The HEDGE-IoT Framework will be implemented, showcased and validated in 6 Large-Scale field Demonstrators set in 6 European countries featuring different climatic, regulatory and social conditions.

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HEDGE-IoT

DEMO 1

Locations in Eastern Finland, covering JSE's MV/LV distribution network, including 2 primary substations, ~420 secondary substations,and ~5900 customers.

Finland

Technology

The Finnish demo integrates ABB's grid virtualized automation platform and Intelligent Electronic Devices (IEDs) to monitor and manage the MV/LV distribution network in real-time. Edge-cloud data exchange is enabled via industry-standard communication protocols like IEC 61850 and 60870-5-104.

Advanced connectivity through 5G and other hybrid solutions ensures low-latency transmission, supporting distributed grid intelligence and proactive asset management across the network.

Key Use Cases

- Distributed grid monitoring and asset management
- Congestion management and grid flexibility
- Real-time data sharing across stakeholders
- Integration of DERs and edge intelligence for resilience

Target Audience/Beneficiaries

- DSOs benefiting from enhanced observability, automation, and grid reliability
- Grid Operators and technical partners using real-time data for advanced grid analytics
- Energy service providers leveraging flexible data sharing for added-value services
- Consumers indirectly benefiting from improved quality of service and fewer outages

HEDGE-IoT Tools Involved

- ABB Edge Platform and SSC600 extensions
- Real-time CM service (IEC61850-based) and anomaly detection modules
- Eclipse Dataspace Connectors and Interoperable Middleware for secure multi-party data sharing

Partners involved: ABB, ENERVA, Järvi-Suomen Energia, Tampere University, VTT

DEMO 2

Primary activities in the Athens Metropolitan Area, with an additional testing/replication site in Western Macedonia through CluBE.

Greece

Technology

The Greek demo features a distributed AI-IoT architecture that connects smart meters, IoT-enabled PV systems, and V2G chargers across urban and regional settings.

Edge and cloud platforms are linked via interoperable middleware to ensure secure and real-time data exchanges among aggregators, DSOs, TSOs, and the energy market.

Federated and reinforcement learning models are applied to forecast flexibility, optimize demand response strategies, and enable dynamic participation in local flexibility markets.

Key Use Cases

- Residential flexibility asset monitoring
- Market-based activation of flexibility through LFM signals
- AI-driven DR (Demand Response) using federated learning
- Real-time interoperability among aggregator, DSO, TSO, and energy exchange
- Integration of flexibility potential forecasting and grid stability analysisd
- Demonstration of flexibility services scaling across urban and rural contexts

Target Audience/Beneficiaries

- Residential consumers through demand-side flexibility programs and submetering
- Aggregators (PPC) deploying federated AI for real-time response
- DSOs/TSOs (HEDNO, IPTO) for accurate grid state estimation and flexibility procurement
- Energy market stakeholders (HEnEx) testing new trading mechanisms
- Energy communities (CluBE) showcasing replicability across rural-urban divide

HEDGE-IoT Tools Involved

- Interoperable middleware for secure market and grid interaction
- Federated Learning module for flexibility optimization
- HEDGE-IoT Edge platform for submetering and real-time control
- Local Flexibility Market (LFM) digital trading environment
- IoT-enabled data governance framework based on IDS concepts

Partners involved: AEH, ipto, HEDNO, enex, CluBE, hse, Que technologies

DEMO 3

Multiple locations across Northern and Central Italy, focusing on energy communities and low-voltage network flexibility management.

Italy

Technology

In Italy, the demo focuses on activating and managing flexibility by combining demand response strategies with forecasting tools based on localized weather data. IoT weather stations, sub-metering systems, and edge-based optimization algorithms for aggregators enable real-time prediction and control of energy flows.

The integration of distributed energy resources (DERs) into Areti's distribution grid supports a more resolient and efficient energy community model.

Key Use Cases

- Predictive load and RES forecasting for improved flexibility
- Real-time grid monitoring to prevent congestion
- Integration of market signals for flexibility activation
- Improved decision support for community operators and DSOs

Target Audience/Beneficiaries

- DSO benefiting from community-based flexibility and real-time load balancing.
- Energy Communities organized locally with active prosumer participation.
- EV drivers through optimized charging and incentive mechanisms.
- Municipality and vulnerable citizens via access to surplus RES and energy poverty mitigation.

HEDGE-IoT Tools Involved

- IoT/Edge infrastructure and forecast algorithms
- Real-time analytics services for flexibility management
- Semantic adapters and interoperability middleware
- Visualization dashboards and UI for community engagement

Partners involved: areti, ISI, Aplio, Acea energia, E.ON Energy Research Center, RWTH AACHEN UNIVERSITY

DEMO 4

Located in the Arnhems Buiten Business Park, Arnhem – a 17-hectare mixed-use area under development as an Energy Innovation Campus.

