ODEON Technical Guidelines

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Welcome to the ODEON Open Call Technical Guidelines. This document outlines the technical requirements of the ODEON project and should be read together with the Open Call Terms and Conditions document.

Please take a moment to read this document carefully to understand the requirements and process. For any questions, please contact us at odeon.helpesk@fundingbox.com

Good luck!
ODEON Team

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1. ODEON Architecture – Narrative Description

The ODEON architecture is conceived as a **federated Cloud–Edge Data and Intelligence ecosystem** designed to enable holistic integration across **data**, **intelligence**, **services**, and **market layers** of the modern energy value chain. It responds to the structural transformation of energy systems, where **Distributed Energy Resources (DERs)**, **prosumers**, **storage assets**, **electric mobility**, and **building systems** generate vast volumes of **heterogeneous**, **distributed**, and **latency-sensitive data**. In such an environment, traditional centralized platforms are insufficient to address the simultaneous requirements of **scalability**, **low latency**, **privacy preservation**, **resilience**, and **stakeholder sovereignty**.

ODEON therefore adopts a **federated architectural paradigm** that interconnects decentralized infrastructures while preserving full stakeholder control over **data**, **policies**, and **operational assets**.

The ODEON Architecture is conceptually divided in two main tiers:

A. The **ODEON Cloud-Edge Data and Intelligence Service Platform** which consists of (i) the Energy Data Space implementations enabling the configuration and execution of the different data pipelines and operations, along with the sharing of data assets across federated data space environments, (ii) the Federated AI Containers for the design, training and execution of AI pipelines across the continuum, in an orchestrated manner instructed by (iii) the Cloud-Edge Orchestrator and Operations Manager which is responsible for the optimal coordination and execution of all DataOps and AIOps across the continuum and the federated Energy Data Space-AI Services bundles, (i.e. **centralized ODEON cloud environment** for stakeholders that cannot host their own data space, **near-edge environments** referring to private cloud/ servers that enable the execution of the necessary operations on-premise for increased security/ trust, and reduced latency, or **edge environments** in low-power devices to handle data produced at the edge and enable the execution of local intelligence/ optimization functions in a resource-efficient and latency-free manner, while addressing connectivity loss issues).

In more details, at the foundation of the ecosystem lies the **ODEON Cloud–Edge Data and Intelligence Service Platform**, which functions as a **standards-based**, **open**, and **highly federated technological backbone**. The platform spans the **cloud–near-edge–edge continuum**, allowing **data processing**, **analytics**, and **AI execution** to be dynamically positioned at the most appropriate computational layer. **Centralized cloud environments** provide **elastic scalability**, **global coordination**, and **cross-stakeholder analytics**. **Near-edge / private infrastructures** enable **localized processing**, enhanced **confidentiality**, **regulatory compliance**, and **reduced latency**. **Edge environments**, typically represented by **IoT gateways** and **low-power devices**, support **real-time data collection**, **local intelligence**, and **operational continuity** under

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connectivity constraints. This distributed deployment model ensures that **workload allocation** can be optimized according to **latency**, **connectivity**, **resource utilization**, **energy efficiency**, and **data sensitivity** requirements.

Within this continuum, **Federated Energy Data Spaces** establish the core mechanism for **secure**, **sovereignty-preserving**, and **trustworthy data management**. These decentralized environments allow stakeholders to retain **data ownership**, **governance**, and **access control**, while participating in **trusted data exchange**. Instead of enforcing central data pooling, ODEON enables controlled interoperability among **distributed Secure Stores**. **Data assets**, including both **raw** and **derived datasets**, can be shared under enforceable **access policies**, **usage constraints**, and **privacy rules**. Embedded mechanisms for **encryption**, **anonymization**, and **data minimization** ensure that sensitive information remains protected. The inclusion of **edge-level Data Minimizer functions** further enables stakeholders to regulate **data granularity** and **storage scope** according to specific operational purposes.

