interconnect

Pilots' **results**

D6.18 Booklet describing the demonstrations and the results of monitorning and evaluation

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InterConnect

InterConnect represents a holistic approach to transforming the energy sector, one that prioritizes collaboration, innovation, and sustainability to create a brighter future for all. The EU funded InterConnect project has been dedicated to shaping the future of energy ecosystems by focusing on three main objectives to:

1. Implement **semantic interoperability framework** within large scale pilots with interoperable devices, services and platforms
2. Engage citizens and other stakeholder in **co-creation and implementation** of innovative energy and non-energy services and their business models
3. Enhance efficiency in energy use, integrate **digital platforms** and services and drive **energy sector innovation**

1. Its primary goal is centred around designing an **interoperable marketplace toolbox** supported by a **novel IoT reference architecture**, streamlining the integration of diverse digital platforms while adhering to established standards such as SAREF. This foundational work is crucial for empowering various stakeholders to focus on developing innovative services within a **human-centric energy ecosystem**. Through large-scale pilots, InterConnect aimed to demonstrate the practical implementation of a **digital marketplace** comprising different platforms, ensuring the **satisfaction of energy users' needs** with cost-effective solutions while upholding stringent **cybersecurity** and **data privacy standards**.
2. Furthermore, the project places a strong emphasis on **co-creation with citizens** to design both energy and non-energy services and applications. By engaging citizens in this process, InterConnect seeks to foster business models and grid operations that prioritize **efficiency, sustainability, and overall well-being** in living environments. Leveraging advancements in **Smart Grids, Smart Homes/ Buildings, and ICT**, InterConnect envisions a future where digital-based marketplaces **enable prosumers to easily trade energy and services**.
3. Finally, InterConnect strives to enhance **efficiency** in energy usage and drive innovation in the sector. By InterConnecting **MSP platforms** and adopting a multidomain strategy, the project addresses market needs while **lowering barriers** to marketplace usage, ultimately facilitating the orchestration of **service offers and workflows**.

What	Reference solution for IoT and energy applicable to pilot sites	Multi-side platforms supporting the EU Digital Single Market	User-centric large scale pilots with diverse and rich ecosystem of devices and applications	Innovation ecosystems fostering wider business uptake
How	Standards-based reference architectures (SGAM, RAMI, AIOTI HLA, ISO/IEC)	Validate through pilots	Validate and extend SAREF as the core convergence ontology for IoT and energy in EU and beyond	Open call to foster innovation and application/service proliferation
1	Leverage & integrate H2020, BRIDGE, IoT EPI, Fiware and industry driven standards	Co-creation and user engagement	Industry and academia engagement in seeking consensus for semantic interoperability	Validation of state of the art AI and ML applications
2	Instantiation to pilot specific setup and regulation	Engagement of academia and market stakeholders	Engage with relevant SDOs & consortia	Validate energy trading scenarios including using blockchains
3		Engage with standard bodies and regulators		
Goal	Large scale pilots leading to market driven deployments	Marketplace of integrated digital platforms bridging the gaps between IoT and energy	Establish interoperability framework validating SAREF and semantic operability	User-centric energy and non energy services

Transforming the energy sector to prioritize **collaboration**, **innovation**, and **sustainability** to create a brighter future for all!

