# Industry takeaways in key sectors

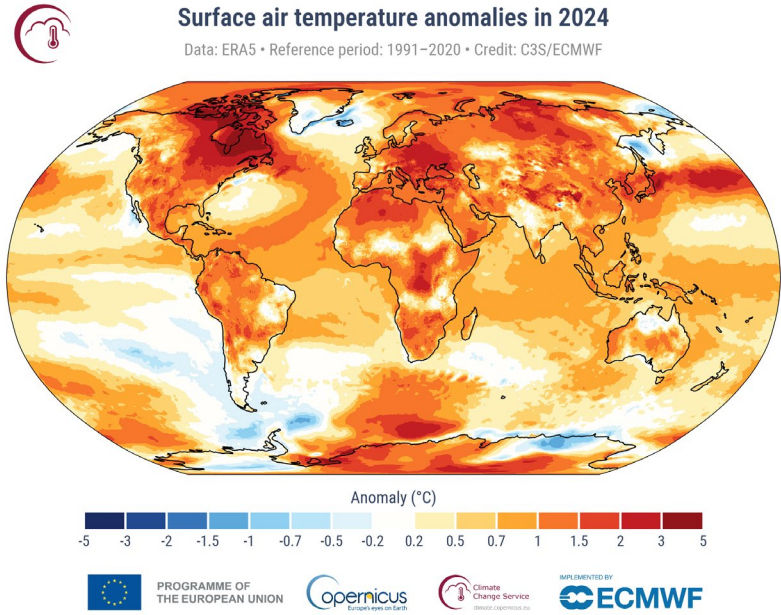## Demand-side energy management and flexibility in French energy distribution

Mathieu SCHUMANN, EDF

O-CEI Workshop - Workshop on Digital ID management and data governance through emerging edge computing and DLT solutions

10th February 2025

# Context (1/2)



**Surface air temperature anomalies in 2024**
Data: ERA5 • Reference period: 1991−2020 • Credit: C3S/ECMWF

Anomaly (°C)
-5  -3  -2  -1.5  -1  -0.7  -0.5  -0.2  0.2  0.5  0.7  1  1.5  2  3  5

PROGRAMME OF THE EUROPEAN UNION

Copernicus
Europe's eyes on Earth

Climate Change Service
climate.copernicus.eu

IMPLEMENTED BY
ECMWF

**Climate change**



**Electrification for decarbonation:
increased consumption and intermittence**

eDF | Our *raison d'être*

*Build a net zero energy future reconciling preservation of the planet, well-being and development, thanks to electricity and innovative solutions and services*

Importance of optimized demand-side energy management that will benefit the grid but also the end-consumers, individually and collectively

# Context (2/2)

The **eDF** Group



Production

Renewables

Transmission (TSO)

Supply

Distribution (DSO)

Flexibility agregation
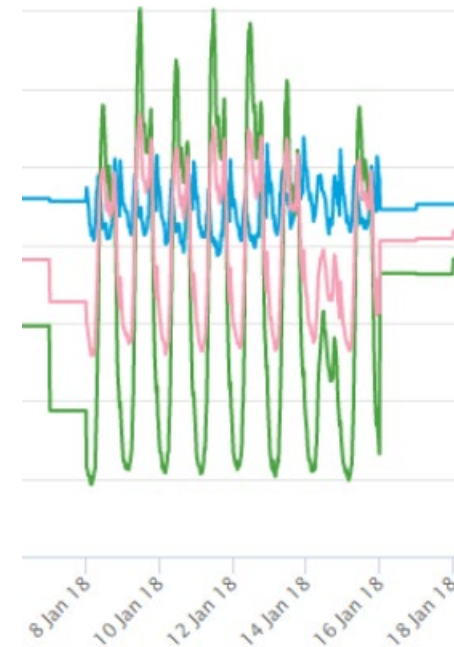
Energy services



Load curves are **highly sensitive data**, their processing poses challenges of:
- **GDPR compliance**
- **Privacy**
- **Acceptance**

Solide **data governance** is essential

Need for new, CEI-based services to adress those **intricated challenges** and improve energy management…

…combining voluntary **behavior**, technological **orchestration**, optimal consumption placement with regards to upcoming **tariff structures**, etc.

