Begonia

Begonia Operational Digital Platforms

Three Use Cases for a connected and sustainable Europe

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BEGONIA Project

Europe is rethinking how digital information is shared and managed to make its energy and transport systems more efficient, sustainable, and connected. At the centre of this effort are **Operational Digital Platforms** (ODPs): cross-border systems that combine data, cloud technologies, and connectivity to improve coordination across sectors.

The BEGONIA Project, supported by the European Union, plays a key role in driving this change. Its goal is to identify, study, and prepare the most promising ODPs for real-world deployment in energy and mobility.

Through collaborative research, BEGONIA examined fourteen potential cross-border and cross-sector ODP Use Cases and selected three with the highest potential impact. These three final ODPs, presented in this document, demonstrate how open and standards-based platforms can support Europe's digital and energy transitions.

In this brochure

This brochure highlights the main aspects of the three final Use Cases selected withing the frame of the project:

- **UC I: Customer-Centric ODP for Electricity Users**
- **UC II: AI-Driven ODP for Integration of EVs, Energy Technologies, and the Grid**
- **UC III: ODP for Smart and Sustainable Data Centers**

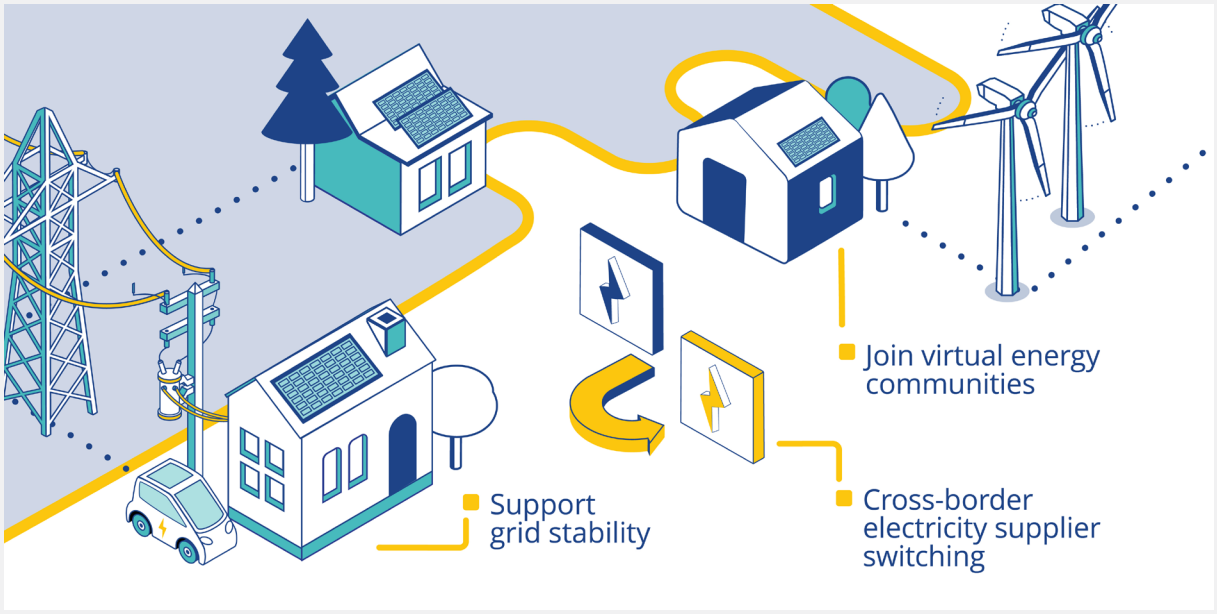
Together, these Use Cases show how digital innovation can enhance consumer empowerment, flexibility markets, clean mobility, and sustainable infrastructure, key goals of the EU's green and digital transformation.

The document builds on previous guidance documents and reports published by BEGONIA, serving as a concise reference for policymakers, researchers, and industry stakeholders willing to have an understanding of the notions developed in the project. While technical details appear in Deliverables D3.2 and D3.3, this brochure presents the core concepts, architectures, and governance models in a clear and accessible format.