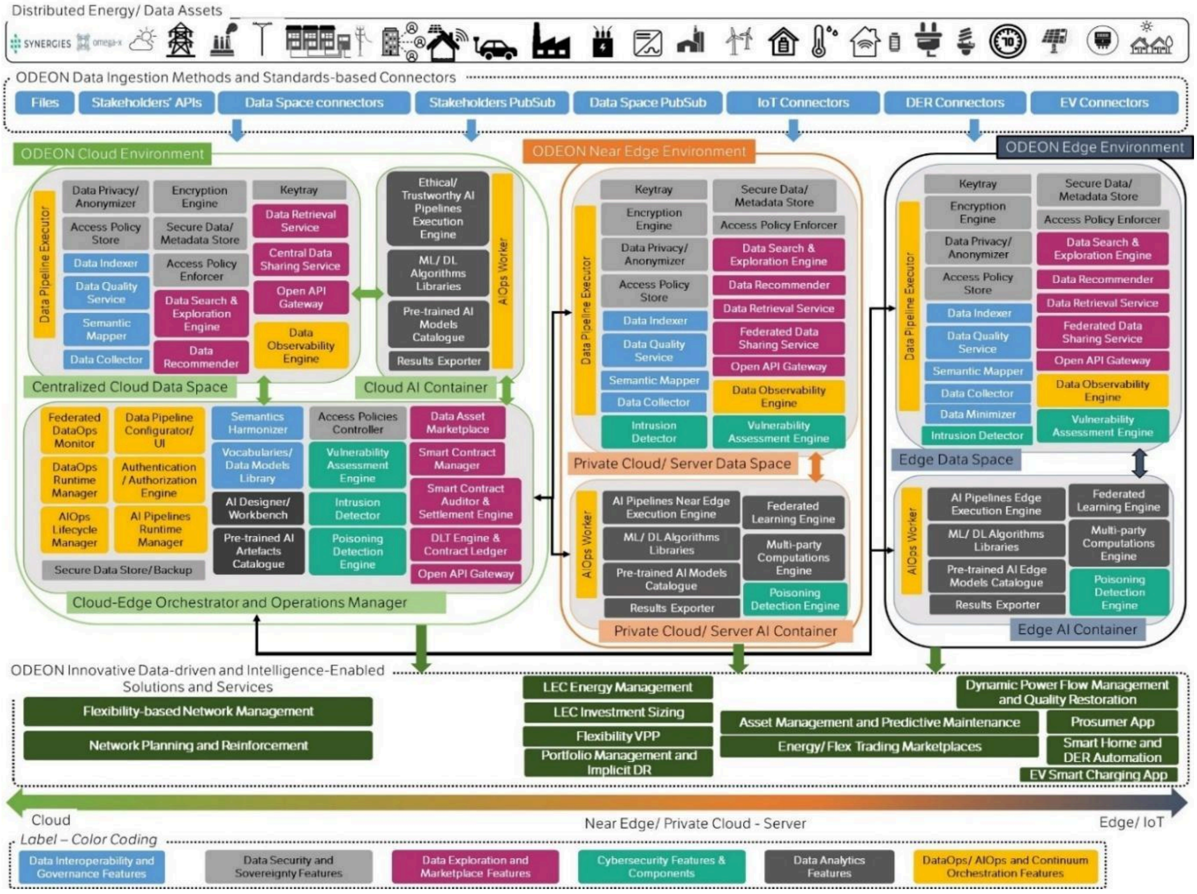

Figure 1: Bird-eye view of the ODEON Conceptual Architecture

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Semantic Interoperability forms another cornerstone of the architecture. The **Unified Semantic Data Model** harmonizes heterogeneous datasets originating from **energy**, **building**, and **mobility domains**. By leveraging **established standards cross-domain vocabularies**, ODEON ensures consistent **data interpretation** across services and applications. The **Semantics Harmonizer** facilitates **cross-standard mappings**, **vocabulary alignment**, and **model extensions** required to accommodate emerging technologies such as **flexibility assets**, **DER orchestration**, **storage systems**, and **electric vehicles**. This semantic backbone removes structural barriers between otherwise incompatible systems and establishes a **common semantic language** for **data-driven services** and **AI analytics**.