Map

Belgium

Residential, Commercial and Tertiary

Germany

Residential & Commercial

Portugal

Residential & Commercial

France

Residential & Commercial

Netherlands

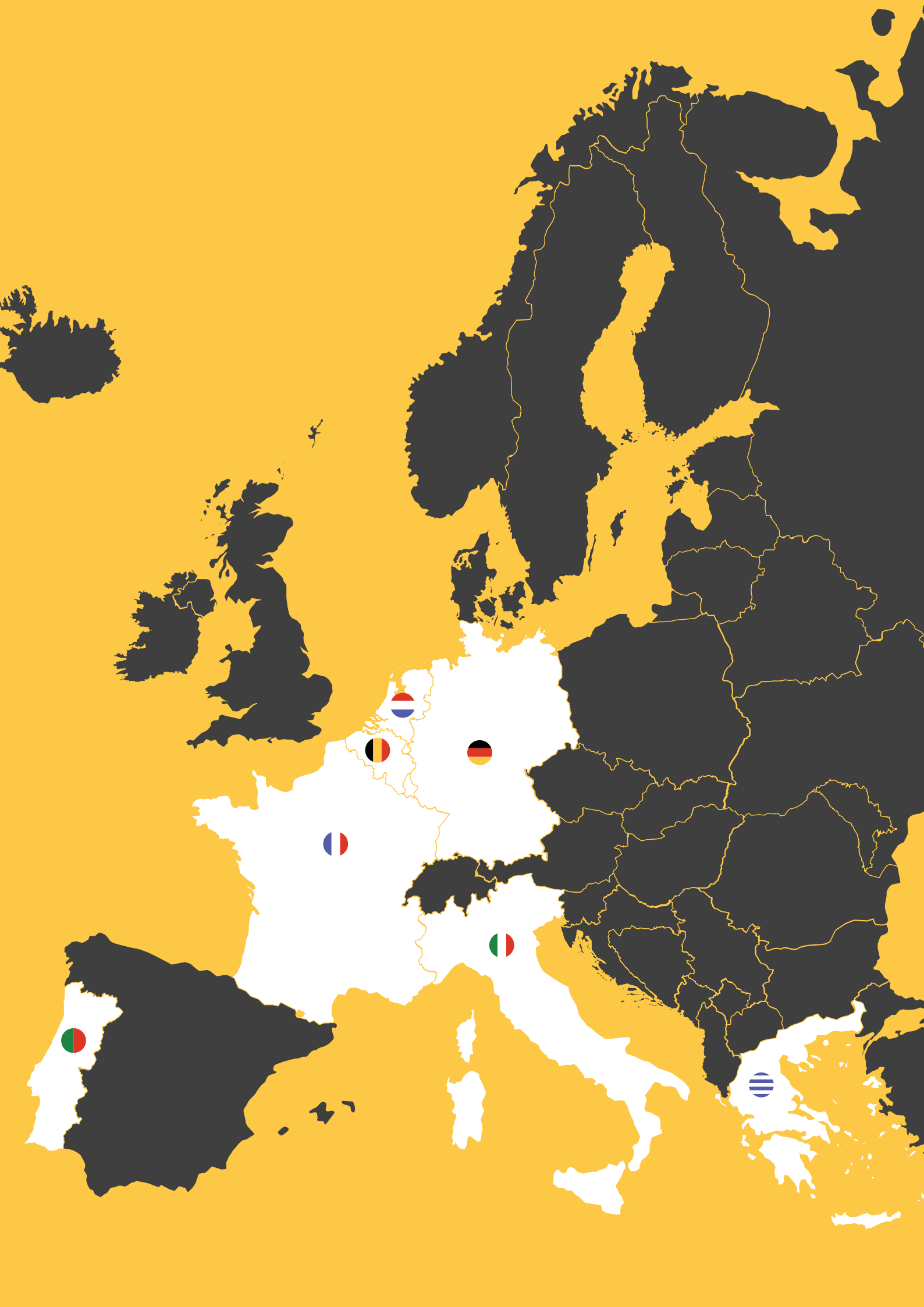
Residential & Commercial

Greece

Residential

Italy

Residential



Overarching pilot

The overarching pilot demonstrates the true potential of flexibility at European level. The pilot uses CyberGrid's platform, CyberNoc, to interact with country-level pilot platforms to act as a virtual aggregator, thereby demonstrating the full chain from device over aggregator to the (virtual) flexibility market. Pan-European adoption does not mean creating one platform to cover all of Europe, the overarching pilot within InterConnect acts as a facilitator for cross-border data exchange.

Main innovation

The implementation of a SAREF-ised flexibility aggregation platform that facilitates cross-border flexibility data exchanges.

The leverage of the InterConnect interoperability framework to expand the flexibility markets to new participants and stakeholders at the LV and MV level, enabling pan-European adoption.

Type of pilot

↳ Virtual platform including residential and commercial end-users

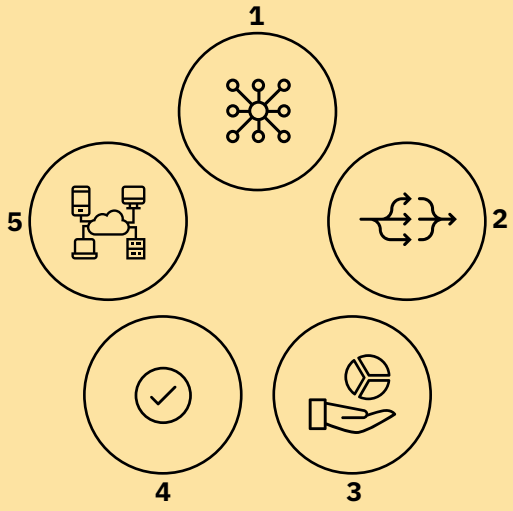
Pilot location

↳ CyberGrid is located in Austria, Vienna; the overarching pilot is involved in Greece, France, Germany, Portugal, Belgium, and Netherlands

Key achievements

9 subpilots within 6 Member States connected using **semantic interoperability framework** and allowing flexibility provisions.

Aggregated flexibility from 9 subpilots offered to a **simulated TSO**, as a key market player.



1 **CyberNoc collects data** (active power and flexibility forecasts) from the platforms/ assets of pilots

2 **CyberNoc aggregates the flexibility**

3 **CyberNoc offers** this aggregated flexibility as **BIDs to the simulated market**

4 If BIDs are accepted: simulation the TSO sends **continuous activation (aFRR) or scheduled activation (mFRR)**

5 **CyberNoc de-aggregates** the activation signals and sends them to the **platforms/assets**

Links

↳ Presentation of the overarching pilot

Partners involved

Greece

The Greek pilot provided residential end-users a comprehensive approach to energy management, combining semantic interoperability, open-source technologies, consumer engagement, and advanced analytics to optimize energy usage and enhance user satisfaction.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Smart meters
- IoT gateways
- Sensors
- Electric water heater controllers
- White goods
- Heat pump
- Mobile app for user engagement and Demand-Response notification/feedback

Main innovation

An integrated and interoperable Smart Home use case including energy monitoring and management system, home comfort and security services to achieve more efficient energy use in a large residential community.

Demand Side Flexibility services based on machine learning algorithms, which exploit high-temporal resolution measurements for accurate demand forecasting, to provide grid flexibility through the active participation of large residential communities in energy markets.

Digital interface that allows residential end-user engagement and tailoring of services based on user preference supported by advice based on advanced data analytics.

Type of pilot

↳ Residential: 270 residential users (single family houses and apartments)

Pilot location

↳ Athens, Volos and Thessaloniki

Key achievements

Enabled semantic interoperability among diverse energy and non-energy services.

Incorporated existing open-source home automation systems to harness the flexibility and community support offered by these platforms.

Enabled technology-agnostic interoperability of various sensor types enhancing flexibility and scalability.

Successfully implemented mechanisms to gather consumer feedback and preferences to enhance engagement and allow user-tailored services.

Implemented DSF services which enhances the accuracy of predictive models for DSOs and encourages energy-saving behaviours among consumers.

Demonstrated holistic approach to energy management by utilizing home comfort and physical security data to improve energy efficiency and maximize the value of existing services.

Provided flexibility from residential consumers to the OV pilot.

Links

↳ Animated introduction of Greek pilot
↳ Animated introduction of Greek pilot (Greek)
↳ Semantic Interoperability Framework
↳ Testimonial by Donatos Stavropoulos - GRIDNet

Partners involved

GRIDNET, Miele, COSMOTE, DAIKIN, inetum., WINGS, B/S/H/, HERON, Whirlpool

France

French pilot has worked with residential end-users and public buildings to enable intelligent management of energy guided by cost and energy savings. It uses SIF to enable orchestration of multiple energy management systems within single home, manage devices to take advantage of dynamic electricity tariffs and maximize use of locally available renewable energy.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Smart power meters
- Gateways
- Electric water heater controllers
- Electric heating radiator controllers
- White goods
- Heat pumps
- EV chargers
- Sensors that measure temperature, humidity, and CO_2

Main innovation

Smart orchestrator to manage various interoperable energy management systems of different devices within the same household.