# Digital Identity Management & Decentralized ID

- ## Current practices in Digital Identity Management: example of a CEI-based service platform for energy

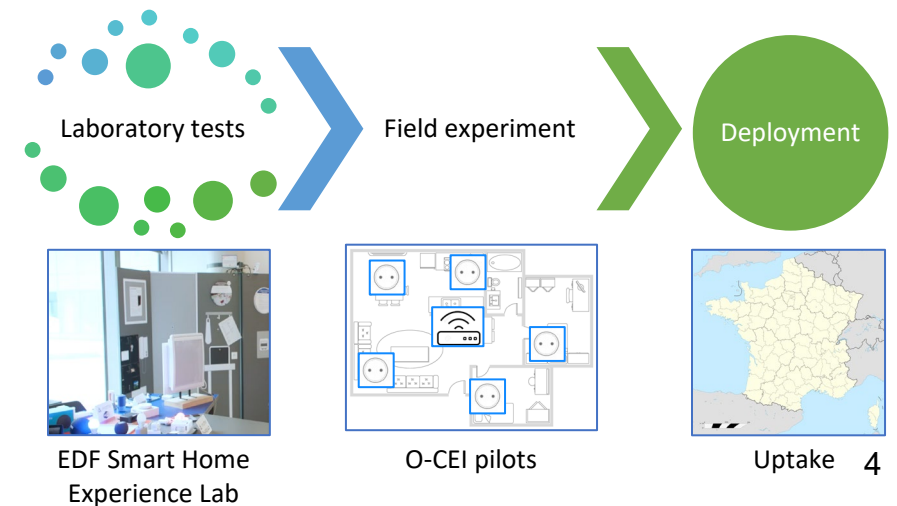| | | |
|---|---|---|
| A platform for the secure monitoring of energy consumption and deployment of Edge-Cloud services | A framework of infrastructure and security solutions whose principles derive from ANSSI (French National Cybersecurity Agency) | As required by EDF Project Review Office on cybersecurity |



ID mgmt

API

Secure pairing
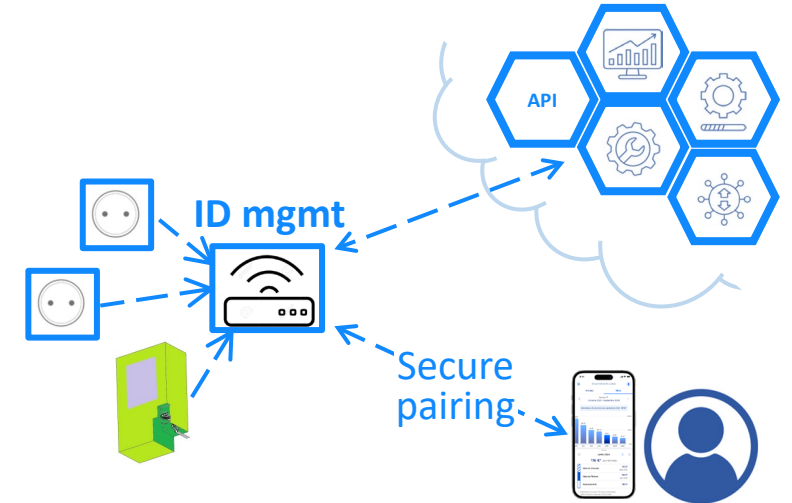
- ## O-CEI contributions and challenges:

| | | |
|---|---|---|
| Pilots testing DID principles in an enhanced service platform leveraging O-CEI blueprints built upon our Use Cases requirements | Challenges for Corporate compliance validation of these innovative solutions | Importance of dynamism of the community to prove active developments and allow Corporate Review Offices to valide innovative solutions (e.g., work on Zigbee/Matter) |



Laboratory tests

Field experiment

Deployment

EDF Smart Home Experience Lab

O-CEI pilots

Uptake

4

# GDPR-compliance-driven governance for energy data

- Management of **Sensitive, Identifying Data** (load curves + client information)

- A **robust Data Governance and Data Lifecycle Management** to ensure Data security and rapid response to data owner inquiries



**EDF Group**

**Chief Data Officer**

**Record of Processing Activities** (RoPA)

**Project Review Office for External Services** (BIPSE) conducting analyses of external services on cybersecurity, legal, asset protection, etc.

