

Innovation Handbook



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Executive Summary

The **DEDALUS Innovation Handbook** explores how residential **demand response** can move from technical promise to practical application.

Building on the work of the DEDALUS project, a European research and innovation initiative, it examines how **human-centred, interoperable** and **data-driven solutions** for residential flexibility perform across diverse real-life contexts.

Drawing on **seven pilot experiences** across Europe, the handbook looks at how digital tools, optimisation models, and user-facing services operate in settings shaped by different infrastructure, user groups and local conditions.

The publication is structured around **two sets of factsheets**. The first presents the seven DEDALUS pilots, showing how flexibility solutions were deployed in contexts including **energy communities, social housing, student residences, elderly**

living environments and residential heat pump optimisation.

The second includes two cross-cutting factsheets focused on the **Social Sciences and Humanities (SSH) framework** and the **Toolkit for Financial and Non-financial Incentives**.

Together, these perspectives show that residential demand response is **not a standardised pathway**, but a field of implementation shaped by technological maturity, interoperability, comfort needs, behavioural factors, and local constraints. The pilot factsheets provide the empirical basis for this reading, while the cross-cutting factsheets help explain the social and economic conditions that influence uptake and long-term viability.

The final section draws on both strands to identify broader lessons for **future replication**. It shows that the success of residential demand response depends not only on how solutions are designed, but also on how they are introduced, experienced, and translated into **meaningful value**.



Introduction

As Europe's energy systems become more decentralised, digitalised and increasingly based on renewables, the residential sector is gaining strategic importance¹. Homes are no longer seen only as sites of consumption, but increasingly as active participants in more flexible and responsive energy systems. In this context, **demand response** is widely recognised as a key enabler of a smarter energy future.²

Yet deploying residential demand response in practice remains far from straightforward. Beyond optimisation models and control logic lies a more complex reality, where technologies meet buildings, routines, preferences, social conditions and local infrastructure. What works well in one setting may prove difficult to replicate in another. **Technical functionality alone does not guarantee adoption**, and success often depends on how well a solution fits into everyday life.

The DEDALUS project³ offers a valuable lens through which to observe this complexity. Across **seven European pilots**, it tested a range of tools and services designed to support residential flexibility under different conditions and at different scales. These pilots do more than demonstrate technology: they show what happens when innovation is exposed to the frictions, limitations and possibilities of real-world deployment.

This handbook brings these experiences together. It frames the broader relevance of residential demand response in lived contexts, presents the pilot factsheets at the core of the publication and closes with a cross-cutting reflection on **implementation, user engagement and future replication**.

2.1 PURPOSE OF THE INNOVATION HANDBOOK

This handbook captures the **practical intelligence** generated by the DEDALUS pilots. It brings together grounded experiences to show how residential demand response unfolds in everyday settings.

Its ambition is twofold. First, it documents the variety of approaches explored across the project, from **comfort-based flexibility, predictive control, peer-to-peer energy exchange, district optimisation and user-centred engagement strategies**. Second, it uses these experiences to reflect more broadly on what enables, complicates or limits the deployment of residential flexibility solutions in practice.

In this sense, the handbook is less a record of what was done than an interpretation of what was learned. It is intended for readers interested not only in the technologies themselves, but also in the conditions under which they become **meaningful, workable and potentially replicable**.

2.2 RESIDENTIAL DEMAND RESPONSE IN REAL-LIFE CONTEXTS

Residential demand response is often described through the language of flexibility, automation and optimisation. In real-life settings, however, it is also shaped by more situated and human factors: **data availability, interface usability, domestic routines, trust and comfort**.

This complexity matters. Residential environments are not neutral containers for technology, but socially and materially diverse spaces shaped by building typologies, ownership structures, demographic conditions, local infrastructure and regulatory frameworks. As a result, deploying demand response in homes cannot be reduced to simply transferring technical solutions from one context to another.

What emerges instead is the need for approaches that are **adaptive, interoperable and context-aware**. Systems must respond not only to grid signals or price variations, but also to the realities of the people and environments in which they operate. In some cases, this means prioritising comfort; in others, simplifying user interaction, compensating for missing data, or relying on mediation and support rather than expecting direct engagement through digital tools alone.

The DEDALUS pilots illustrate this clearly. Taken together, they show that residential demand response is **not a single model to be rolled out uniformly**, but a set of practices shaped by the contexts in which they are deployed.

2.3 HOW TO READ THE PILOT FACTSHEETS

The pilot factsheets are the **core of this handbook**. Each one offers a focused account of a DEDALUS pilot, outlining its setting, the main technologies and services involved, selected results, engagement activities and reflections on replication.

They can be read first as **individual stories of implementation**. Each pilot reflects a particular combination of users, infrastructure, technological choices and operational conditions. For that reason, each factsheet provides a self-contained perspective on what residential demand response can look like in practice.

At the same time, the factsheets gain further meaning when read together. Their value lies not only in what each pilot achieved, but also in the contrasts they reveal: between highly digital and strongly mediated settings, between automation and behavioural participation, between technical ambition and operational constraint. These differences are not incidental; they are central to understanding how flexibility solutions take shape in the real world. The sections that follow invite this double reading: as a set of distinct case studies and as a collective body of evidence from which broader lessons can be drawn.

DEDALUS Project at a Glance

DEDALUS is a European research and innovation project focused on enabling a **socially inclusive, multi-energy demand response ecosystem** for residential buildings. It explores how Europe's residential sector can contribute to energy flexibility while preserving **comfort, inclusion and affordability**.

The DEDALUS approach combines three complementary dimensions: a **social and behavioural dimension**, focused on how people engage with energy and non-financial motivations; a **technological dimension**, based on artificial intelligence, the Internet of Things, blockchain and digital twins; and a **business-oriented dimension**, aimed at making demand response economically viable and scalable.

