Fabric | |

# 04

What comes next?

# 2nd iteration

*Content & timeline*

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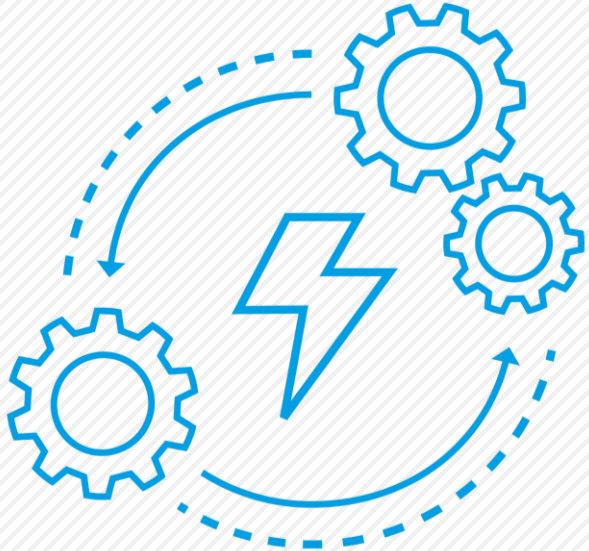
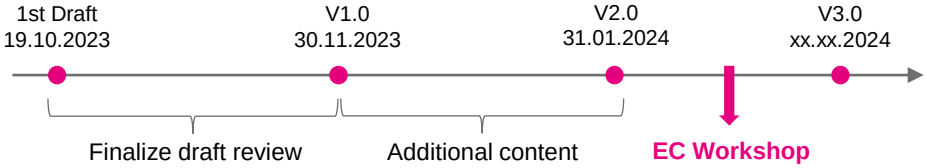
## New content

- Use case implementation
- Governance interoperability
- Cross-domain interoperability => which domain? Mobility?
- What else?



## Timeline



# Next steps

- **Review draft and publish v1.0** – End of November 2023
- **Presentation at Enlit Europe** 28-30 November 2023, Paris
- **Second iteration** – November 2023 to January 2024:
  - Include projects´ current developments in Technical and Semantic interoperability
  - Describe system use case to demonstrate the interoperability amongst sister projects
- **Presentation of 2nd version to EC** in Energy data spaces projects cluster event – February 2024 (tbc)

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# Projects achieving Interoperability
# Maturing for the market


- The question that we are asking ourselves is: What happens after a project finishes its circle? How to obtain private funding to achieve a second opportunity / life.
- The Commission is working in this direction. Through the Innovation Radar aims to create a steady flow of promising tech companies that can scale up into future industrial champions.
- It is supported in this by the EU-funded project Dealflow, which is linking investors with investment opportunities presented by results emerging from the EU's Horizon 2020 research and innovation programme. We need to learn from it and build on the lessons learned.
- Through my earlier presentation IDSA and the projects involved are working to achieve interoperability that this opens the doors to seamless market evolution.



https://digital-strategy.ec.europa.eu/en/activities/innovation-radar