UC I · Customer-Centric ODP for Electricity Users

Use case overview

Electricity consumers are increasingly equipped with digital tools, from smart meters to rooftop solar, heat pumps, and electric vehicles, yet they often experience fragmented services, limited control, and minimal opportunities to actively participate in the energy transition. This Use Case proposes a platform that transforms the role of consumers from passive recipients to active contributors in the grid ecosystem. The ODP empowers users to balance supply and demand, trade flexibility or surplus power across national borders, and make informed decisions based on real-time data and AI-driven recommendations.

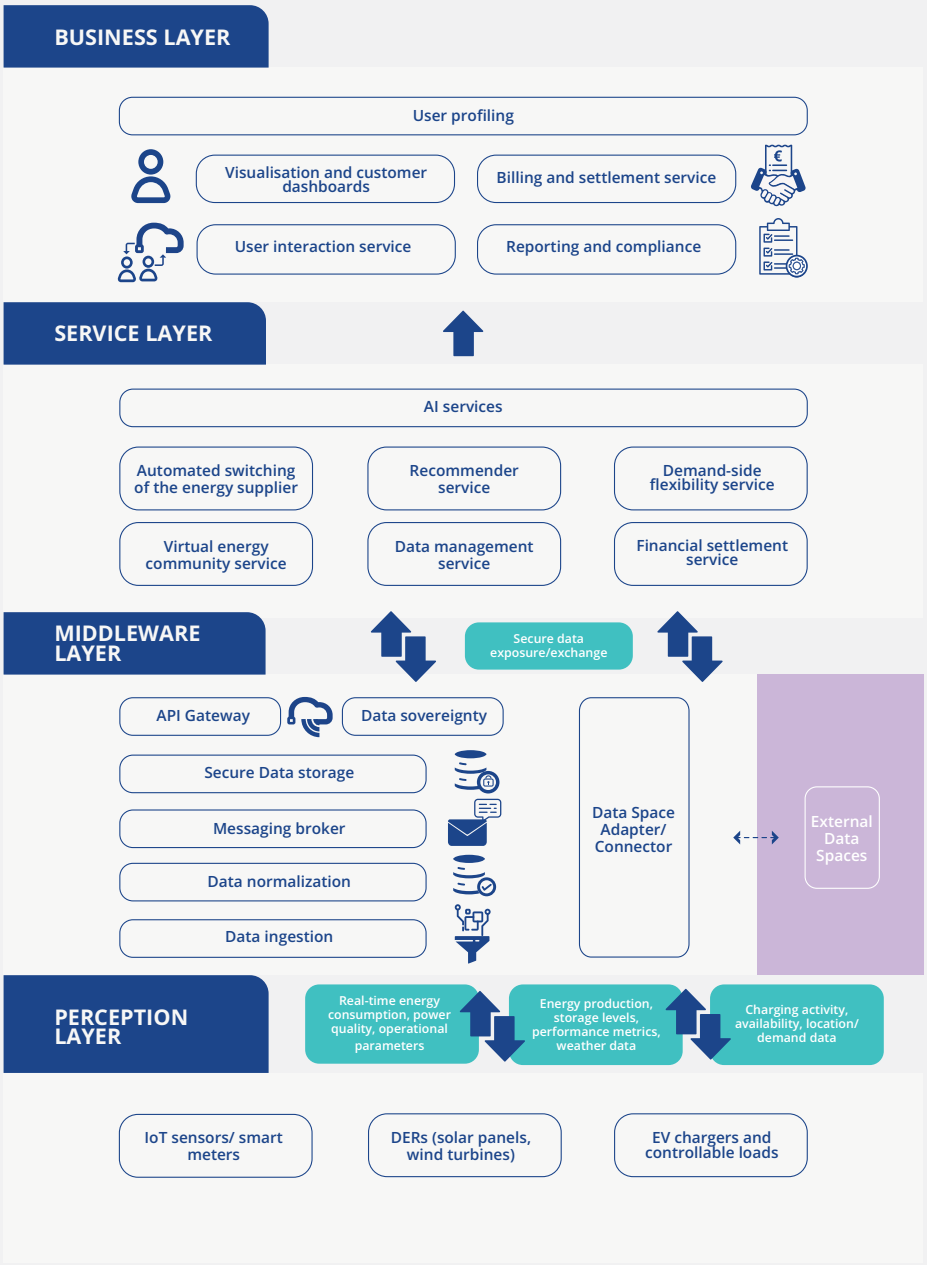


Key functionalities

- Real-time monitoring and feedback for consumers on energy use, carbon footprint, and tariff optimisation.
- Automated supplier switching, enabling customers to seamlessly move to better energy offers.
- Streamline the participation in virtual energy communities, allowing local prosumers to trade surplus energy or flexibility.
- Integration of controllable assets such as EV chargers, heat pumps, or batteries to provide demand response.
- AI-based advisory services, helping users adjust behaviours or schedules to match renewable availability.

Technical Architecture

The ODP's proposed architecture ensures interoperability, scalability, and security, enabling collaboration between diverse technologies and actors. Built on four layers, it allows to transform raw data from smart devices into actionable insights, using AI and forecasting tools and presents them through dashboards that link consumers directly to energy markets.



Proposed layered architecture of Use Case I

Policy and regulatory alignment

Use Case I aligns with the main EU strategies on data governance, consumer participation, and digitalisation of the energy sector. Its design follows key EU frameworks, but compliance will need to be verified during deployment.