Maximised the use of locally produced renewable energy by managing interoperable devices.

Managed usage of various devices of residential users to take advantage of the dynamic electricity tariffs for cost savings.

Type of pilot

↳ Residential: 108 households (Engie and ThermoVault)
↳ Commercial: 13 public buildings, a public school, museum, mayors office, municipality buildings and Yncréa public building)

Pilot location

↳ Metropolis of Toulon Provence Méditerranée and some customers in Marseille region

Key achievements

Optimal activation of available local flexibilities in preventive or emergency scenarios, using interoperable ICT solutions, relying on existing smart metering infrastructure.

Allowed Demand Side Flexibility by residential end-users using interoperable appliances, smart heating devices and heat pumps to take advantage of dynamic tariffs.

Improved building energy efficiency by using devices that track energy use in real-time and a user-friendly interface that clearly shows how and where energy is being used.

Maximized use of local RES for peer to peer energy trading within the energy community of public buildings in Le Pradet, France.

Provided aggregated flexibility from public buildings to the OV pilot.

Links

↳ Presentation of the French pilot
↳ Testimonials by Mayor of Le Pradet

Partners involved

Trialog, ENGIE, inetum, THERMO VAULT, Miele, ENEDIS, DAIKIN, ISEN, yncréa, Wirelane, Whirlpool

De Nieuwe Dokken
Ghent, Belgium

Belgium

The Belgium pilot of the InterConnect project is divided in eight different sites, located in seven cities – Antwerp, Genk, Ghent, Hasselt, Kobbegem, Oud-Heverlee and Zellik and managed by different partners.

Demonstrated

Overall the Belgian pilot demonstrated:

- Applicability and value of a common ontology with residential (apartments, single family homes, social housing) and commercial (office and research) end-users and various services
- Variety of services that can be offered to both end-users, energy communities, aggregators and DSOs in the future
- Pilots that include multiple energy vectors with holistic view to environmental benefits

Imec HomeLab

The IDLab-Imec HomeLab is a **unique liveable residential test and co-innovation environment for smart home services and devices**. The HomeLab has been used in the pre-testing phase (e.g. Daikin heat pump) before being installed in the pilots spread over different countries in Europe.

Links

↳ Testimonial by Lucija Rakocevic - Th!nk E
↳ Presentation of the Belgian pilot
↳ Animated introduction to the Belgian pilot (Dutch)
↳ Animated introduction to the Belgian pilot
↳ Interview with Thierry Coosemans - VUB
↳ Information session on white goods (Dutch)

Imec (BE.01)

Imec Belgium subpilot demonstrates how gamification method can be used through digital platform to nudge residential end users to change intended timing of use of household appliances. The aim has been to motivate end users to shift time of use of appliances to match optimal energy prices and achieve savings, as well as reduce their carbon footprint and promote the continuous use of the solutions developed by the InterConnect project increasing the social impact of the project across Europe.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- White goods

Main innovation

Interoperable gamification app that nudges and motivates residential end users to shift their consumption to periods of day when saving can be made. The app promotes the use of the smart white goods devices through competition of most energy saved or least carbon footprint in various time periods (e.g., week, month, etc.). This creates a social wave of healthy competition where energy saving and reduced CO_2 emissions are the goal.

Type of pilot

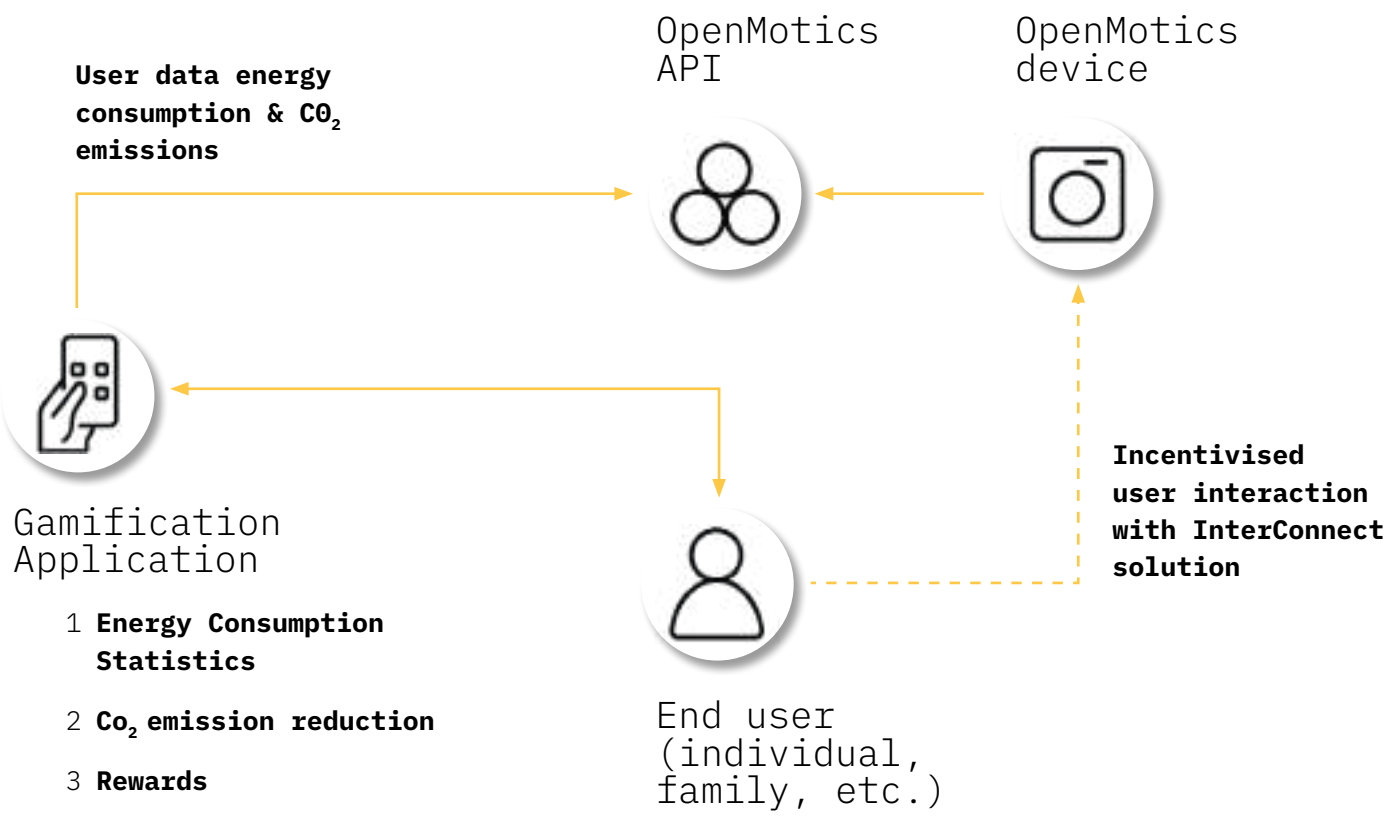
↳ Residential: applied in households from BE04 pilot