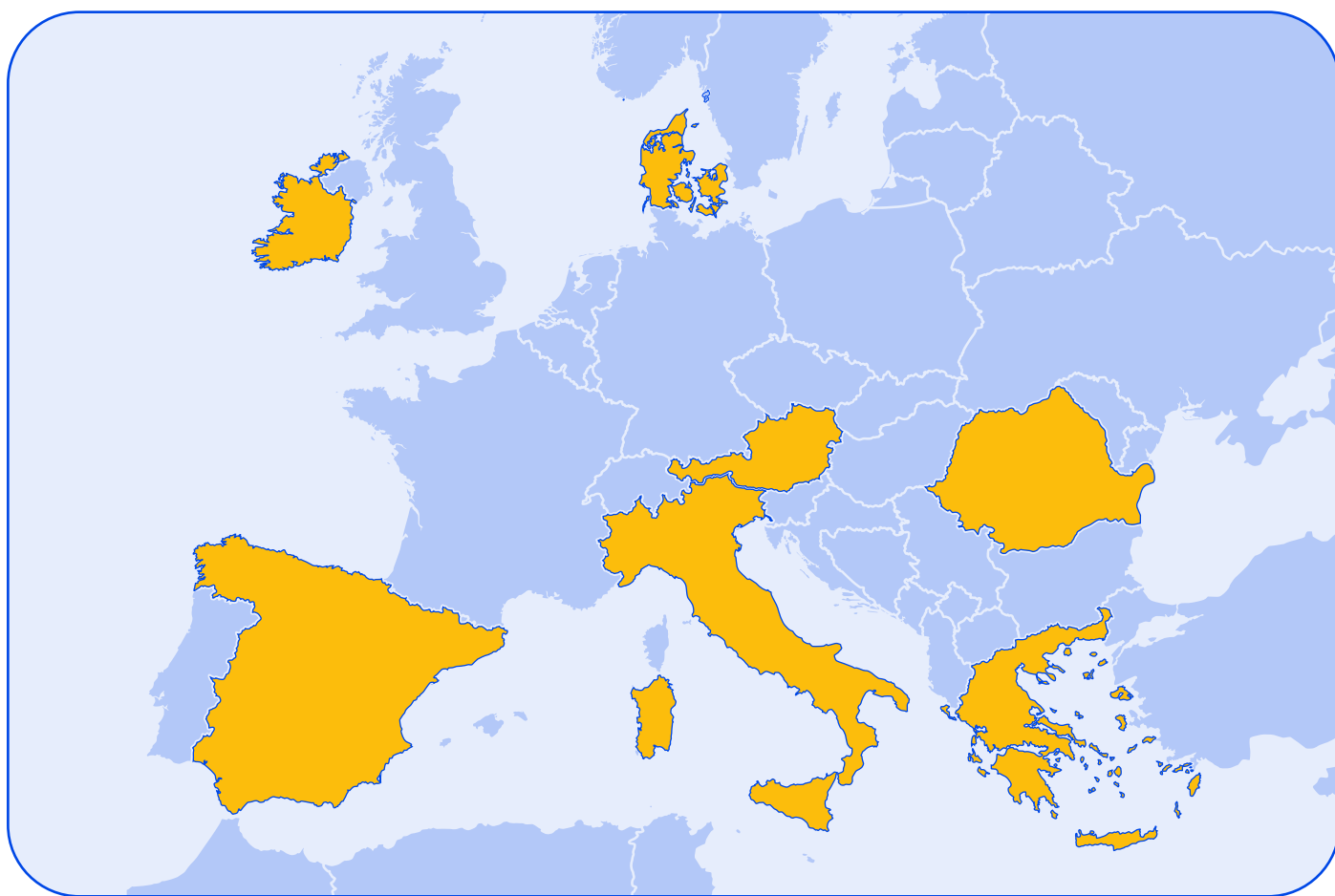
Across **seven pilot sites**, DEDALUS tests this approach in diverse residential contexts, including elderly cohousing, social housing, university campuses, energy communities and residential heating systems. This variety provides a real-life testbed for assessing demand response under different operating conditions, climatic zones and digital infrastructures.

Within this broader ecosystem, DEDALUS develops innovative services for residential flexibility, including **energy flexibility tools, comfort flexibility services and district-level energy management systems**. These are part of a wider framework that connects technology, user engagement, data governance, flexibility management and replication pathways.



DEDALUS Pilot factsheets

The following factsheets present the **seven pilot experiences** developed within the DEDALUS project, offering a grounded view of how residential demand response solutions were deployed and tested across different European contexts. Each pilot shows how residential flexibility takes shape in different real-life settings, from energy communities and social housing to student and elderly living environments. Together, they highlight that effective demand response depends not only on technology, but also on usability, context and user engagement.



Interoperable Digital Platforms for Residential Energy Communities

ABSTRACT

The Austrian pilot of DEDALUS shows how **interoperable digital platforms** can empower a **residential energy community** in Wiener Neustadt. Implemented in a multi-unit building complex, the pilot combines automated local energy optimisation and user-facing services, while also highlighting the importance of user onboarding and flexible engagement formats.



KEY POINTS

- Interoperable platforms to seamlessly connect diverse assets and manage residential energy communities.
- Automated local energy optimisation with user-friendly applications that drive active resident engagement.
- Successful validation of peer-to-peer trading and flexibility management in a real-life, multi-unit building complex.
- Practical insights for future replication of smart energy communities.

The Austrian pilot was implemented in a **multi-unit building complex** in Wiener Neustadt, comprising **84 apartments** and **20 offices**. The site includes photovoltaic systems, battery storage, smart meters and EV charging stations, providing a suitable real-life environment for testing **integrated energy community services**.

INTEGRATED TECHNOLOGIES AND SERVICES

The Austrian pilot combines a set of **interoperable digital tools** supporting the operation of a residential energy community:

- **OURPOWER peer-to-peer trading platform**, enabling community management, participant administration, billing and settlement, and local energy exchange among members.
- **Pre-aggregation platform with USG**, supporting secure data collection, local optimisation and flexibility management across distributed energy assets.
- **OURPOWER Community App**, providing users with historical and forecast energy insights, nudging suggestions and a community feed.
- **Integrated asset and data ecosystem**, including photovoltaic systems, battery storage, smart meters, EV charging stations and an energy database with API supporting the pilot services.

ENGAGEMENT

- **11 engagement activities** were implemented across the pilot.
- Engagement formats matured from initial co-creation workshops to practical user training and live demonstrations alongside operational training for community managers on the newly deployed OURPOWER peer-to-peer trading platform.
- Continuous collaboration with the building manager to troubleshoot and overcome practical implementation barriers such as technical issues with initial user onboarding.
- Post-test assessments revealed a **positive perception** among the Austrian participants, who specifically praised the newly deployed services for their exceptional “**ease of use**” and practical value.



● KEY RESULTS

- Participants achieved a **48.26% reduction in energy costs** over the project lifecycle by sharing locally produced solar power within the energy community.
- Automated smart management of the building's solar panels and battery storage successfully boosted the **community's self-consumption by 16.89%**.
- **100 consumers engaged in residential DR**, achieving a **26% active user** rate following the public launch of the OURPOWER Community App on iOS and Android.

● REPLICATION RELEVANCE

- **Interoperability** should be treated as a core condition for replication.
- **Technical deployment and user uptake** should be developed in parallel rather than as separate steps.
- **Early onboarding** should be considered essential to support participation and understanding.
- **Community management, optimisation and user-facing** tools should be combined within one integrated system.

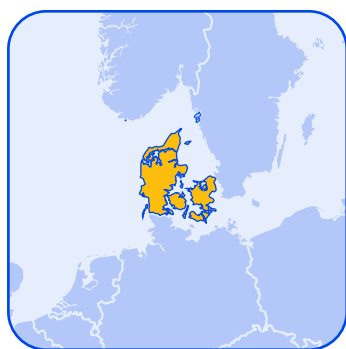
● RECOMMENDATIONS

- **Interoperable system design** should be prioritised from the outset.
- **Technical deployment** should be accompanied by continuous user engagement.
- **Clear preparatory materials and practical support** should be provided to users.
- **Participation formats** should be adapted to different user needs and levels of digital confidence.

Digital Comfort and Flexibility Services for Social Housing

ABSTRACT

The Danish pilot of DEDALUS shows how **digital tools** can optimise district heating and indoor climate management in **social housing**. Implemented across two residential blocks with 56 apartments, it combines **smart predictive heating control** and **tenant-facing services**. Crucially, it highlights that successfully deploying DR in diverse demographics requires highly **accessible, in-person onboarding** to overcome severe language and digital literacy barriers.