The most relevant regulations include the GDPR for data protection, the Data Governance Act and Data Act for data sharing and interoperability, and the forthcoming AI Act due to the use of AI in flexibility and pricing services. The Electricity Market Directive and Regulation define consumer rights and flexibility participation, while the Renewable Energy Directive supports energy communities and local renewable integration.

At deployment stage, these frameworks will need to be carefully applied to ensure that the platform's operation meets all data protection, interoperability, and market access requirements in the targeted countries. Differences between national implementations, for example regarding the role of aggregators or the regulation of energy communities, may affect timing and approach. The initial target countries, Germany, Sweden, and Denmark, offer a favourable starting point, but continuous monitoring of national legislation is essential for scaling the solution across Europe.

Governance

The proposed governance model envisions the ODP as a private, for-profit entity operating as an innovative energy market player. It connects traditional suppliers and consumers with emerging roles such as prosumers and energy communities, offering all services like automated supplier switching, flexibility aggregation, and AI-based recommendations.

The model involves a wide range of stakeholders, from electricity end-users and renewable energy providers to grid operators and data service companies, each benefiting directly or indirectly from the platform. Ownership structures would adapt to national contexts, with separate ODP implementations likely in each country and the possibility of a single operator managing several in the future. Virtual energy communities using the ODP would be governed independently as not-for-profit entities, ensuring transparency and equal access to shared digital infrastructure.