The embedded **DataOps framework** orchestrates the complete **data lifecycle**. **Data ingestion pipelines** support diverse acquisition methods, including **batch uploads**, **streaming subscriptions**, **IoT connectors**, and **APIs**. Once collected, data flows through **transformation**, **semantic mapping**, **quality validation**, and **curation processes**. **Privacy preservation** and **sovereignty enforcement** are integral to these workflows, incorporating **anonymization**, **minimization**, **encryption**, and **attribute-based access control**. The **DataOps Runtime Manager** coordinates pipeline execution across federated infrastructures, while the **Data Observability Engine** continuously monitors pipeline health, detects anomalies, and triggers corrective actions. These mechanisms collectively ensure **reliability**, **resilience**, and **performance optimization**.

Complementing DataOps, the **AIOps stack** governs the lifecycle of **Artificial Intelligence (AI)** and **Machine Learning (ML/DL) pipelines**. The architecture supports the **design**, **training**, **deployment**, **execution**, and **monitoring** of AI models across the continuum. AI workloads are encapsulated within **Federated AI Containers**, enabling **portable**, **scalable**, and **secure execution**. **Edge-optimized AI pipelines** introduce localized intelligence directly at the data source, significantly reducing **latency** and enabling **real-time decision-making**. The **Federated Learning Engine** supports collaborative model training without centralized data aggregation, preserving **privacy** and **data sovereignty**. Continuous monitoring and retraining capabilities ensure **model accuracy**, **efficiency**, and **trustworthiness**, reinforced by mechanisms such as **Poisoning Detection** and **Multi-party Computation**.

Trust, **security**, and **accountability** are deeply embedded within the architecture. **Policy-controlled data access**, **end-to-end encryption**, and secure **key/token management** ensure protection of digital assets. The **Smart Contract Framework**, supported by a **DLT-based Contract Ledger**, governs **data-sharing agreements**, enabling **transparent**, **auditable**, and **enforceable transactions**. The **Smart Contract Auditor & Settlement Engine** verifies compliance with contractual terms, monitors data usage consistency, and automates compensation mechanisms. These trust-by-design mechanisms collectively rebuild confidence in **data transactions**, **AI usage**, and **cross-stakeholder collaboration**.

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The **Cloud–Edge Orchestrator and Operations Manager** coordinates **DataOps** and **AIOps workflows**, dynamically allocating workloads, optimizing resources, and ensuring that critical operational parameters such as **latency**, **resilience**, and **energy efficiency** are satisfied. By managing **container deployment**, **pipeline execution**, and **system monitoring**, the orchestration layer enables seamless cooperation across heterogeneous infrastructures.

B. The **ODEON Innovative Data-driven and Intelligence-enabled Energy Services and Applications** including a variety of solutions deployed across the continuum, leveraging data assets and derivative intelligence from the federated data spaces and AI containers in different locations and continuum nodes to enhance grid resilience, enable flexibility markets, empower prosumers and Local Energy Communities (LECs), and support evidence-based decision-making. The application suite addresses the needs of:

- Distribution System Operators (DSOs)
- Local Energy Communities (LECs)
- Aggregators / Flexibility Service Providers
- Prosumers / Consumers
- Charging Point Operators (CPOs)
- EV users and fleet managers

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2. DSO-Oriented Applications

Flexibility-based Network Management

A digital twin-enabled solution supporting DSOs through:

- Fine-grained, real-time representation of the distribution grid
- AI-enabled forecasting for operational planning
- Anticipation and prioritization of congestion and voltage violations
- Estimation of required flexibility volumes and characteristics
- Decision support for flexibility activation within ancillary services