KEY POINTS

- Interoperable digital platforms to seamlessly connect indoor climate sensors and smart thermostats for advanced district heating management.
- Heating optimisation with passive feedback mechanisms to guarantee resident comfort while bypassing severe demographic barriers.
- Validation of AI-driven heating control and decentralised apartment-level flexibility within a real-life social housing complex.
- Practical lessons for inclusive replication of DR in diverse social housing environments.

The Danish pilot was implemented across two renovated residential blocks in Herning with a total of 56 social housing apartments. The site provides a real-world testing ground for combining district heating control, indoor climate monitoring and tenant-facing interfaces within a highly diverse demographic context.

INTEGRATED TECHNOLOGIES AND SERVICES

The Danish pilot combines a suite of **interoperable digital tools** supporting automated heating optimisation and indoor climate management:

- **NEOGRID PreHeat App V2**, enhanced to manage sensor hierarchies from entire buildings down to individual apartments and rooms.
- **Resident web-app interface**, allowing tenants to interact with the system and set flexibility preferences linked to comfort or financial savings.
- **Predictive central heating control**, connected to the district heating system and supporting more efficient building-level operation.
- **Integrated monitoring and control layer**, including smart thermostats on radiators, indoor climate sensors, water and heating meters and monitoring of decentralised ventilation systems.
- **Interoperability support for structured data exchange**, including for additional services such as the digital twin and the comfort flexibility model.

ENGAGEMENT

- **10 engagement activities** were implemented, including co-creation workshops, technical training, SMS communication and personalised verbal assistance for residents with specific accessibility needs (e.g., dyslexia).
- Relied on **continuous, direct household-level engagement** by building managers to successfully onboard tenants, overcoming severe communication barriers **across 24 nationalities**.
- Adapted to tenants' low digital literacy and reluctance to use digital apps by pivoting from app-based feedback to **passively inferring comfort** directly through physical thermostat interactions.



● KEY RESULTS

- Achieved **27–31% actual heating savings** compared to the baseline control systems.
- Reported **30% reduction in district heating operational costs**.
- Achieved a **30% reduction in carbon emissions** linked to the local district heating grid.
- Supported the enrolment of **32 apartments out of 56**, despite severe socio-technical challenges.

● REPLICATION RELEVANCE

- **Interoperability** is essential for replication, connecting sensors, heating control, tenant interfaces and data services within one coherent system.
- **User uptake cannot be taken for granted**, even when the technical system is operational and user-friendly.
- Replication in social housing should account for **language diversity**, varying levels of digital literacy and the need for personalised onboarding support.

● RECOMMENDATIONS

- The Danish pilot confirms the value of combining **digital monitoring, predictive heating control and tenant-facing interfaces** in one integrated social housing system.
- The pilot demonstrates the value of **comfort-oriented optimisation** in social housing, while showing the practical relevance of accessibility and user diversity.
- **Interoperable architecture** remains a core design principle, so that sensing, control and user interaction operate as one connected service environment.
- Effective engagement requires **accessible language, personalised support and practical onboarding**, especially in residential settings characterised by diverse user backgrounds and uneven familiarity with digital tools.

Multi-vector Demand Response for Residential Flexibility

ABSTRACT

The Greek pilot of DEDALUS shows how **multi-vector demand response** can optimise both electricity and heating flexibility in residential environments. Deployed across **more than 130 households**, the pilot combines smart heating control, advanced appliance-level disaggregation and digital twins with user-friendly nudging applications. It highlights how sophisticated forecasting with personalised, continuous app-based interaction is crucial for sustaining user participation and balancing grid efficiency with occupant comfort.



KEY POINTS

- Interoperable multi-vector platforms to seamlessly manage both electricity and heating flexibility within a unified residential DR environment.
- Combining smart heating control and appliance-level disaggregation with personalised nudging apps to drive active and sustained resident engagement.
- Validating day-ahead optimisation across highly diverse household configurations and a broad portfolio of flexible assets.
- Useful lessons and practical behavioural insights for the deployment of user-centred residential demand response.

The Greek pilot is a **residential multi-vector DR demonstration**, deployed across the wider Athens area and other cities. It combines electricity and heating flexibility through two complementary streams: the **HERON electricity-focused pilot** and the **DOM-X heating-focused pilot**. Together, they provide a real-world testbed for evaluating the interaction between flexible household assets, forecasting tools and user-facing services within the same residential DR environment.

INTEGRATED TECHNOLOGIES AND SERVICES

The pilot combines a set of interoperable technologies supporting both heating- and electricity-based flexibility:

- **Forecasting and optimisation components**, including dynamic tariffs and day-ahead RES-share signals calculated from the Greek TSO's data to generate optimal DR recommendations for clusters of buildings.
- **HERON energy control platform and EnergiQ Lab app**, upgraded with a unified "Home" concept to coordinate 204 flexible assets (including ACs, smart plugs, and white goods) across 91 households, providing appliance-level energy breakdowns and an intuitive "RES wheel" to align consumption with green energy.
- **DOM-X smart heating control infrastructure**, a network of 55 heating controllers for gas boilers, 25 controllers for heat pumps, 50 energy meters and IAQ sensors successfully converting legacy systems into DR-ready assets.
- **Two nudging applications**, enhanced to provide near real-time, personalised and context-aware notifications that guide users to shift loads toward high-RES and low-carbon periods.
- **Advanced digital twin**, delivering interactive dashboards and clustering analytics to visualise real-time consumption behaviours and evaluate flexibility planning for building managers.

ENGAGEMENT

- **9 engagement activities** were implemented across the pilot, including co-creation workshops and technical training sessions, using clear real-life examples and dynamic visual signals to build users' confidence in the new digital services.
- Leveraged application usage tracking and nudging activities to identify critical behavioural barriers, revealing that grid-driven midday optimization often conflicts with users' actual availability at home.
- Successfully onboarded **133 consumers** through targeted nudging applications, combining continuous app-based interaction with **localised 1-on-1 support**.



● KEY RESULTS

- Achieved **37.88% gas savings** through smart, automated heating control.
- Reached **34.6% electricity efficiency** by successfully shifting flexible appliance usage to renewable-rich midday periods.
- Successfully mobilised **2.03% of aggregated flexibility** and achieved a **77.6% exploitation ratio** of planned flexibility by using daily optimisation algorithms that maximised DR opportunities.
- Delivered tangible well-being and financial benefits, including a **66.67% reduction in temperature-related complaints** and a **29.87% reduction in gas energy costs**.

● REPLICATION RELEVANCE

- The Greek pilot shows the value of **deploying modular multi-vector architectures** to seamlessly manage both electricity and heating flexibility within a unified, interoperable residential DR environment.
- Replication should build on **interoperable systems** that connect flexible assets, forecasting tools and user-facing applications rather than treating them as separate layers.
- User engagement should rely on **clear real-life examples, transparent communication and practical familiarisation**, especially when services require behavioural participation.

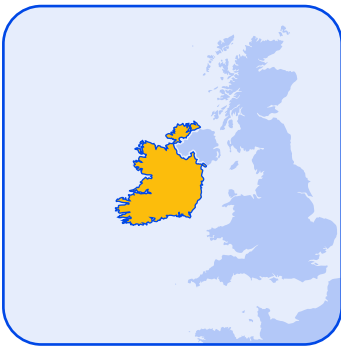
● RECOMMENDATIONS

- Multi-vector DR services should be designed as **integrated systems** combining flexibility activation, forecasting and user interaction across both electricity and heating.
- **Comfort and user control** should remain core design parameters, ensuring that smart heating deployments respect individual household preferences and daily routines.
- **Interoperable control systems, flexible household assets and accessible user applications** are all necessary to support effective residential DR deployment.
- **Engagement should not be treated as secondary**: preparatory materials, familiarisation actions and clear in-app feedback can strengthen participation and acceptance.