Pilot location

↳ De Nieuwe Dokken, Ghent

Key achievements

Demonstrated interoperable communication between home appliances and gamification application platform.



Partners involved

OpenMotics imec

ThermoVault (BE.02)

ThermoVault Belgium subpilot demonstrated how management and upgrade of existing thermal loads (electric water and space heaters) of 86 residential end users living in apartment and social housing can be used for optimizing energy costs of residential end users, enabling peak shaving and providing balancing services on the energy market.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Electric water heater controllers
- Electric heating radiator controllers
- Boilers ThermoVault IoT modules and cloud service are used for smartify legacy-based assets like water boilers and space heaters

Main innovation

Service for more efficient energy consumption, peak shaving and balancing services on Belgium energy market of household electric water and space heaters at community and household level.

Type of pilot

↳ Residential: 16 apartments in the city of Genk, and 70 social apartments at Tienen

Pilot location

↳ Genk and Tienen

Key achievements

Thermovault's controllers installed in 86 apartments to regulate electrical water heaters and space heaters.

Demonstrated use of controlled residential thermal loads to provide energy efficiency, peak shaving, and balancing services without affecting comfort level of end-users.

Tested self-consumption and analysed potential benefits derived from offering this service.

Acquired learning in regards to obtaining consents from and engagement of residential end users to control their thermal loads.

Utilized Thermovault's thermal loads retrofit solution in French and Portuguese pilots, with slight variations in services offered across all three pilots.

Partners involved

VITO Genk Thor Park (BE.03)

The Thor Park subpilot demonstrates EV Smart Charging that leverages charging needs information to outperform dynamic load-balancing. Also a community that uses white good flex to maximize community self-consumption was demonstrated. Both demonstrations use semantic interactions over the SIF to interact with external data sources - to retrieve forecasts and tariff information - and to charging infrastructure and white goods.

Technologies & Infrastructure

- Rooftop PV 369kWp (multiple orientations)
- EV charging stations (527kW) 18 smart-controllable sockets + 23 non-smart controllable sockets – including fast charging socket and V2G socket - distributed over 7 brands;
- White goods

Main innovation

Smart Charging algorithm that minimizes the charging cost by maximizing PV self-consumption, shifting EV charging to times of low energy prices (dynamic ToU tariff) and avoiding peak penalties, while ensuring that all feasible charging needs are met. It can handle a hierarchy of charging sub-nets, each with its own fuse protection, and combinations of single-phase and multi-phase charging.

EMS platform with semantic Knowledge Interactions for access to external data sources and assets that connect to the SIF.

Semantic Knowledge Interactions for baseline and flexibility information exchanges between Building EMS-es and a Community/Neighbourhood EMS, or either of these with grid stakeholders (e.g., aggregator: demonstrated as part of the Overarching Pilot).

Type of pilot

↳ Commercial: Energyville1 research building located at the Thor Park which is a new science and business park on a former mining site, and part of the Energy Ville Living lab.

Pilot location

↳ Thor Park, Genk

Key achievements

Demonstrated a scalable EV smart charging solution that outperforms dynamic load-balancing for complex sites: hierarchy of charging subnets and combinations of single- and multi-phase charging. Maximizing the charging service offering for a minimal cost. Exploitation under the form of a spin-off is underway.

Increased user awareness for flexibility. Users (car owners) are given the option to enable smart charging (yes/no), and if they do, they can optionally explicitly provide charging needs information to allow for a better optimization. By the end of the project the number of registered users that allow smart charging grew to over 80, and the vast majority of them is providing charging needs information for their daily charging sessions.

Developed an EMS platform (the EV smart charging solution is a specialized instantiation) that interacts through semantic Knowledge Interactions over the SIF with external data sources (e.g., retrieving forecasts or tariff information), assets (e.g., EV charging infrastructure, white goods), and grid stakeholders (e.g. CyberGrid, CyberNoc platform in the overarching pilot).

Acquired learnings with respect to ontologies and semantic interoperability which resulted in the decision to promote this technology by offering semantic Knowledge Interactions as the default interface for future EMS developments and exploitations.

Partners involved

Miele Whirlpool vito B/S/H/

OpenMotics (BE.04)

De Nieuwe Dokken is a Belgian subpilot that demonstrated use of an interoperable centralized energy management system for a city district with residential and commercial end users. The smart district includes local PV generation, and encompasses the three energy vectors of electricity, heat and transport to optimally manage energy and the environmental impacts associated with building infrastructure.

Technologies & Infrastructure

- Smart meters
- Smart white goods
- District heating network that distributes heat from different sources, such as waste heat from a nearby company, wastewater heat, and biogas.
- Heat pump that transfer the heat available in wastewater to the district heating network, and could in the future charge the district heating network with that same heat when electricity prices are low.
- Charging infrastructure at De Nieuwe Dokken consists of 44 charging points, 16 of which are part of a public parking.
- PV panel includes 357 panels and delivers 125 kWp.
- Battery has a storage capacity of 240 kWh and serves to increase the degree of self-sufficiency by storing solar energy. It also delivers low-level grid support by charging/discharging when prices are low/high, respectively.
- Energy management platform to efficiently align the different technologies.