The Netherlands

Technology

The Dutch demo deploys smart meters, V2G charging stations, residential batteries, heat pumps, and solar PVs across 15 buildings. These assets are coordinated through Building and Energy Management Systems (BEMS/EMS) and enhanced with semantic adapters based on SAREF ontologies.

A Knowledge Engine and an edge-cloud IoT architecture allow seamless communication and control, enabling real-time energy optimization and flexibility operations at both the user and system level.

Key Use Cases

- Monitoring and visualization of energy consumption across buildings
- Semantic integration and alignment of distributed energy assets
- Flexibility services through predictive optimization and V2G
- Grid fault detection and predictive maintenance via anomaly detection

Target Audience/Beneficiaries

- Building managers and facility owners involved in energy efficiency projects
- Residential users participating in energy shifting and flexibility trials
- EV users and tenants interacting with EMS and smart charging infrastructure
- DSOs and service operators accessing real-time insights for system balancing and flexibility

HEDGE-IoT Tools Involved

- Knowledge Engine (KE) with explainable AI on SAREF data
- Semantic adapters and data pipelines
- Data conversion pipelines into knowledge graphs
- Edge-based control, anomaly detection, and scheduling tools

Partners involved: ARNHEMS BUITEN, TNO innovation for life, VU Vrije Universiteit Amsterdam

DEMO 5

Focused in Metropolitan Porto area, across commercial buildings, energy communities, and residential users.

Portugal

Technology

The Portuguese demo revolves around the EdgeConnect platform, which enables real-time coordination of flexibility services through integration with building and energy management systems (BEMS/EMS), smart meters, and PVs.

Semantic adapters and interoperable data layers facilitate smooth communication between assets and stakeholders while digital twins are used to model flexible resources and predict system behavior, supporting multi-market participation and advanced demand-side flexibility activation.

Key Use Cases

- Activation and orchestration of demand-side flexibility across commercial and residential assets
- Integration of multiple flexibility value chains (balancing, congestion, market trading)
- Interoperable data exchange across actors via data space infrastructure
- Intelligent forecasting and valorisation for grid and market-based services

Target Audience/Beneficiaries

- Energy communities and building managers participating in coordinated flexibility aggregation
- Commercial and industrial prosumers accessing value through dynamic flexibility valorisation
- DSOs and market operators integrating BEMS/EMS systems multi-market orchestrationinto
- Technology providers contributing with semantic adapters, forecasting tools, and digital twins

HEDGE-IoT Tools Involved

- EdgeConnect platform for edge-cloud orchestration
- OptiFlex tool for flexibility asset scheduling and valorisation
- EnergyBox for asset-level monitoring and control
- Semantic interoperability connectors for standardized data exchange

Partners involved: CEVE, MC Sonae, elergone energia, INESCTEC, R&D NESTER, REN

DEMO 6

Located in Gorenjska region - including MV/LV substations and local DSO grid operated by Elektro Gorenjska

Slovenia

Technology

Slovenia's demo leverages edge-based Dynamic Thermal Rating (DTR) and Dynamic Line Rating (DLR) systems integrated into substations to enhance grid situational awareness. These systems collect real-time data through intelligent sensors, GIS layers, and environmental models.

AI-powered tools process this data to support predictive grid planning and automation while a unified semantic modeling layer ensures interoperability between heterogeneous data sources and grid components.

Key Use Cases

- Real-time dynamic thermal and line rating
- Asset lifetime extension through predictive analytics
- Enhanced visibility of LV networks with edge sensors
- Semantic data fusion for operational decision-making
- Autonomous grid resilience management using AI

Target Audience/Beneficiaries

- TSO using predictive and AI-based analytics for enhanced grid monitoring
- DSOs and operators benefiting from dynamic line ratings and automated substation intelligence
- Grid planners and engineers accessing detailed semantic models and enhanced data integration
- Citizens and energy communities indirectly benefiting through improved grid stability

HEDGE-IoT Tools Involved

- PowerCIM semantic integration and mapping services
- ML-based services for DER hosting capacity and grid forecasting
- Edge analytics components for DTR/DLR execution
- Data exchange and monitoring platform for real-time grid status
- Secure interoperable middleware enabling cross-domain data flow

Partners involved: skupina elektro gorenjska, ELES, KONČAR DIGITAL, OPERATO, FER Faculty of Electrical Engineering and Computing, Institut "Jožef Stefan" Ljubljana, Slovenija

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