Heat Pump Optimisation for Residential Flexibility

ABSTRACT

The Irish pilot of DEDALUS shows how **API-based heat pump optimisation** can support residential demand response by aligning heat pump operation with electricity prices, PV availability and grid carbon intensity. The pilot combines residential heat pump connectivity with controlled laboratory validation, highlighting the potential of **cloud-to-cloud heat pump integration** while also underlining the importance of reliable connectivity, complete data availability and realistic testing conditions.



KEY POINTS

- Deploying API-based heat pump integration to collect data and enable remote control of residential systems.
- Validating optimised heat pump operation under controlled conditions while preserving thermal comfort.
- Demonstrating the potential of heat pumps to support cost reduction, PV self-consumption and flexibility activation.
- Practical lessons on the infrastructure requirements needed to scale residential heat pump optimisation.

The Irish pilot focused on **API-based heat pump optimisation** in residential settings. Data and control links were established with **5 out of 7 targeted household heat pumps**, while full physical optimisation was validated in a **controlled climate chamber** to ensure complete data availability and stable testing conditions.

INTEGRATED TECHNOLOGIES AND SERVICES

The Irish pilot combines digital tools and services supporting the monitoring and optimisation of residential heat pumps:

- **Heat pump OEM API integration**, enabling data collection and the transmission of control signals.
- **Data-driven optimisation logic**, aligning heat pump operation with electricity prices, PV availability and grid carbon intensity.
- **Controlled testing environment**, using a climate chamber to validate optimisation strategies under stable and measurable conditions.
- **Residential connectivity layer**, highlighting the role of reliable Wi-Fi, complete datasets and API accessibility in enabling real-life deployment.

ENGAGEMENT

- Engaged **5 out of 7 targeted households**, based on the ability to establish data and control connections with residential heat pumps.
- A technical workshop involved **4 participants**, presenting pilot results, KPIs and system functionalities.
- Users **perceived the service positively**, particularly in terms of usefulness and ease of use.
- Feedback highlighted the need for **additional familiarisation** to support confident user interaction with heat pump optimisation services.



● KEY RESULTS

- Achieved a **16.5% reduction in energy system costs** compared to a fixed control strategy.
- Reduced compressor start cycles from 12 to 7, corresponding to a **42% reduction in start-ups**.
- Increased PV self-consumption from 7.9 kWh to 18.9 kWh, corresponding to a **207% increase in self-consumption**.
- Recorded a **2.6% reduction in carbon emissions**, influenced by stable grid conditions during the test period.
- Established operational connectivity with **5 out of 7 household heat pumps**, confirming that reliable local infrastructure is a prerequisite for residential heat pump DR.

● REPLICATION RELEVANCE

- The Irish pilot shows that **heat pump optimisation** can support residential flexibility when reliable data and control infrastructure are available.
- Replication should prioritise **connectivity, real-time data availability and system interoperability**.
- Climate chamber validation provides robust technical insights, but real-life deployment requires adaptation to **household behaviour, domestic hot water use and operational variability**.
- Heat pumps can become key flexible assets in residential DR, provided that optimisation models are supported by adequate infrastructure and realistic operational data.

● RECOMMENDATIONS

- Residential heat pump optimisation should rely **on robust OEM API integration** and complete data availability.
- Real-life deployment requires **real-time power measurements and indoor temperature data**.
- Validation results should be communicated carefully when based on controlled testing environments rather than occupied homes.
- User engagement should include **clear explanations and practical familiarisation** to support understanding, confidence, and adoption.

Comfort-aware Energy Management for Elderly Residents

ABSTRACT

The Italian pilot demonstrates how **comfort-aware energy management** can support residential demand response in a **senior cohousing setting**. Combining environmental monitoring, a digital twin and an **AI-driven comfort-based flexibility model**, it addresses elderly users and centralised building management. The pilot shows that DR in vulnerable-user contexts requires **accessible, low-barrier engagement formats** and the vital mediation of **on-site care staff** to bridge the digital divide.



KEY POINTS

- Deploying interoperable Digital Twins to seamlessly visualise real-time environmental conditions and optimise building-level flexibility without disrupting resident routines.
- Combining comfort-based flexibility models with tailored, accessible feedback mechanisms to ensure optimal well-being for elderly residents.
- Successfully validating human-centric energy services within a highly centralised, vulnerable-user senior cohousing facility.
- Useful lessons for mediated residential DR deployment that strictly prioritises occupant health.

The pilot is implemented at **Borgo Mazzini Smart Cohousing in Treviso**, which hosts nearly 80 residents. Within DEDALUS, activities focus on **16 apartments** and on the residential test cluster of **Casa Maddalena**, where **3 rooms** were used to validate comfort-aware digital energy services under real operating conditions.

INTEGRATED TECHNOLOGIES AND SERVICES

The Italian pilot combines interoperable tools supporting monitoring, comfort assessment and personalised flexibility services:

- **IoT Platform & Monitoring Ecosystem**, a comprehensive network of 3-phase energy meters, Indoor Air Quality (IAQ) sensors (tracking CO2 and humidity), and light sensors enabling precise, apartment-level environmental monitoring.
- **Comfort Flexibility Model**, an AI-driven engine that harmonises occupant comfort with energy efficiency, generating three daily optimisation strategies (Comfort-oriented, Balanced, and Energy-oriented) based on residents' actual Thermal Sensation Votes (TSV).
- **Digital Twin**, providing building managers with an interactive dashboard that displays real-time comfort data, energy consumption simulations, and actionable day-ahead DR recommendations.

ENGAGEMENT

- Successfully engaged **20 elderly residents** by adapting to their specific psychophysical needs, utilising **on-site psychologists and nursing staff** as vital "engagement ambassadors" to build trust and facilitate participation.
- The residential engagement format was adapted to the elderly residents' profile, with a **modified questionnaire focused on comfort** and the option to answer on paper rather than digitally.
- The pilot organised **two technical workshops**: one for three professional participants at ISRAA's technical office and one for six residential participants at the cohousing site.
- The residential discussion worked best when framed around **comfort, health and wellbeing**, while the professional audience showed interest but also some resistance regarding immediate operational applicability.
- The pilot highlighted the importance of **early promotion, realistic mock-ups** and the **role of care staff** as mediators between technologies and end users.



● KEY RESULTS

- By basing recommendations on actual resident feedback, the pilot successfully reduced **temperature-related complaints** against a high historical baseline of thermal dissatisfaction, where 33% of households experienced complaints in the summer and 57% in the winter.
- **Achieved a 29.05% ratio of exploited versus planned flexibility**, confirming that the system successfully triggers load shifting.
- Delivered net **reduction in energy consumption of 1.78%** over a five-day validation period testing at the Casa Maddalena cluster.

● REPLICATION RELEVANCE

- The Italian pilot provides a relevant use case for residential DR services in **vulnerable-user contexts**.
- Replication should combine **environmental monitoring, comfort modelling and digital twin functionality** within one coherent operational framework.
- In elderly or mediated living environments, energy optimisation should be aligned with users' **subjective comfort** and supported by accessible, low-barrier engagement formats.