**Implementation at EDF R&D level**

**Chief Information Security Officer** (R&D)    (Dpt. level)
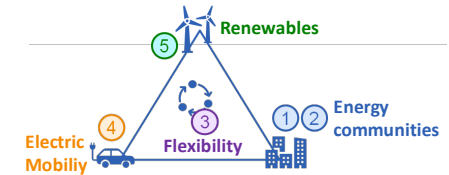
**Processing Records**

**R&D Project Review Office** (BIPSE R&D)

- Datacatalogues
- Data stewards
- Unification of data location
- Secure access and data processing

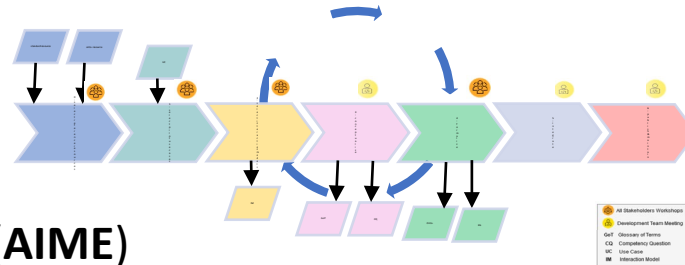# Innovating beyond current Data Model practices



"Orchestrating an interoperable sovereign federated Multi-vector Energy data space built on open standards and ready for GAia-X"
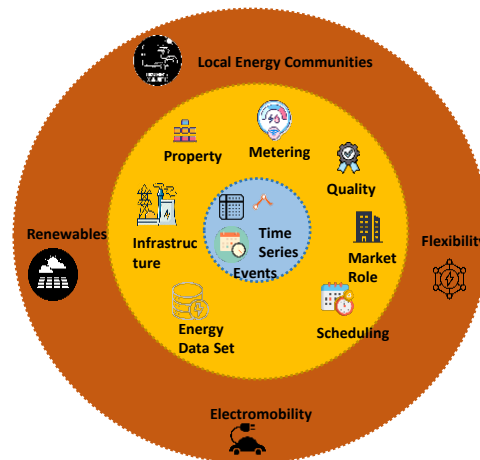
✓ **Agile Interaction model-based Methodology for Energy dataspaces (AIME)**
An agile methodology focused on use case requirements.
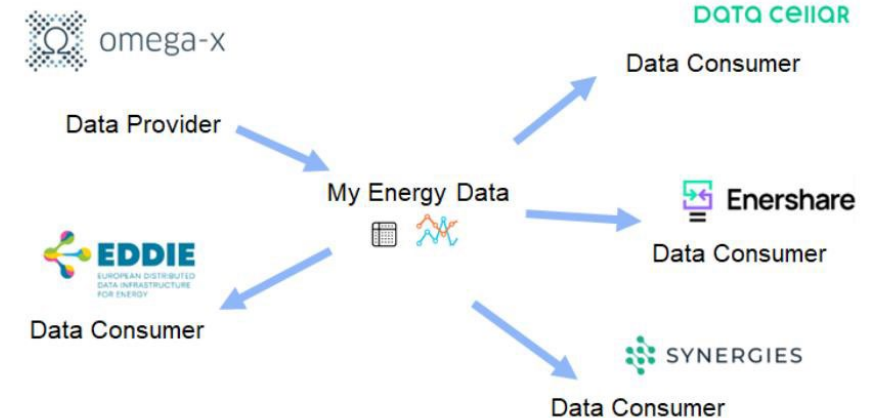
✓ **Common Semantic Data Model (CSDM)**
A knowledge representation organized in multiple dimensions (data types, attributes, sector/use cases)



✓ CIM-based common data model and data transformation services demonstrating that data **providers** and data **consumers** in **heterogeneous data spaces** can share a common understanding of **metered datasets**.

# EDF's commitment to innovation: Leveraging academic research in the heart of Paris-Saclay's academic hub

## How to Solve the Privacy-Decentralization Dilemma? Applied research initiatives in:

**Computer science, cryptography:**

- Privacy-preserving algorithms in energy services and demand response (F. Leukam, EDF/Télécom SudParis)
- DLT-based solutions for private yet verifiable transactions on energy markets (V. Languille, EDF/Télécom Paris)