Main innovation

Centralized energy management system (CEMS) to be used by a local ESCO for the whole district, reducing their operational costs and direct control of end-user appliances for offered services.

Type of pilot

↳ A city district that consists of a kindergarten, sport infrastructure, a city administration building and 150 apartments (250 more planned), complemented with a park

Pilot location

↳ Ghent

Key achievements

Installed smart home gateways in 150 pilot participants' homes, enabling inhabitants to monitor electricity usage and control home appliances.

Implemented two district-level gateways connected to the local network, facilitating data acquisition and control of district-level assets, including communication with various devices such as battery, solar panels, heat pump, wastewater treatment plant, vacuum system, and electric vehicle charging station.

Developed an Energy Management System to control the battery and heat pump based on locally produced energy availability, electricity and heat demand, dynamic pricing, and other mechanisms.

Deployed the Semantic Interoperability Framework for white goods and integrated into OpenMotics EMS. Installed white goods in 40 apartments allowing residential end-users to register and test their interoperable devices and monitor consumption.

Organized info-sessions for residential end-users about their energy usage, offered services and importance of interoperability.

Raised user awareness about the local energy system and actively involved them in service development, particularly for white-good appliance control.

Partners involved

DuCoop Whirlpool Miele OpenMotics B/S/H/

VITO Hasselt Cordium (BE.05)

The Cordium subpilot demonstrates how social housing apartment blocks can provide thermal and electrical flexibility to minimize site-level power-2-heat generation costs by maximizing PV-T self-consumption. The demonstration uses semantic interactions over the SIF to interact with external data sources, and to exchange information between the apartment EMS -es and the site (community) EMS.

Technologies & Infrastructure

- Rooftop PV-T 35kWe
- Electric Heat-pump (30 kWth) feeding a small heating network that connects the 3 buildings / 20 apartments
- Gas Heat-pump (36 kWth)
- Central thermal buffer (2m3) with power controller (6kWe)
- White goods Miele, BSH, Whirlpool

Main innovation

Neighbourhood/Community cost optimizer that controls the central heat pumps and power controller of the central thermal buffer to minimize heating costs for the social housing tenants. This is done by maximizing PV-T self-consumption and leveraging virtual dynamic ToU prices, and by smart switching between the gas Heat pump (whose running time is minimized) and the electrical Heat pump.
The optimization uses thermal flexibility from the apartments and considers the smart control of white goods as well.

EMS platform with semantic Knowledge Interactions for access to external data sources and assets that connect to the SIF.

Semantic Knowledge Interactions for baseline and flexibility information exchanges between Building EMS-es and a Community/Neighbourhood EMS.

Type of pilot

↳ Residential: Social housing, three clusters of multi-apartment buildings containing 20 apartments and households in total, with a central heat-pump, thermal buffers, and PV-T generation.

Pilot location

↳ Hasselt

Key achievements

Demonstrated a neighbourhood/community EMS that optimizes energy consumption by controlling central heat pumps, the power controller of the electric booster resistor of a central thermal buffer, and by collaborating with apartment EMS-es to ensure alignment with community objectives.

The community-level optimization is fed by information provided by multiple apartment EMS-es. All interactions between the community and the apartment EMS-es, and with external data sources, are achieved through semantic interactions over the SIF. Specifically, novel asset type agnostic flexibility formulations were defined that enable unified whole-building flexibility representations to be exchanged by the apartment EMS-es to the community EMS.

Partners involved

B/S/H/ Whirlpool Miele Cordium vito

Th!nk E Nanogrid (BE.06)

Nanogrid Belgium subpilot demonstrates how various fixed and flexible load assets, such as heat pump, home appliances and smart EV charging, can be used within residential end users in a single home or energy community to provide energy consumption flexibility and increase self-consumption of locally generated RE without losing comfort.

Technologies & Infrastructure

- PV panels 30 solar panels (in total 7.8 kWp) with an SMA invertor
- Energy storage Enersys lead acid battery with Studer Invertor
- Energy Management System Combination of Loxone and Impower as the 'energy brain' of the community. Through Loxone there is a user interface, while Impower runs in the background and makes the smart decisions
- Heat pump replaced the existing natural gas boiler-based central heating for the purpose of the project
- EV charger ABB DC charger with power delimitation for electric vehicles
- White goods

Main innovation

Flexibility service offer from residential homes exploiting home appliances and flexible load devices through EMS.

Type of pilot

↳ Residential: two single family homes

Pilot location

↳ Kobbegem

Key achievements

Demonstrated use of various home devices in interoperable communication including the residential EMS.

Demonstrated use of flexible home devices to increase self-consumption of locally generated RE across multiple households.

Connection with OV pilot

Partners involved

ABB Whirlpool DAIKIN Miele Think E

3E (BE.07)

The site is a free field PV system test area with two buildings office and a lab equipped with heat pumps. It is connected to 3-phase 400V grid located in Obing, Germany where they can also sell the power to the grid.

Technologies & Infrastructure

- Hardware Split unit, battery, EV charger, PV panels
- Software Extending SynaptiQ platform to support interoperable flexibility usage for local energy management and for offering the flexibility to a distribution grid through aggregators. With these paradigm shifts:
  - From off-line to real-time data
  - From manual policies to dynamic policies
  - From no control to dynamic control
- Communication, monitoring and control IoT gateways, field sensors and actuators, smart meters, heat pumps.

Main innovation

Maximize RES self-consumption

E-Mobility Services for Energy Communities

Energy Monitoring and Management

Peak Shaving

Tariff-based Management

Assets Flexibility Aggregation and Disaggregation via the SIL of InterConnect

Type of pilot

↳ The site is a free field PV system test area with 2 office buildings and a lab equipped with heat pumps.