● RECOMMENDATIONS

- Residential DR services for vulnerable users should combine **energy monitoring, environmental sensing and personalised comfort assessment**.
- **Comfort** should be treated as a core operational parameter, especially in senior living environments where wellbeing and usability are central.
- **Digital twins and comfort-based flexibility models** can support more adaptive residential energy management, but their value should be communicated through realistic use cases and mediated support.
- User-friendly interfaces alone are not enough: vulnerable-user contexts benefit from **care staff involvement, paper-based alternatives and communication framed around comfort** rather than technical optimisation.

Data-driven Residential Flexibility for Student Housing

ABSTRACT

The Romanian pilot of DEDALUS shows how **data-driven residential flexibility** can be tested in a student housing environment. Implemented across university dormitory buildings, the pilot combines structured data modelling, predictive digital twin services and a blockchain-enabled flexibility market. It also highlights the value of **hands-on engagement and educational support** when advanced digital tools are introduced to residential users.



KEY POINTS

- Validating data-driven flexibility in a dynamic, real-life student dormitory environment characterised by highly variable occupancy.
- Combining privacy-preserving blockchain markets with advanced multi-token standards to successfully automate local energy trading and secure settlements.
- Deploying an interoperable digital twin to seamlessly disaggregate building-level data and optimise apartment-level flexibility without requiring intrusive metering hardware.
- Useful lessons for introducing complex decentralised technologies to residential energy communities.

The Romanian pilot is implemented in a **university residence context** and focuses on residential flexibility in student dormitories. The pilot infrastructure covers two dormitory buildings with **468 rooms** and relies on energy consumption measurements collected through the local building management system. This makes it a relevant setting for testing advanced, data-driven DR services that must overcome the lack of granular, apartment-level monitoring infrastructure.

INTEGRATED TECHNOLOGIES AND SERVICES

The Romanian pilot combines interoperable tools supporting monitoring, forecasting and transactional flexibility services:

- **DEDALUS ontology-compliant data model**, extended in the large-scale cycle to include pilot-specific user preferences alongside rooms, sensors and devices.
- **Blockchain and smart contracts market**, enhanced with the ERC-1155 multi-token standard (to reduce transaction costs and handle multiple token types simultaneously) and homomorphic encryption (HE) to execute privacy-preserving, on-chain P2P market matching, commitments and settlements.
- **Apartment Building Digital Twin**, developed to compensate for the lack of apartment-level monitoring by modelling apartments, performing load disaggregation and selecting the minimum number of apartments to involve in DR actions.
- **Dashboards and visualisation tools**, supporting users and managers to seamlessly use their locally stored private keys to decrypt and view their trading sessions, commitments and financial settlements.

ENGAGEMENT

- Successfully engaged **152 consumers** (primarily university students and staff) in residential DR.
- The Romanian pilot implemented **5 engagement activities**. Main formats included a co-creation workshop, technical workshop, dashboard-based interaction, smart contract-related activities and a post-test questionnaire.
- Capitalised on the academic setting by executing physical, **hands-on technical workshops** that provided dedicated learning materials, proving far more effective for gathering experience-based feedback than explanation-only formats.
- At the same time, the pilot shows that advanced technologies such as blockchain require clear introductory explanations and **structured user familiarisation**.



● KEY RESULTS

- The Romanian pilot recorded a **21.3% energy efficiency increase** through predictive digital twin services, successfully overcoming the severe data complexities caused by students' academic vacations.
- It mobilised **13.81% of aggregated flexibility** through a simulated blockchain-driven peer-to-peer flexibility market.
- It achieved a **24% carbon emissions reduction** linked to the local energy grid by accurately predicting day-ahead consumption and optimising DR offers.

● REPLICATION RELEVANCE

- **Residential DR services** can benefit from combining **interoperable data models**, **predictive digital twin services** and **privacy-preserving blockchain mechanisms** within one integrated system.
- **Student housing environments** can provide a strong testbed for advanced flexibility services, especially in campus-like or high-density residential settings.
- Future replication can preserve the **core service logic** while adapting the data integration layer to local APIs, consumption patterns and infrastructure constraints.
- The replication of the Romanian blockchain solution in Spain confirms the **transferability of the approach** beyond the original pilot context

● RECOMMENDATIONS

- **Educational support** should be treated as a core condition when users are asked to interact with **complex digital services**.
- **Structured user familiarisation** should accompany the introduction of advanced technologies such as blockchain.
- **Well-documented APIs** and reliable data flows should be prioritised to support effective deployment and future replication.
- Technical innovation should be matched with **engagement formats** that enable users to understand, test and provide feedback on the services.

District-level Energy Optimisation for Local Energy Communities

ABSTRACT

The Spanish pilot of DEDALUS shows how **district-level optimisation** can support local energy management in a residential energy community. Implemented in La Seu d'Urgell, it combines household-level flexibility, shared battery storage and a dedicated optimisation platform, while also showing that effective rollout depends on **accessible communication, user recruitment and practical familiarisation**.



KEY POINTS

- Deploying interoperable cloud-based platforms to seamlessly aggregate distributed household assets and optimise shared district-level battery storage.
- Combining automated local energy optimisation with user-friendly nudging applications to actively guide residents toward high-renewable and low-cost consumption periods.
- Useful lessons for navigating local regulatory frameworks based on strong simulation-based results on flexibility, and driving active user recruitment in residential demand response.

The Spanish pilot is a **district-level residential demonstration** implemented in La Seu d'Urgell. It combines household-level devices with shared district infrastructure to test local energy optimisation and demand response services at community scale. The pilot includes **12 dwellings** supported by a shared district battery and a collective rooftop PV system, together with smart plugs, gateways, heat pumps and high-frequency smart meters.

INTEGRATED TECHNOLOGIES AND SERVICES

The Spanish pilot combines interoperable tools supporting district-wide energy optimisation:

- **District-level DR and shared battery optimisation** developed and containerised to schedule battery operation for self-consumption and cost optimisation.
- **Cloud-based acquisition and optimisation layer**, collecting and harmonising data from smart plugs, gateways, the battery and high-frequency smart meters.
- **Personalised nudging application**, a fully deployed mobile app providing near real-time notifications on predicted savings (across sunny, cloudy and rainy scenarios) and advising residents on the optimal, low-carbon hours to operate home appliances.

ENGAGEMENT

- The Spanish pilot organised two technical workshops: one in person at **PEUSA headquarters** with **16 professional participants**, and one residential workshop with **6 participants**, purposefully separating the groups to effectively tailor the technical complexity and language of the presentations.
- Actively addressed unexpected user-driven operational challenges, such as residents inadvertently disconnecting their smart plugs, by implementing **continuous, non-technical educational campaigns** on the importance of keeping DR hardware operational.
- Post-test feedback showed a **more positive overall perception** than in the initial assessment, with the increase mainly driven by professional users.
- The pilot also highlighted two key engagement needs: **more time for recruitment** and **simpler, less technical language** for residential users.



● KEY RESULTS

- Reached **62% aggregated flexibility mobilised**, supported by the automated dispatch of the shared community battery to successfully displace loads.
- Delivered a massive **56% reduction in carbon emissions**, thanks to the battery's active optimisation of renewable energy.
- Boosted the **rate of self-consumption to 59%**, highlighting the critical role of shared energy storage in community-level DR.
- Achieved a **37% building energy efficiency gain** and a **5% reduction in overall energy system costs**, proving the financial and operational viability of the optimisation models.