Network Planning and Reinforcement Assessment

A mid-to-long-term planning tool providing:

- Reliability, performance, and power quality evaluation
- Scenario-based grid evolution analysis (demand, RES, EVs, storage)
- Integration of SCADA, forecasts, demographic and asset data
- Identification of optimal reinforcement strategies
- Investment assessment and prioritization

Dynamic Power Flow Management & Power Quality Restoration

An edge-enabled operational solution offering:

- Continuous monitoring of grid segments
- Real-time tracking of power quality KPIs (voltage, harmonics, imbalances)
- Early detection of localized instabilities
- Automated power flow optimization
- Flexibility activation for stability and quality restoration

Network Asset Management & Predictive Maintenance

A near-edge analytics and optimization tool enabling:

- Assessment of asset health and performance
- Failure probability estimation
- Criticality analysis of potential outages
- Prioritization of maintenance actions
- Optimized predictive maintenance scheduling
- Maintenance logging and traceability

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3. LEC & Prosumer-Oriented Applications

Flexibility Virtual Power Plant (VPP) Configuration

A flexibility orchestration application supporting:

- Segmentation and classification of flexibility profiles
- Clustering of distributed assets into optimized VPPs
- Consideration of asset constraints and contractual parameters
- Dynamic reconfiguration of flexibility portfolios
- Delivery of ancillary services to DSOs

Flexibility Trading Marketplace & Smart Contracts

A market-enabling platform facilitating:

- Participation of distributed flexibility providers
- Flexibility bidding and market clearing
- Smart contract-based transactions
- Automated settlement and penalties
- Monitoring of contractual compliance
- Transparency of realized benefits

Personalized Prosumer Engagement & Capacity Building

An edge-deployed application providing:

- Intuitive dashboards based on real-time energy data
- AI-driven forecasts and flexibility insights
- Context-aware notifications and recommendations
- NILM-based analytics for enhanced user understanding
- Awareness and education on flexibility participation

Smart Home & DER Automated Control

A human-centric automation solution enabling:

- Intelligent control of flexible loads and DERs
- Self-consumption maximization strategies
- Participation in explicit demand response
- Translation of high-level flexibility strategies into device-level actions
- Comfort-aware and non-intrusive operation

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Smart EV Charging (G2V / V2G)

An optimization-driven charging management solution supporting:

- Dynamic load balancing
- Cost- and RES-driven charging strategies
- Battery wear-aware optimization
- Fleet and driver constraint handling
- Participation in flexibility services
- Scalable and cyber-secure deployment

LEC Energy Management & Self-consumption Optimization

A community-level optimization application offering:

- Monitoring of energy flows and performance KPIs
- AI-based demand and generation forecasts
- Optimal coordination of DERs, storage, and loads
- Continuous strategy evaluation and refinement
- Reduction of energy costs and grid dependency

Community Portfolio Management & Elasticity-based Demand Response

A portfolio intelligence tool enabling:

- Price elasticity inference
- Implicit demand response via dynamic pricing
- Imbalance reduction
- Market participation optimization
- Forecast-driven portfolio management

Community-based P2P Energy Trading Marketplace

A local energy trading environment providing:

- Peer-to-peer energy transactions
- Automated market clearing
- Smart contract enforcement
- Distributed ledger-based settlement
- Monitoring of economic benefits

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RES & DER Investment Sizing and Guidance

A digital twin-enabled decision-support application supporting:

- Evaluation of alternative investment scenarios
- Assessment of self-consumption and flexibility KPIs
- Economic feasibility analysis (ROI, IRR, payback)
- Ranking of investment options
- Informed decision-making for RES and flexible assets

4. AI artefacts

This is the summary of the characteristics of each AI artefact included in the ODEON Catalogue. For each artefact category, the common features and the main differences among artefacts are described in a uniform and coherent way.