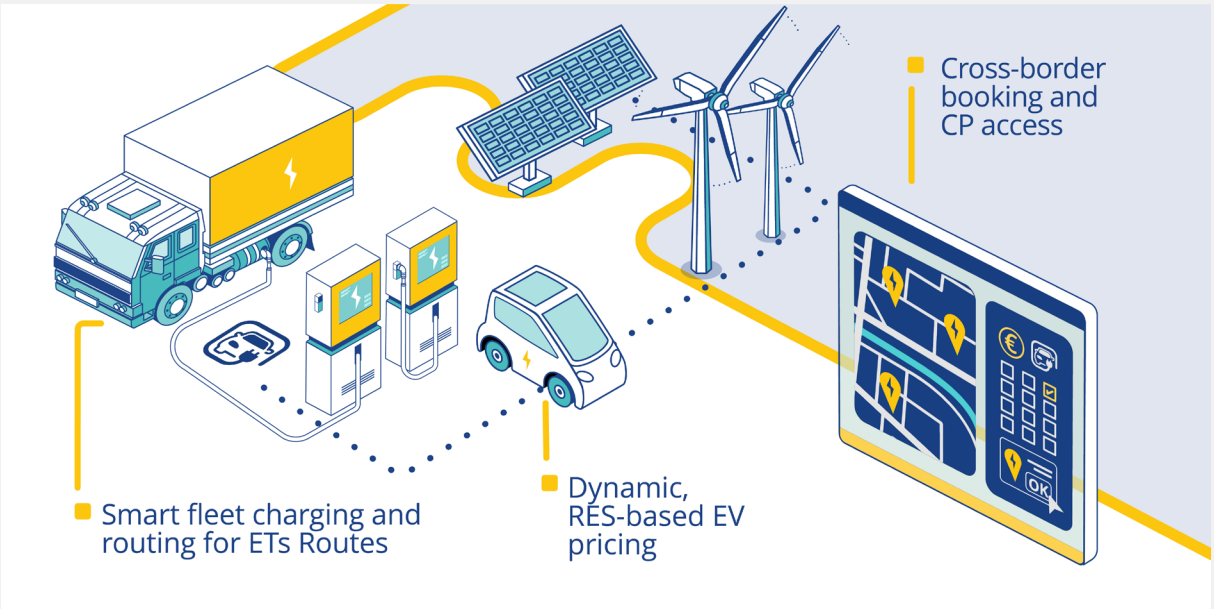
Final considerations

The proposed ODP is a cross-border, cross-sector platform that enables energy trading, monitoring, and management with GDPR-compliant governance aligned to EU frameworks like the Electricity Market Directive, Data Act, and AI Act. By linking consumers, grid operators, and energy communities through real-time data and AI insights, it promotes transparency, flexibility, and active market participation. The platform boosts grid resilience, supports renewable integration, and fosters virtual energy communities that advance Europe's green and digital transitions

Use Case II: AI-Driven ODP for Integration of EVs, ETs, RES, and the Grid

Use case overview

Europe's transition to electric mobility presents both opportunity and challenge: enabling mass charging without straining electricity networks. UC II introduces an AI-driven ODP that coordinates the energy and transport sectors, optimising charging in real time. By combining renewable generation data, grid capacity, and traffic flow, the platform helps drivers and fleet operators plan routes efficiently while allowing grid operators to predict and manage demand peaks. Initially thought to be deployed in Austria, Hungary, and Slovenia, the ODP establishes a shared digital layer for energy and mobility actors, delivering secure data exchange, efficient charging, and reduced emissions.