● REPLICATION RELEVANCE

- Combine distributed household assets and shared district-level storage within one coherent, **interoperable cloud architecture** to successfully deploy and scale community-level demand response.
- Adapt optimisation algorithms to **local regulatory frameworks**, ensuring that district-level DR can incorporate mandatory, country-specific energy-sharing legislation before executing standard day-ahead scheduling.
- **Never assume automatic user uptake**: technical rollout needs to be accompanied by recruitment effort, tailored communication and practical familiarisation.

● RECOMMENDATIONS

- District-level energy optimisation should be designed as an **integrated system** combining household flexibility, shared storage and interoperable data infrastructure.
- **Shared battery control** can generate strong flexibility and cost results, but these should be communicated carefully when they are simulation-based.
- Effective replication also depends on user-facing design: **recruitment, accessible language** and **gradual familiarisation** are essential to support participation and confidence.

Key Lessons from the Pilots

Viewed across the seven pilot contexts, the DEDALUS factsheets show that residential demand response cannot be treated as a single, **standardised model**. Across very different settings — including energy communities, social housing, student residences, elderly living environments, district-scale contexts and residential heat pump systems — flexibility proved most effective when solutions were adapted to the **realities of the environment** in which they were deployed.

INTEROPERABILITY AS A CONDITION FOR DEPLOYMENT

A first key lesson concerns **interoperability**. In Austria, Denmark and Greece, the ability to connect assets, control systems, user interfaces and data services was essential to making flexibility operational. These cases show that interoperability is not an added feature, but a basic condition for deployment and future scaling.

ENGAGEMENT MUST BE DESIGNED INTO THE SERVICE

A second lesson is that **engagement must be embedded in the service model**. The pilots show consistently that **user uptake does not follow automatically** from technical deployment. Austria underlines the need to develop **rollout and uptake in parallel**. Greece and Spain highlight the value of **practical familiarisation and nudging tools**. Italy and Denmark show that in vulnerable or low-literacy contexts, engagement may depend on **mediated, low-barrier and sometimes non-digital formats**. Read alongside the SSH framework, these experiences confirm that participation

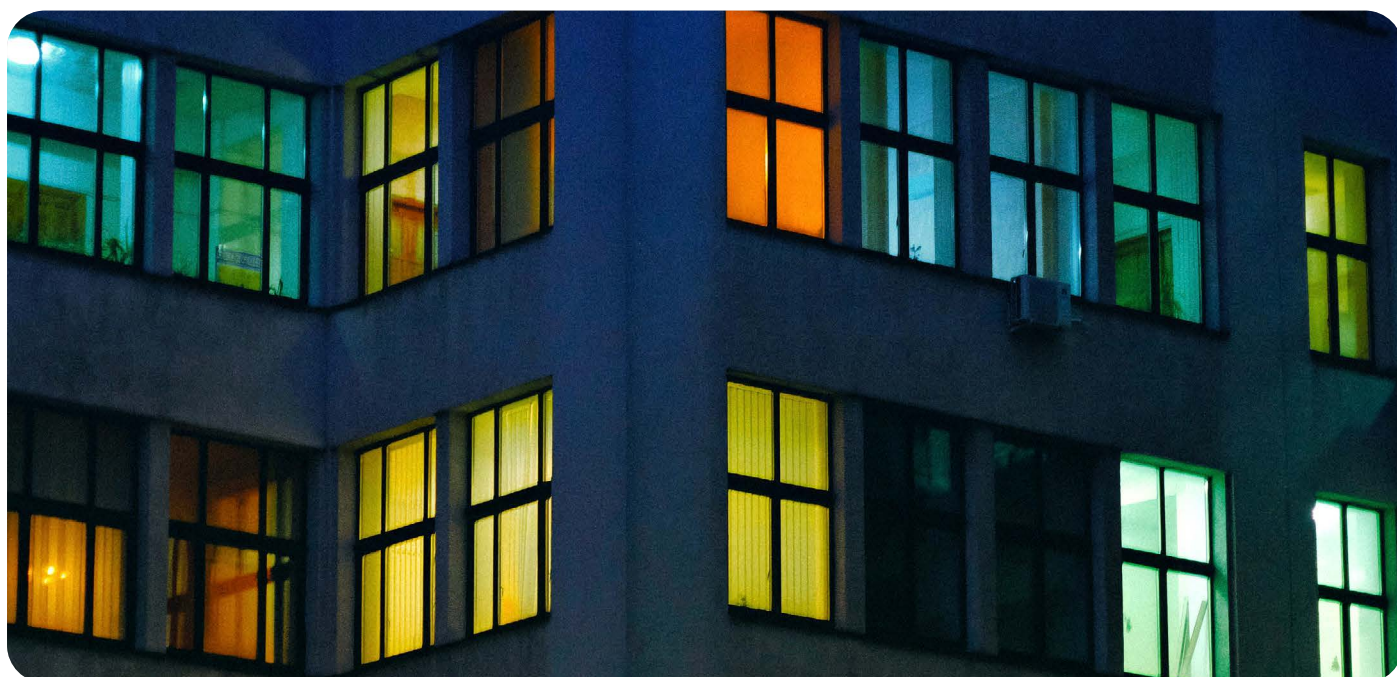
is shaped by **trust, communication and behavioural alignment** as much as by access to technology.

COMFORT MAKES FLEXIBILITY ACCEPTABLE

A third lesson concerns **comfort, usability and perceived relevance**. In Italy, comfort had to be treated as a **core operational parameter**. Denmark framed **heating optimisation around resident comfort** while adapting services to major accessibility barriers. Greece showed that smart heating and appliance-level flexibility need to preserve **user control and everyday routines**. Across these cases, residential DR proved more acceptable when experienced not as a disruption, but as a service **aligned with daily life**.

VALUE MUST BE VISIBLE TO SUSTAIN UPTAKE

The pilots show that residential DR can generate **multiple forms of value**. Austria and Spain highlight gains in **self-consumption and local optimisation**. Greece and Denmark show clear **efficiency and cost-related benefits** in heating-related contexts. Romania points to the potential of **predictive and privacy-preserving digital services** in student housing. Ireland shows the potential of **heat pumps as flexible residential assets**, particularly when API-based control can align operation with electricity prices, PV availability and grid carbon intensity. Read together with the financial toolkit, these cases suggest that the **value of flexibility** must be legible not only in technical terms, but also in **economic and operational ones** if uptake is to endure.



Common Deployment Challenges

Alongside these lessons, the pilot factsheets point to a set of recurring deployment challenges.

DATA READINESS CANNOT BE ASSUMED

The first recurring challenge concerns **data and infrastructure conditions**. The Romanian pilot shows how advanced services may need to compensate for the absence of apartment-level monitoring through digital twins, load disaggregation and structured data models. The Spanish and Greek pilots also illustrate the complexity of integrating devices, assets and data layers into coherent optimisation architectures. The Irish pilot adds a further infrastructure-related lesson, showing that residential heat pump optimisation depends on reliable household connectivity, complete data availability and access to real-time operational measurements. These experiences show that data readiness cannot be taken for granted, and that many residential DR services must operate within imperfect or heterogeneous infrastructures.