Pilot location

↳ Obing (Germany)

Key achievements

A technology-neutral platform for managing solar energy and batteries. SynaptiQ has proven its effectiveness in monitoring solar and wind power assets. InterConnect aims to demonstrate this model for managing flexibility too. SynaptiQ's platform monitors and controls flexible assets, communicating with different hardware like electric vehicles and regional flexibility traders. It forecasts battery behaviour based on solar power and electricity demand.

Enhanced Energy Efficiency

Increased Renewable Energy Integration

Optimized Peak Load Management

Empowerment of Prosumers

Education and Awareness about energy consumption patterns, renewable energy utilization, and the importance of demand-side flexibility.

Connection with OV pilot

Partners involved

CyberGrid 3E E3/DC

VUB Zellik (BE.08)

Green Energy Park at Zellik, Belgium, is a large-scale testing ground equipped to a living Lab where companies, research institutes and governments work together in co-creation of energy, mobility and societal solutions.

Technologies & Infrastructure

- PV panels
- Energy Storage battery modules
- EV charging infrastructure that consists of several charging points, V2G and fast charging technologies
- White goods being controlled remotely through considering user preferences
- Energy management system tailored to adapt to user preferences, enabling control and monitoring of energy consumption while gathering consumption behaviour data

Main innovation

Testing and deployment of software, platforms-based strategies within InterConnect.

P2P energy trading between virtual houses using commercial off-the market blockchain-based technology.

Further P2P trading between virtual houses and further real-life participants.

Inter-pilot connection with BE.03, BE.04 and BE.05 through interoperability framework: the use of forecasting and flexibility services.

Type of pilot

↳ The Green Energy Park is a large-scale living lab and its infrastructure is composed by dwellings, smart home lab, tertiary offices and tertiary labs. Participation of 5 real-life residential participants.

Pilot location

↳ Zellik

Key achievements

Integration of multiple energy management systems for peer-to-peer market engagement.

Development of a peer-to-peer energy sharing and trading platform.

Simulation of 6 virtual houses with real devices.

Installation and implementation of energy management systems and controllable appliances for 6 houses.

Control and scheduling of appliances using SAREF-ised services within the developed P2P framework.

Connection and testing of smart dongles, along with testing the P2P market for virtual and real users.

Scheduling appliances based on available energy in smart contracts.

Creation of smart contracts with transparent and accurate energy flow logging.

Installation and implementation of white goods.

Local access to dongle data via a web interface, securely transmitted to the VUB platform.

Optimization and implementation of a battery management system within LECO in collaboration with WeSmart.

Partners involved

ABB, vito, OpenMotics, DuCoop, VUB Vrije Universiteit Brussel, Whirlpool, Miele, Think E

Germany Hamburg

German pilot in Hamburg developed a future-oriented hotel service to providing grid compatible and tariff-based charging infrastructure to benefit hotel operators and owners and hotel customers. Using the developed services the hotel can provide support for grid stability and ensure usage of renewable energy and at the same time provide smart EV charging to hotel customers.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Smart meters
- Smart meter gateways including CLS value-added modules
- EV chargers

For hotel guests

- Optimized EV charging price
- Minimum charging time
- Maximum charging service

For hotel operators & owners

- Smart meter gateway infrastructure
- Fairshare energy management
- Data integration platform
- Charge point operator service
- Intelligent DSO grid analysis and tariff services
- Optimized use and number of charging stations per grid connection

Main innovation

Power limitation at grid connection to enable control of energy consumption in electricity grid congestion scenarios and help prevent blackouts or system instabilities.

Cost optimized operation of EV chargers to use flexible tariffs to balance generation and demand.

Type of pilot

↳ Commercial - 5 Hotels selected in Hamburg (Heikotel - Hotel Am Stadtpark Heikotel - Stadtpark Residenz, Heikotel - City Nord, Pier 3 Hotel, Hotel Lindtner)

Pilot location

↳ Hamburg

Key achievements

Enabling price-optimized operation of EVs for hotel customers.

Cost-optimization for hotel operators through **peak-shaving** and avoidance of high electricity prices.

Balance local generation and EV charging demand by implementation of flexible tariffs.

Enhanced grid monitoring and transparency for DSOs on hotel level via interoperable data and smart meter gateway infrastructure.

Identifying hot spots and preventing blackouts for DSOs.

Smart interaction of hotel operator and the grid (DSO) via interoperable data.

Development of a local Fairshare-Energy Management System on Theben value-added module, incorporating data from smart meters.

Links

↳ EEBUS presentation of the reference test set app
↳ Animated introduction to German pilot (German)
↳ Animated introduction to German pilot
↳ Interview with Ralph-Ino Prümm - EEBUS
↳ Testimonial by Thomas Fischedick - KEO
↳ Data exchange process between hotels and grid - KEO

Partners involved

B/S/H/ · UNIKASSEL VERSITÄT · Miele · DAIKIN · EEBUS · Fraunhofer · Wirelane · KEO

Germany Norderstedt

German pilot in Norderstedt worked with residential end-users and DSO to provide flexibility to the grid, cost and energy savings to the end-users and allow for secure integration of local renewable generation and distributed energy resources (EVs, heat pumps) from various technology providers.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Energy Management System (EMS)The energy manager provides central logic inside the building, monitors power consumption of connected devices (e.g. charging stations). The user interface allows visualisation of current and future energy behaviours.
- Smart meter gateways provide certified and secure communication entry point to enable safe communication and interaction between market and grid on the one side and buildings with their smart devices on the other side.
- Smart heat pump system for heating and domestic hot water
- EV chargers Electric charging station for EVs with smart/IP interface.
- PV generation via a rooftop PV system that is part of the EMS
- White goods

Main innovation

Flexibility from various interoperable home devices (heat pumps, white goods and EVs) to provide grid services and to optimize energy costs.

Control of grid overload and underload scenarios using bi-directional communication from DSO to device level (EVs, heat pumps, PV/battery, white goods) via an energy management system (EMS).