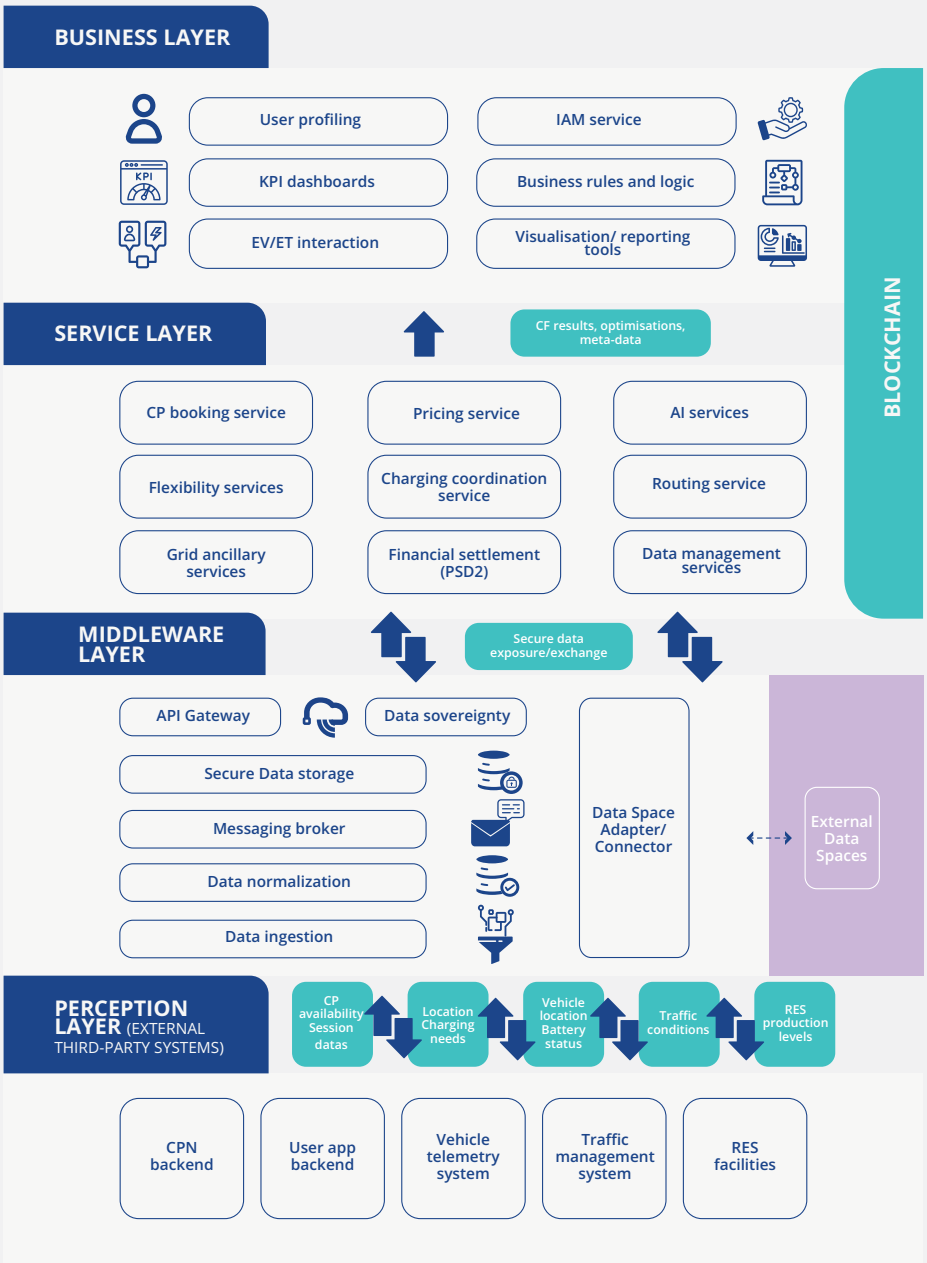


Key functionalities

- Real-time optimisation of charging based on grid status, weather, traffic, and fleet requirements.
- AI-based route planning integrating vehicle range, energy prices, and charger availability.
- Dynamic pricing and congestion signals to align charging behaviour with system needs.
- Integration of RES forecasts to prioritise green charging windows.
- Automated scheduling and allocation of charging slots for fleet operators.
- Support for vehicle-to-grid operations to unlock bidirectional flexibility.
- Interoperable data exchange with DSOs, TSOs, and traffic management systems.

Technical Architecture

The ODP's architecture is built on four interoperable layers that connect mobility and energy systems. From collecting live data on vehicles and renewables to using AI for forecasting, routing, and flexibility management, the platform transforms complex information into clear, actionable insights through user-friendly dashboards.



Proposed layered architecture of Use Case II

Policy and regulatory alignment

Use Case II aligns with EU strategies for transport decarbonisation, smart mobility, and digital integration. Its implementation will need to comply with several key regulations, including the GDPR for personal data protection, the Data Act and Data Governance Act for data sharing and interoperability, and the NIS 2 Directive for cybersecurity.
The forthcoming AI Act will apply to the platform's use of AI in charging optimisation and pricing, while the Electricity Market Directive and Regulation and the Alternative Fuels Infrastructure Regulation set rules for flexibility services, dynamic pricing, and charging infrastructure.

Together, these frameworks define the legal context for deployment, ensuring transparency, security, and fair participation. The reference countries (namely Austria, Hungary, and Slovenia) provide a supportive regulatory basis, though continued c oordination will be needed to harmonise aggregator roles and data exchange standards across borders, also to allow the replication in other countries across the EU.

Governance

The proposed governance model presents the ODP as a not-for-profit, member-governed organisation based in Europe. This structure promotes fairness, transparency, and long-term sustainability, with any revenues reinvested into improving the platform rather than generating profit.