1. Load Forecasting Models (LFM)

Approximate number of artefacts: ~12

General purpose: Predict short-term to long-term electricity demand at different levels (building, prosumer, portfolio, grid) to support operational planning, flexibility management and energy services.

Common Characteristics: These artefacts use historical electricity consumption time series, often complemented with weather information and calendar variables. They usually require a minimum historical window of 7–14 days, depending on the model and the temporal granularity (15-minute or hourly). Their outputs are multi-step forecasts expressed as pandas DataFrames, covering horizons that range from short (1–6 hours) to full day-ahead predictions or even monthly projections. They are implemented predominantly as supervised learning models, typically regression-based or tree-based pipelines, sometimes with compiled components when intellectual property must be protected.

Main Differences: The artefacts in this category differ primarily in their prediction horizon, their spatial scope, the complexity of their feature sets and the implementation technologies used. Some models are tailored for ultra-short-term operation (for example, hourly or 6-hour horizons), whereas others are designed for 24-hour day-ahead forecasts or long-term projections at monthly granularity. Their intended scale varies from individual buildings and prosumers to aggregated portfolios or even entire substations. Differences also arise from the feature engineering strategy: while some artefacts use only lagged consumption values, others incorporate weather forecasts, holiday indicators, and time-of-day encodings that capture local behaviours. Finally, implementation choices range from simple scikit-learn pipelines to more

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complex compiled pipelines designed to secure intellectual property and improve performance during execution.

2. Renewable Energy Generation Forecasting Models (REGFM)

Approximate number of artefacts: ~17.

General purpose: Generate forecasts for PV or wind generation at different levels (household, asset, district, grid segment) to support VPP operation, flexibility management and energy services.

Common Characteristics: These artefacts rely on historical generation data combined with meteorological forecasts such as irradiance components, temperature, or wind speed. They typically operate at 15-minute or hourly resolution and require several days of historical information. Their outputs are generation forecasts for horizons ranging from 1 hour to 48 hours or, in some cases, month-ahead predictions. Most artefacts follow supervised regression approaches, although some integrate physical modelling components, especially when simulating PV generation based on irradiance and plant geometry.

Main Differences: Differences across artefacts in this category relate to the targeted renewable technology, the spatial coverage, the forecasting horizon, and the modelling philosophy. Certain artefacts are specific to PV generation using irradiance-driven features, while others focus on wind using speed and direction characteristics. Their scale ranges from highly local household-level forecasters to district-level or grid-segment models. Horizons vary from intra-day to full 48-hour community forecasting. Some artefacts adopt purely data-driven techniques, while others combine data-driven inference with physical simulation to better capture the behaviour of renewable systems. As a result, artefacts differ in the extent to which they rely on sensor measurements, meteorological forecasts, and plant-specific parameters.

3. Operational Planning Congestion Management Tools (OPCMT)

Approximate number of artefacts: 2

General purpose: Support grid operators by estimating flexibility capacity or thermosensitivity in order to anticipate congestion and operational constraints.

Common Characteristics: These artefacts process historical asset measurements, baseline forecasts or network telemetry, often complemented with temperature or other contextual information. Their outputs include flexibility envelopes (minimum, expected and maximum capacity) or thermal thresholds indicating how loads and weather jointly affect grid stress. They operate at hourly granularity and support aggregation at feeder or substation level.

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Main Differences: The artefacts differ in their analytical focus, the type of risk they quantify, and the level of aggregation they address. One focuses on predicting upward and downward flexibility capacity for assets or aggregated nodes, while the other concentrates on estimating temperature-driven load sensitivity using quantile regression to identify risk thresholds. Their methodological foundations also vary, with some emphasising behavioural flexibility extraction from historical activations and others applying statistical techniques to discover temperature–load relationships. The type of operational insight they produce therefore ranges from flexibility headroom estimation to identification of weather-driven overload conditions.