Type of pilot

↳ Residential: 50 households

Pilot location

↳ Norderstedt

Key achievements

Established full chain standard-based end-to-end connectivity, linking the DSO to interoperable smart home devices via BSI-certified smart meter gateway infrastructure together with the Theben value-added module as digital grid communication module.

Implemented dynamic grid support through power limitation at the building or device level, enabling real-time reactions by DSOs to curtail consumption or local production and prevent overload scenarios on the grid. This is facilitated through interoperable EEBUS or SAREF-ised services, with a focus on devices like EVs or heat pumps.

Introduced grid support via flexible tariffs, utilizing energy-relevant device flexibility to match renewable energy.

Implementation of incentive-based energy management strategies, involving negotiation of energy consumption plans with intelligent devices (e.g., EVs or heat pumps) to maintain comfort levels, enhance efficiency, and prevent conflicts with internal processes.

Enhanced grid monitoring and transparency for DSOs via interoperable data and smart meter gateway infrastructure.

Links

↳ Presentation of Living Lab Cologne - EEBUS
↳ Animated introduction to German pilot
↳ Animated introduction to German pilot (German)
↳ Interview with Ralph-Ino Prümm - EEBUS
↳ Interview with Robert Böhm - EEBUS

Partners involved

EEBUS, Miele, Wirelane, DAIKIN, keo, Vaillant, B/S/H/

Italy

The Italian pilot has been working with social housing residential districts to use interoperable white goods with a user-friendly community energy management platform, Planet App, to enable residential end-users to engage in energy management. The engagement aimed to both help achieve cost and energy savings and foster innovation within the community, facilitating collaboration and interaction among residents.

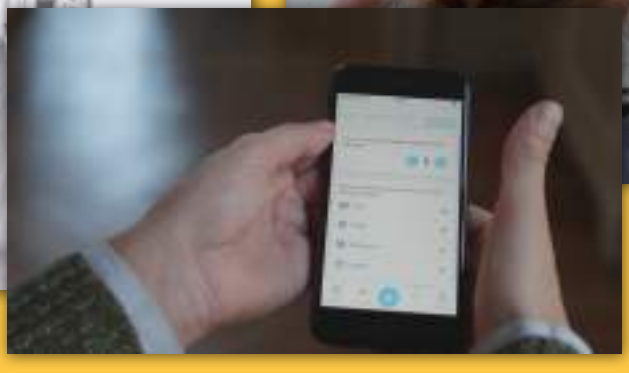
Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- White goods

Main innovation

Interoperable community energy management and environmental performance digital platform to optimize costs and energy use and increasing awareness and knowledge of end-users.



Type of pilot

↳ The Italian pilot project takes place in three different social housing districts, REDO Moneta, REDO Merezzate and Quintiliano

Pilot location

↳ Milan

Key achievements

Demonstrated interoperable communication between flexible devices and aggregator.

Developed a modular and interoperable community energy management system enhanced by machine learning techniques. End-user consent required for data transfer, enabling implicit flexibility, seamless data exchange, and raising awareness and energy literacy for users.

Raised the sense of belonging of social housing residents in the neighbourhood and their feeling of contributing to a common goal as a community through gamification in the Planet App platform.

Raised awareness of social housing end-users of their energy usage, costs and related carbon footprint through use of interoperable platform and in-person community events.

Links

↳ Presentation of Italian pilot
↳ Presentation of developed digital services
↳ Engagement activity in Moneta
↳ Animated introduction of the Italian pilot
↳ Testimonial by Stefano Fava - Planet Smart City
↳ Video REDO - Milano
↳ Testimonials Planet Smart City
↳ What is a HEMS?
↳ Interview with Daniele Russolillo - Planet Smart City
↳ Interview with Silvia Boccadamo - Whirlpool

Partners involved

Portugal Commercial

Portuguese commercial pilot involved 12 retail store buildings across Portugal and demonstrated interoperable flexibility aggregation, flexibility services to DSO with variable demand and use of local RE generation with smart charging for store customers. The goal is to both optimize energy management of commercial buildings for cost savings and improved operation of the grid.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Metering devices
- EV chargers (InterConnect + existing)
- Building Management System that integrates subsystems and devices available within a store
- iEMS that integrates the BMS systems of different stores
- Interoperability layer is a set of semantic adapters that enables different systems to communicate with each other
- Technical platforms from various actors (e-mobility manager, retailer, flexibility aggregator, store manager, etc.) that will communicate through the interoperability layer enabling the deployment of new services and solutions

Main innovation

Aggregated flexibility from commercial retail building, taking into account EVs and heating and cooling devices.

Interoperable smart EV charging at retail stores for customers.

Flexibility management of commercial buildings for distribution grid support.

Type of pilot

↳ Commercial, 12 retail stores (Continente, Continente Modelo and Continente Bom Dia)

Pilot location

↳ Along Portuguese territory

Key achievements

Developed an integrated Energy Management System (iEMS) that brings together building management systems of multiple commercial building using SIF.

Demonstrated flexibility aggregation for DSF (Demand Side Flexibility) to DSO through the DSO Interface.

Demonstrated that convenient smart EV charging in retail store parking can foster **uptake of e-mobility**.

Achieve technology agnostic interoperable communication between building energy management system and store devices for improved monitoring and grid observability.

Successfully adapted legacy resources to enhance controllability, resulting in increased efficiency and active management capabilities.

Implemented new methods for acquiring data to operate the distribution grid, utilizing the created interoperability to enhance network observability.

Flexibility provisions of commercial building devices to the OV pilot.

Links

↳ Animated introduction to the Portuguese pilot
↳ Supermarket cold storage flexibility - Elergone Energia
↳ Portuguese Commercial pilot (Portuguese)
↳ Portuguese Commercial pilot
↳ Testimonials by Amândio Ferreira – Elergone

Partners involved

MC Sonae, elergone energia, Schneider Electric, sensinov, domotica sgta gestão técnica de edifícios, INESCTEC, CyberGrid, KEO, E-REDES

Portugal Residential

Portuguese residential pilot provided improvement of interoperable energy management on the end-user side using interoperable new and existing devices. In addition, this pilot demonstrates use of residential flexibility providing flexibility and improving observability of the electricity grid with DSO interface.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Smart meters
- White goods
- Heat pumps
- Electric water heater controllers
- EV chargers
- InterConnect app where users can schedule their operation, at their convenience

Main innovation

Flexibility management for distribution grid support.