A supervisory board composed of stakeholder representatives (including energy and mobility operators, fleet managers, grid operators, and data providers) would oversee the platform to ensure balanced value distribution and strategic alignment.

This shared-utility model is designed to support broad participation across sectors and countries, making it more suitable than a for-profit approach for the "infrastructure-heavy" and collaborative nature of the e-mobility ecosystem.

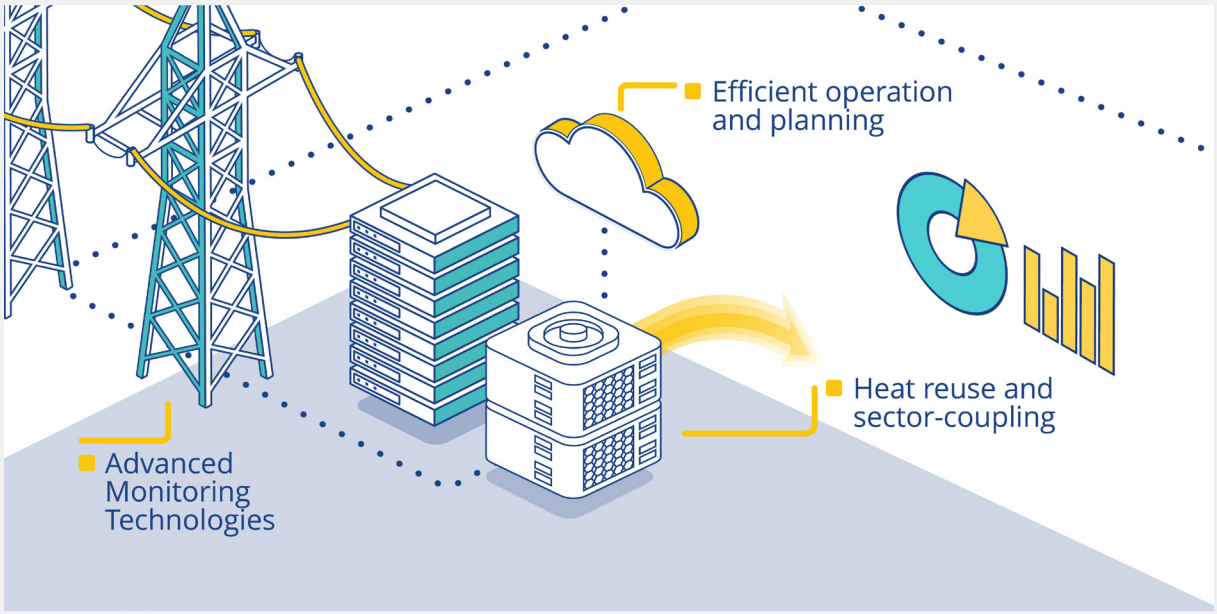
Final considerations

The proposed ODP is a cross-border system that connects the energy and transport sectors to support efficient and sustainable e-mobility in Europe. It enables real-time coordination between vehicles, grids, and renewable generation through AI-based services such as route optimisation, smart charging, flexibility management, and dynamic pricing. The platform also includes secure settlement functions and tools for data management, communication, and verification, ensuring transparent and reliable operation for all stakeholders.

Use Case III: ODP for Smart and Sustainable Data Centers

Use case overview

Data centers are the backbone of Europe's digital economy but among its fastest-growing energy consumers. Use Case III introduces an ODP that turns data centers into active participants in the energy transition. The platform combines AI-driven optimization, real-time monitoring, and integration with local energy systems to reduce emissions and improve efficiency. It allows data centers to provide grid flexibility, reuse waste heat through district heating, and shift computing workloads to regions with cleaner energy. Initially developed in Germany, Denmark, and Sweden, the model is scalable across Europe, adaptable to diverse infrastructures and regulations.