PARTICIPATION REQUIRES CONTINUOUS SUPPORT

A second challenge is user **onboarding and continued participation**. The Danish pilot highlights how language diversity and low digital literacy can affect uptake, requiring direct and personalised support. Italy shows that in elderly contexts, participation may depend on the mediation of care staff and simplified interaction formats. The Spanish pilot points to the need for more time for recruitment and less technical language, while the Greek pilot reveals that even engaged users may struggle to align behavioural participation

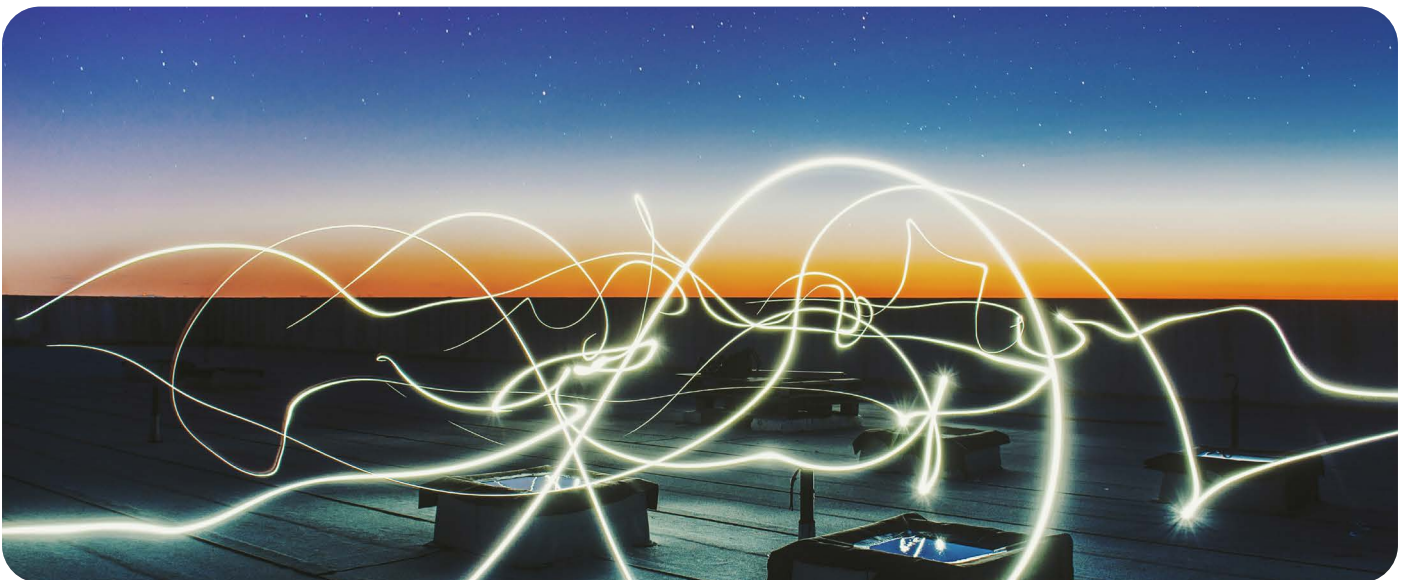
with daily routines. From an SSH perspective, these barriers are social and behavioural as much as technical.

REAL-LIFE BEHAVIOUR DISRUPTS TECHNICAL ASSUMPTIONS

A third challenge lies in the gap between **technical design and real-life behaviour**. The Spanish pilot reported that residents unintentionally disconnected smart plugs, affecting operational continuity. The Danish pilot found that digital interfaces were not always suitable in practice and had to shift towards passive comfort inference. Greece observed that optimisation signals did not always align with the times when users were actually at home and able to shift loads. These examples show that residential DR is shaped as much by everyday behaviour as by system design.

TRANSFERABILITY REQUIRES ADAPTATION

A further challenge concerns **transferability**. The pilots suggest that no solution can be expected to move unchanged from one context to another. The Spanish pilot stresses the need to adapt optimisation algorithms to local regulatory conditions, while the Romanian pilot highlights the importance of adjusting data integration to local APIs, infrastructure and consumption patterns. Ireland adds that results validated under controlled testing conditions must be carefully translated before real-life deployment. The financial toolkit reinforces this point by showing that future deployment also depends on local economic conditions and the viability of the service model in each setting.



Recommendations for Replication

BUILD INTEROPERABILITY FROM THE OUTSET

First, interoperability should be built in from the outset. Effective deployment depends on linking monitoring, control, optimisation and user interaction within a coherent framework. Replication is therefore more likely to succeed when systems are conceived as integrated service environments rather than isolated technical components.

ADAPT BEFORE REPLICATING

Second, **replication should adapt the solution to the context** rather than reproduce it unchanged. The pilots show that regulatory conditions, data infrastructure, demographic characteristics and local practices can all shape how a service works in practice. Replication must therefore account not only for technical feasibility, but also for social and economic fit.

PLAN ENGAGEMENT AS PART OF DEPLOYMENT

Third, **engagement should be planned as part of deployment**, not treated as a later communication layer. The pilots show the importance of familiarisation, tailored communication, accessible formats and human support, especially where digital confi-

dence is limited. In this sense, engagement is not an accessory to deployment, but one of its enabling conditions.

DESIGN FOR IMPERFECT DATA AND INFRASTRUCTURE

Fourth, replication strategies should make **realistic assumptions about data quality, system integration and local technical support**. Several pilots show that residential DR may require additional layers of modelling, forecasting or harmonisation where infrastructure is fragmented or incomplete. Where results are based on controlled testing environments, replication strategies should clearly distinguish between technical validation and real-life deployment conditions. These requirements should be anticipated from the start.

MAKE THE VALUE OF FLEXIBILITY VISIBLE

Finally, the **value of flexibility** must be clear and meaningful to different actors. Depending on the setting, that value may be economic, operational, comfort-related or educational. What matters is that it can be clearly articulated to users, operators and future adopters. Without a credible value proposition, technical performance alone is unlikely to sustain uptake beyond the pilot phase.

Final Thoughts

The DEDALUS pilots suggest that the future of residential demand response will depend on the ability to combine **technical robustness** with **context-sensitive deployment**. Flexibility can be enabled by digital tools, optimisation models and interoperable systems, but it becomes viable only when these elements are aligned with user needs, building conditions and local energy realities.

For future replication, this means moving beyond one-size-fits-all solutions. Residential flexibility should be designed as an adaptable service, capable of generating clear value for users, operators and energy systems while remaining understandable, accessible and grounded in real-life conditions.



Annex

Project Legacy Resources

This annex brings together the main public outputs of the DEDALUS project, offering a consolidated view of the knowledge, methodologies and results developed to support replication, further research and real-world uptake.