Home Energy Management system for residential load optimization.

DSO open data sharing and enhanced distribution grid observability.

Type of pilot

↳ Residential: covering around 250 homes

Pilot location

↳ Braga, Porto, Guarda, Santarém, and Évora

Key achievements

Allowed end-user monitoring and control over various appliances using manufacturer's applications in interaction with InterConnect home EMS and energy consumption/production statistical insights.

Developed IT platforms and frameworks facilitating the **mobilization and activation of flexibility** from residential resources.

Successful adaptation of existing legacy heating and hot-water devices to enhance controllability, resulting in increased efficiency and available flexibility.

Implemented new methods of acquiring data to operate the distribution grid, utilizing the created interoperability to enhance network observability.

Residential flexibility available to OV pilot.

Links

↳ Animated introduction to Portuguese residential pilot
↳ Animation piloto Português residencial (Portuguese)
↳ Sistema de Gestão de Energia – o que é? (Portuguese)
↳ Testimonial by Carlos Damas - E-REDES
↳ Portuguese residential pilot workshop - E-REDES

Partners involved

E-REDES CyberGrid INESCTEC DAIKIN

Miele Whirlpool B/S/H/ THERMO VAULT

Dutch Residential

The Dutch residential pilot has implemented interoperable residential appliances to all rental apartments of the new residential building. This opens up opportunities to renters to use flexibility of their devices through the smart living platform where flexibility services are offered.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Smart meters
- Sensors
- White goods

Services used within the pilot to enable interoperable services:

- Graphical User Interface to manage and control all sensors, devices and appliances in the home
- Hyrde's Ekco platform provides additional services to the interface and is the central communication point of the home. It runs all the necessary software for operating the system
- TNO's ReFlex platform optimizes demand and supply of energy, as tool for aggregation and scheduling of energy flexibility

Main innovation

Interoperable flexibility offered by smart appliances which are connected to the semantic interoperability platform and allowing the energy manager ReFlex to optimize the smart appliances.

Type of pilot

↳ Residential: 99 appartments inside of a new building NEXT

Pilot location

↳ Strijp-S, Eindhoven

Key achievements

Successful installation of 300 smart appliances and connection of approximately 100 appliances to the SIF.

Demonstrated interoperable residential white goods operating with 99 rental apartments and integrated within interoperable ReFlex platform for smart homes based on granted user permissions with data collections from January 2023.

Provided support in testing the SPINE-SSA within Dutch pilot, in collaboration with the Portuguese pilot. This critical component connects smart appliances to the Interoperability Framework, benefiting pilots in Greece, Belgium, and Italy through meticulous documentation and testing efforts.

Links

↳ Dutch Pilot - iWonen Demo
↳ Nederland Pilot - Appartementencomplex (Dutch)
↳ The Netherlands: residential pilot
↳ Testimonials by Ronnie Groenewold - Volkerwessels iCity
↳ iWonen 1: iCity by Ronnie Groenewold
↳ iWonen 2: Functionalities: dryer and washer - Siemens
↳ iWonen 3: Functionalities: dishwasher - Siemens
↳ iWonen 4: Functionalities - Loxone Hyrde Rajkumar
↳ iWonen 5: Smart sustainability - TNO
↳ iWonen 6: Next steps - iCity

Partners involved

Hyrde TNO B/S/H/ Miele iCity VU VolkerWessels

Dutch Commercial

The Dutch commercial pilot demonstrated how smart office building can be used to provide interoperable flexibility including forecasting on Graph Learning methods and Explainable AI, for example to optimize the BEMS.

Technologies & Infrastructure

Devices used within the pilot to enable providing interoperable services:

- Smart meters
- Sub-metering devices
- Sensors
- (Simulated) Neighbourhood Battery
- EV charger

Services used within the pilot to enable interoperable services:

- Hyrde's Ekco platform enables its user to manage and control the complete (IoT) ecosystem of a building on an intelligent way
- iOffice app enables office users to use different services and is a platform for communication between users and the communication manager
- TNO's ReFlex platform optimizes demand and supply of energy, as tool for aggregation and scheduling of energy flexibility

Main innovation

Interoperable aggregated flexibility of the smart office building with its smart devices to provide flexibility and forecast consumption using 100+ IoT devices available at the building.

Explainable AI and SAREF Graph Learning on IoT and building data, which after SAREFizing, allows valuable AI reasoning that are understandable, reproducible and accessible.

Type of pilot

↳ Commercial: 1 existing office building consisting out of 200 companies

Pilot location

↳ Strijp-S, Eindhoven

Key achievements

Demonstrated use of the ReFlex platform by aggregators to optimize the value of flexible energy assets across various energy markets. This integration combines the S2 flexibility standard (prEN50491-12-2) with SPINE flexibility concepts in SAREF.

Integrated EV charger into the SIF platform of a commercial building in the Dutch pilot. The platform aims to optimize EV operation through the ReFlex service to prevent grid connection overload and shift charging load to lower energy tariff timeslots. Communication between ReFlex and chargers utilizes SAREF-ised S2 concepts via the Knowledge Engine.

Implemented Relational Graph Machine Learning methods for forecasting and error detection.

Demonstrated unlocking of flexibility for aggregators through the InterConnect interoperability platform.

Offered aggregated office building flexibility to the OV pilot.

Links

↳ Animated introduction to Dutch Commercial pilot
↳ Presentation of the Dutch Commercial pilot
↳ Testimonial by Laura Daniele - TNO
↳ How did the idea of the InterConnect project arise?
↳ Interview with Wouter Beelen - VolkerWessels iCity
↳ Dutch Commercial pilot: the office building
↳ Publication of office building data in SAREF - VU Amsterdam

Partners involved

Hyrde, VolkerWessels, Vebego, TNO, B/S/H/, iCity, VU Amsterdam, Miele, OFFICE-S, recognize