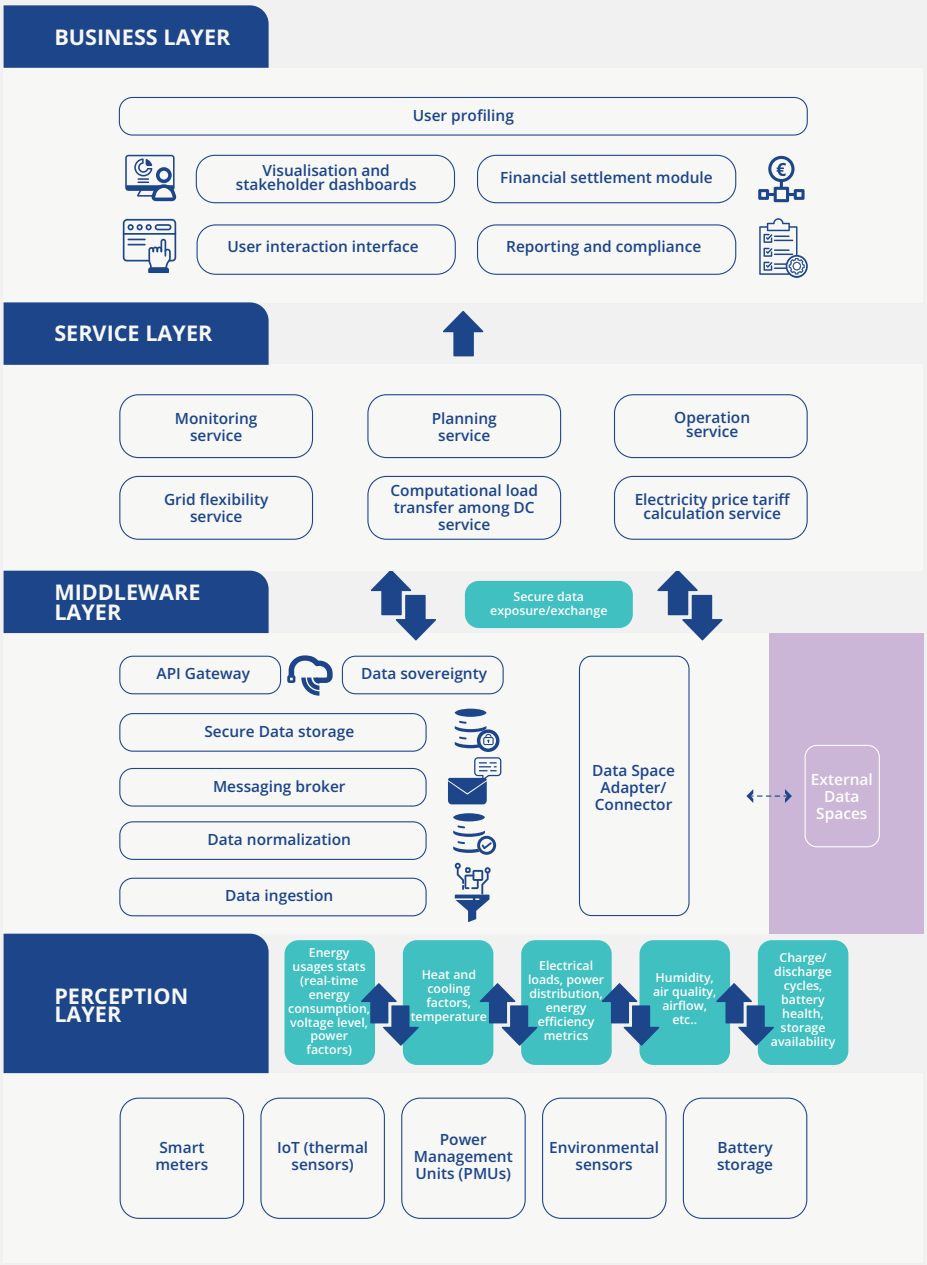


Key functionalities

- Real-time energy and emissions tracking, including PUE, WUE, CO_2, and flexibility KPIs.
- AI-based optimisation of server workloads, cooling systems, and electrical loads.
- Integration with district heating networks, enabling automated waste heat reuse.
- Workload migration, allowing computing tasks to be routed across data centers in different countries to maximise overall RES consumption or alleviate grid congestions.
- Participation in flexibility markets, via dynamic load shifting or reserve services.