**Social sciences:**

- The issues of Privacy and Trust in the Appropriation of blockchain technology by EDF in support of the energy transition (B. Ozdemir, EDF/Université Côte d'Azur)
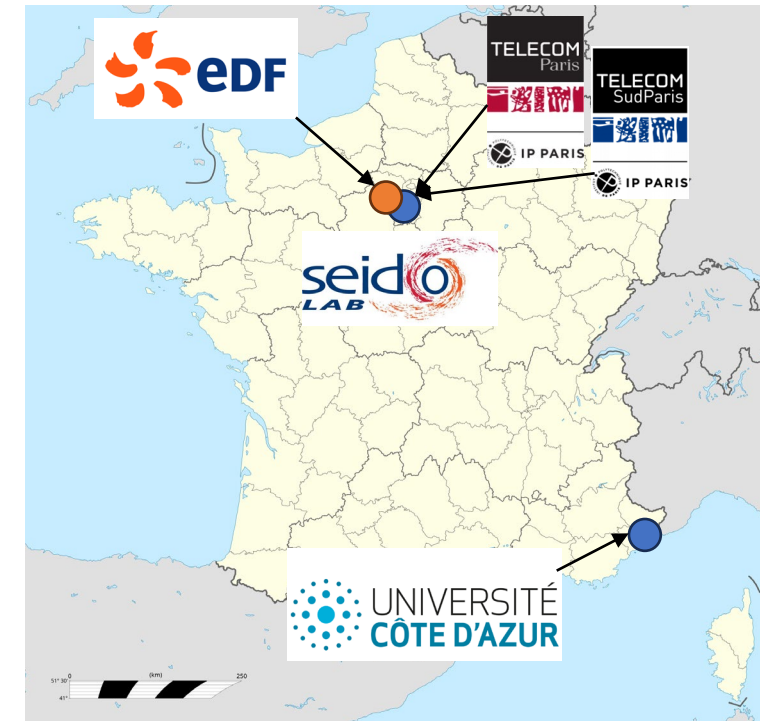
# An example of DLT-based solution: Privacy-Preserving Auctions

## Blockchain-Based Privacy-Preserving Protocol for Auctions in Decentralized Energy Markets

**Privacy-Preserving Auctions**: Utilizes blockchain and zero-knowledge proofs (ZKP) to keep bids, participant identities, and auction results private. ZKP ensures that transactions are verifiable without revealing sensitive information.

**Decentralized Energy Market** with auctions for microgrid energy exchanges. Multiple units of energy can be bought and sold simultaneously in a single auction, with both buyers and sellers submitting bids. The protocol ensures that the highest bids match the lowest asks, facilitating efficient and secure energy trading.
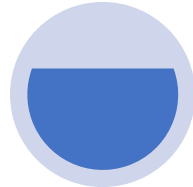
V. Languille, H. Zarfaoui, G. Memmi and D. Menga,

*"Privacy-Preserving Exchange Mechanism and its Application to Energy Markets"*

12th International Conference on Smart Grid and Clean Energy Technologies (ICSGCE), Jilin, China, 2024

doi:10.1109/ICSGCE63738.2024.10830594

## How Transactions are <u>Verifiable</u> and <u>Transparent</u>

**Public Ledger**: All transactions are recorded on a public, immutable blockchain ledger, ensuring transparency.

**Consensus Mechanism**: Transactions are validated by network consensus, ensuring only legitimate transactions are added to the ledger.

**Zero-Knowledge Proofs (ZKP)**: Allows verification of transaction validity without revealing sensitive details. Ensures privacy while maintaining verifiability.

**Cryptographic Proofs**: Participants use cryptographic proofs to demonstrate compliance with protocol rules without disclosing private information.

**Auditability**: Transactions can be audited by third parties to ensure no fraud or manipulation, with cryptographic proofs providing a solid audit trail.
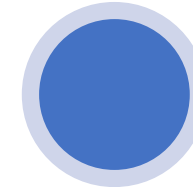
## Challenges for Flexibility

**Production-consumption imbalance** & impact on grid stability due to lack of centralized coordination

**Lack of reactivity**: Slow activation of flexibilities in case of sudden network variations

**Minimum volume of flexibility products** to participate efficiently in the flexibility market

# Conclusion

1. **Challenges in**
   - The need for new, CEI-based services to address intricated issues related to grid stability in a context of global electrification
   - Corporate compliance validation of these innovative solutions
   - Interoperability and common data models
   - Risk/benefits of decentralization for grid management

2. Demand-side energy management **cannot be a purely technological answer**, it must be done *with* the consumers and not against their will

Thank you for your attention