4. Market Price Forecasting Tools (MPFT)

Approximate number of artefacts: 3

General purpose: Provide price forecasts for different electricity markets (day-ahead, intraday, continuous) to support trading strategies and community portfolio optimisation.

Common Characteristics: The artefacts ingest historical price time series together with engineered features derived from temporal structures (hour of day, day of week, month, holidays). They produce multi-step price forecasts for horizons of 24 to 48 hours and operate at 1-hour or 15-minute granularity. Models are mainly supervised regressors using engineered lags and seasonal patterns.

Main Differences: Differences arise primarily from the target electricity market, the temporal granularity and the forecasting horizon. Some artefacts are specialised in hourly day-ahead prices, others in intraday markets using higher-resolution data, and a subset addresses continuous markets where 15-minute granularity is required. Although the core regression methodology is similar across artefacts, the feature engineering approach, the sensitivity to market-specific dynamics and the horizon covered lead to variations in design and performance expectations.

5. Virtual Sensors (VS)

Approximate number of artefacts: 1

General purpose: Infer unmeasured physical quantities for asset health monitoring and predictive maintenance.

Common Characteristics: The single artefact in this category estimates internal transformer variables—such as top-oil temperature—using load-related measurements and ambient temperature forecasts. It produces time-indexed predictions with the same granularity as the input.

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Main Differences: This category contains only one artefact, so internal variability does not arise. The only differences relevant within the category are related to the operational parameters provided during execution, such as temperature forecasts or asset-specific ratings.

6. LEC Clustering Tools (LECCT)

Approximate number of artefacts: 2

General purpose: Segment customers into behavioural or elasticity-based profiles to support tariff design and flexibility management in Local Energy Communities.

Common Characteristics: These artefacts rely on user-level time series (consumption and generation) or questionnaire-based building characteristics. They transform these into behavioural or elasticity features and feed pre-trained unsupervised models (e.g., clustering algorithms) to assign users to distinct profiles or archetypes.

Main Differences: Differences emerge from the nature of the segmentation approach and the type of input information required. Some artefacts classify users according to their responsiveness to price signals, using correlations and consumption patterns across hourly and weekly cycles. Others identify archetypes based on building characteristics and long-term behavioural data, without relying on price information. As a result, the underlying feature spaces differ significantly, leading to differences in the interpretability of clusters and the applications they support in community-level decision mechanisms.

7. Asset Behaviour Prediction Models (ABPM)

Approximate number of artefacts: 1–2

General purpose: Predict operation-related variables such as required EV state of charge or asset-specific consumption to support scheduling and fleet operation.

Common Characteristics: These artefacts use historical measurements, operational context (e.g., past trip distances or battery characteristics) and temporal features to estimate future asset requirements. Their outputs are operational set-points such as required SOC percentages or expected consumption values.

Main Differences: The artefacts vary in the specific assets they target, the operational parameters they predict, and the contextual features they require. Some models focus on EV fleet operation, combining trip information with vehicle characteristics, while others address building or device-specific behavioural modelling. The scope and nature of the required operational features thus differ, leading to variations in how the artefacts interpret historical data and generate future operational requirements.

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5. Core Architecture Tiers

A. ODEON Cloud–Edge Platform Layer

This layer provides the **digital backbone** enabling:

Federated Energy Data Spaces

Decentralized environments where stakeholders:

1. Maintain full control over their data
2. Share data securely under enforceable policies
3. Exchange raw and derived data assets

Key functions:

- Secure storage of data & metadata
- Access policy definition & enforcement
- Privacy preservation & anonymization
- Data minimization at the edge

Semantic Interoperability Framework

Ensures harmonization of heterogeneous data via:

- Unified Semantic Data Model
- Cross-domain ontology alignment (energy, buildings, mobility)
- Standards-based mappings (IEC, SAREF, OCPP, OpenADR)

DataOps Automation

Supports the full data lifecycle:

- Multi-source data ingestion (APIs, IoT, streams, batch)
- Semantic mapping & transformation
- Data quality & curation
- Privacy, minimization & encryption
- Pipeline observability & monitoring

Distributed AI & AIOps Stack

Enables:

- AI pipeline design & lifecycle management
- Federated AI container deployment
- Distributed training & inference
- Edge-optimized AI execution

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- Continuous monitoring & retraining

Includes:

- AI Designer / Workbench
- AI Pipelines Runtime Manager
-
- Federated AI Containers
- Federated Learning Engine

Trust & Smart Contract Framework

Provides:

- Contract-based data sharing & monetization
- Transparent, auditable transactions
- Usage compliance verification
- Automated settlement mechanisms

B. ODEON Energy Services & Applications Layer

Built on top of the platform layer, this tier delivers **stakeholder-facing innovation**, including:

- Flexibility & Demand Response services
- DER & storage optimization
- Predictive maintenance
- Energy efficiency applications
- Prosumers & LEC empowerment tools
- Decentralized control mechanisms

The Energy Services and Applications will be demonstrated through the resources and infrastructure of five pilot sites located in Spain, Greece, France, Denmark, and Ireland.

External Open Call projects are primarily expected to **extend this layer**.

6. Key Platform Capabilities Relevant to Applicants

ODEON provides a comprehensive Cloud–Edge Data and Intelligence Service Platform that already implements the core technological building blocks required for secure, interoperable, and sovereignty-preserving data and AI operations. The objective of this Open Call is to fund external innovations that extend and complement this ecosystem rather than duplicate its baseline infrastructure. To ensure seamless interoperability and minimize integration complexity, ODEON follows an **API-centric integration model**. External solutions developed by FSTP

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beneficiaries are expected to interact with the platform primarily through standardized interfaces for data access, AI interaction, and AI analytics consumption.

Within the Open Call framework, external projects will integrate with ODEON by:

- Accessing **datasets** via secure APIs
- Retrieving **AI analytics results and insights**
- Publishing **derived data products or analytics outputs**

This approach allows applicants to leverage ODEON capabilities without modifying or replicating internal platform mechanisms. By interacting through APIs, FSTP projects gain immediate access to a **secure**, **federated**, and **semantically harmonized** ecosystem while ensuring their solutions naturally complement the ODEON platform. The API-first integration strategy:

1. Preserves **architectural integrity**
2. Prevents **functional duplication**
3. Ensures **technology neutrality** for applicants
4. Enables **rapid onboarding** of external solutions
5. Maximizes **reusability of ODEON services**

Expected Role of External Solutions

External projects are encouraged to deliver:

- **Value-added energy services and applications**
- **AI and analytics modules**
- **Optimization and decision-support tools**
- **Visualization and user-facing dashboards**
- **Domain-specific enhancements**

These solutions should **consume**, **exploit**, or **enhance** ODEON services.

Integration Touchpoints

Applicants should design solutions that interface with:

- **ODEON Open API Gateway** for data and service interaction
- **Federated Data Spaces** (via APIs, not direct modification)
- **AI Pipelines Execution Engines** for analytics consumption
- **Results Explorer / visualization endpoints**

Complementarity and Non-Overlap Requirement

ODEON already delivers core platform capabilities, including:

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- Federated Data Space infrastructure
- DataOps orchestration mechanisms
- Semantic harmonization framework
- AIOps lifecycle management
- Federated AI Containers
- Cybersecurity and privacy mechanisms
- Smart Contract and DLT framework
- Marketplace infrastructure

Accordingly, proposals **must not**:

- Introduce competing platform infrastructures
- Replicate data governance or orchestration layers
- Replace semantic interoperability mechanisms
- Propose alternative marketplaces or ledgers

Proposals **should instead**:

- Extend platform functionality
- Build innovative services on top of ODEON
- Deliver specialized analytics or AI pipelines
- Provide domain-specific intelligence

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