Technical Architecture

As it was for the previous ones, this ODP's architecture is built on four interconnected layers that ensure efficiency, transparency, and seamless integration with the wider energy ecosystem. It collects real-time data from energy meters and environmental sensors, processes and secures it, and applies AI-based optimisation and flexibility forecasting before presenting insights through intuitive dashboards. Together, these layers enable data centres to operate intelligently and sustainably within Europe's evolving digital energy landscape.



Proposed layered architecture of Use Case III

Policy and regulatory alignment

Use Case III aligns with EU strategies on digitalisation, energy efficiency, and data centre sustainability. Its deployment will need to comply with several key frameworks, including the GDPR for data management, the Data Governance Act and Data Act for data sharing and interoperability, and the Interoperable Europe Act for cross-border data exchange. The forthcoming AI Act will also apply to AI-based optimisation and forecasting tools.

Energy-related regulations such as the Electricity Market Directive and Regulation, the Renewable Energy Directive, and the Energy Efficiency Directive provide the necessary framework to enable DCs to participate in flexibility markets and optimise energy use across EU countries, while the REMIT Regulation has to be followed to ensure transparency in energy transactions. The reference countries for this ODP (namely Germany, Denmark, and Sweden) offer a rather supportive regulatory setting, though differences in national frameworks may affect early deployment, as it happened for other Use Cases.

Governance

The proposed governance model for UC III foresees the ODP as a not-for-profit, member-driven organisation led by data centres and their associations. These members collaborate to optimise energy use, provide flexibility services, and reuse waste heat, gaining both efficiency benefits and stronger bargaining power in energy markets.

Other stakeholders (grid operators, energy retailers, aggregators, and district heating providers) also benefit from improved coordination and access to operational data.

A supervisory board representing the different stakeholder groups would oversee the platform, ensuring transparent decision-making and fair participation. Revenues from membership fees or service charges would be reinvested in maintaining and evolving the ODP, reinforcing its role as a shared digital utility that promotes sustainability and efficiency across Europe's data infrastructure sector.

Final considerations

This ODP provides a practical framework for improving how digital infrastructure interacts with the energy system. As data centres continue to grow in number and energy demand across Europe, their integration into flexibility markets and local energy systems becomes increasingly important.

By combining AI-based optimisation, waste heat recovery, and flexibility services, the ODP helps data centres lower energy costs and emissions while contributing to grid stability. It also fosters collaboration between data centres, energy operators, and district heating providers, promoting more efficient use of resources and alignment with EU objectives for sustainability, energy efficiency, and digital resilience.

Conclusions

The work of BEGONIA shows how ODPs can support Europe's green and digital transitions. Through three concrete Use Cases focused on consumer participation, e-mobility integration, and sustainable data centres, the project demonstrates how interoperable digital tools can connect energy, transport, and data systems in a practical way. These examples, ready for deployment, illustrate how EU policy goals can be implemented through cross-border solutions that improve efficiency, transparency, and cooperation.

Strategic alignment and challenges

While technically and strategically robust, the successful rollout of these platforms will require careful consideration of regulatory, technical, and operational challenges. Differences between national frameworks may affect progress, and ensuring interoperability, data access, and cross-border compatibility will be essential for large-scale adoption.
These challenges are, however, manageable. As Member States continue to implement the EU's evolving digital, energy and mobility legislation, the regulatory environment is becoming more consistent, creating favourable conditions for deploying open and replicable ODP solutions. In the short term, regulatory sandboxes can be used to test and adapt these systems where national frameworks are still developing.

Looking ahead

The work carried out so far provides a strong foundation for developing ODPs that enable sector coupling across energy, transport, and digital domains and between countries. As the consortium continues its testing and validation activities, further insights and refinements will emerge, supporting the practical deployment of the three Use Cases. These results will help translate the ODP concepts into actionable, interoperable solutions ready for implementation and scale-up across Europe.

Disclaimer

This ODP provides a practical framework for improving how digital infrastructure Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or HADEA. Neither the European Union nor the granting authority can be held responsible for them.

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