In line with the project's commitment to Open Access, transparency and long-term knowledge sharing, the resources listed in this annex are made available through both the Resources section of the project website and the DEDALUS Zenodo Community.⁴

DELIVERABLES

D3.1: DEDALUS technological enablers for multi-value and energy carrier-agnostic residential DR (1st technology release)

Authors: Susana M^a Gutiérrez (CARTIF), José L. Hernández (CARTIF), Marzia Mammina (ENG), Luca Vitale (ENG), Ionut Anghel (Technical University of Cluj-Napoca), Klemen Bregar (COMSENSUS), Giannis Papias (NTUA), Tuğçe Pinar (ARCELIK), Mehmet Ali Akyol (ARCELIK)

D4.1: 'First wave' of DEDALUS digital twins and data-driven services for residential DR

Authors: Marilena Lazzaro (ENG), Andrea Natalini (ENG), John Papias (NTUA), Roberto Arnanz (CARTIF), Riccardo Naccarelli (Università Politecnica delle Marche), Andrija Goranović, Simon Pernegger (OURPOWER), Henrik Lund Stærmose (NEOGRID), Athanasios Papakonstantinou (HERON), Marion Paraschi (HERON), Giannis Kazdaridis (DOM-X), Viktor Daropoulos (DOM-X), Ellie Efstathiou (DOM-X), Marc Girona (CIMNE), Tudor Cioara (Technical University of Cluj-Napoca), Ionut Anghel (Technical University of Cluj-Napoca)

D5.2: DEDALUS Pilots' execution documentation and consumers' engagement pre-pilot phase

Authors: Marc Girona (CIMNE), Álvaro Luna (CIMNE), Panos Skaloumpakas (NTUA), Katerina Sianni (NTUA), Paul Tobin (Smart Innovation Norway), Bonnie Murphy (Smart Innovation Norway), John Papias (NTUA), Vasilis Michalakopoulos (NTUA), Andrija Goranović (OURPOWER), Hans BJERREGAARD (FAELESSBO), Henrik Lund Stærmose (NEOGRID), Silvia Palma (EnEA), Sara Casaccia (Università Politecnica delle Marche), Mahtab Kaffash (CENTRICA), Ionut Anghel (Technical University of Cluj-Napoca), Tudor Cioara (Technical University of Cluj-Napoca), Athanasios Papakonstantinou (HERON), Giannis Kazdaridis (DOM-X), Ellie Efstathiou (DOM-X), Vitaliy Kryvoruchko (GREENPOINT)

D7.2: DEDALUS Communication Kit

Authors: Ilaria Orfino and Ilaria Bonetti (Fondazione ICONS)

SCIENTIFIC PAPERS

DEDALUS partners have capitalised on the project results to develop several scientific publications that have been published in

international peer-reviewed journals. The papers produced cover several topics that are fundamental to fostering technological innovations applied to the residential demand response. These topics and the related publications are listed below.

Review of Blockchain Tokens Creation and Valuation

Authors: Oana Marin, Tudor Cioara, Liana Todorean, Dan Mitrea, Ionut Anghel

DOL: <https://doi.org/10.3390/fi15120382>

A machine learning-based framework for clustering residential electricity load profiles to enhance demand response programs

Authors: Vasilis Michalakopoulos, Elissaios Sarmas, Ioannis Papias, Panagiotis Skaloumpakas, Vangelis Marinakis, Haris Doukas

DOL: <https://doi.org/10.1016/j.apenergy.2024.122943>

Methodological Approach for Optimizing Demand Response in Building Energy Management through AI-Enhanced Comfort-Based Flexibility Models

Authors: Riccardo Naccarelli, Serena Serroni, Sara Casaccia, Gian Marco Revel, Susana Gutiérrez, Diego Arnone

DOL: <https://doi.org/10.23919/SpliTech61897.2024.10612382>

Demand response optimization for smart grid integrated buildings: Review of technology enablers landscape and innovation challenges

Authors: Liana Todorean, Tudor Cioara, Ionut Anghel, Elissaios Sarmas, Vasilis Michalakopoulos, Vangelis Marinakis

DOL: <https://doi.org/10.1016/j.enbuild.2024.115067>

Evolutionary game for incentivizing the social cooperation of prosumers in transactive energy communities

Authors: Dan Mitrea, Tudor Cioara, Ionut Anghel, Liana Todorean

DOL: <https://doi.org/10.1016/j.enbuild.2024.115057>

Blockchain Solution for Buildings' Multi-Energy Flexibility Trading Using Multi-Token Standards

Authors: Oana Marin, Tudor Cioara, Ionut Anghel

DOL: <https://doi.org/10.3390/fi15050177>

Social Factors in P2P Energy Trading Using Hedonic Games

Authors: Dan Mitrea, Viorica Chifu, Tudor Cioara, Ionut Anghel, Cristina Pop DOL: <https://doi.org/10.48550/arXiv.2309.01418>

Hybrid transformer model with liquid neural networks and learnable encodings for buildings' energy forecasting

Authors: Gabriel Antonesi, Tudor Cioara, Ionut Anghel, Ioannis Papias, Vasilis Michalakopoulos, Elissaios Sarmas

DOL: <https://doi.org/10.1016/j.egyai.2025.100489>

Heuristic-based federated learning with adaptive hyperparameter tuning for households energy prediction

Authors: Liana Todorean, Mihai Daian, Tudor Cioara, Ionut

Anghel, Vasilis Michalakopoulos, Efstathios Sarantinopoulos, Elissaios Sarmas

DOI: <https://doi.org/10.1038/s41598-025-96443-3>

Social-Sciences- and Humanities-Based Profiling of Energy Consumers Towards Increasing Demand Response Engagement

Authors: Panagiotis Skaloumpakas, Aikaterini Sianni, Vasilis Michalakopoulos, Paul Tobin, Bonnie Murphy, Elissaios Sarmas, Vangelis Marinakis

DOI: <https://doi.org/10.3390/electronics14183700>

Optimal Photovoltaic Energy Allocation in Residential Renewable Energy Communities

Authors: Marc Girona-Badia, Gerard Laguna, Jordi Cipriano, Alvaro Luna

DOI: <https://doi.org/10.1109/ACCESS.2025.3607516>

Optimizing Electricity Sharing from Generation and Storage Within District-Based Renewable Energy Communities

Authors: Marc Girona-Badia, Jaume Asensio, Gerard Laguna, Pablo Moreno, Jordi Cipriano, Álvaro Luna

DOI: <https://doi.org/10.1109/MetroLivEnv64961.2025.11107090>

Data-driven techniques to improve the reliability of low voltage electricity networks through dynamical evaluation of non-technical losses

Authors: Marc Girona-Badia, G. Mor, Gerard Laguna, Jordi Cipriano, Álvaro Luna

DOI: <https://doi.org/10.1049/icp.2023.1209>

EDUCATIONAL KIT

In the final year of the DEDALUS project, several partners worked on the production of an Educational Kit designed to support knowledge transfer and capacity building on residential demand response, translating project results into accessible and actionable learning materials for a wider audience.

Authors: Diego Arnone (Engineering S.p.A), Sara Casaccia (Università Politecnica delle Marche), Susana Gutiérrez Caballero (CARTIF, Technology Centre), Richard Kaculi (Università Politecnica delle Marche), Viviana Martínez (CARTIF, Technology Centre), Ilaria Orfino (Fondazione ICONS), Giannis Papias (NTUA), Gian Marco Revel (Università Politecnica delle Marche), Panos Skaloumpakas (NTUA)

FACTSHEETS

During the final phase of the project, DEDALUS partners developed a set of factsheets to consolidate key project outputs and support the replication, uptake and long-term use of the project's results. The factsheets are organised into two groups: pilot-based factsheets and cross-cutting factsheets.

PILOT-BASED FACTSHEETS

The following factsheets present the pilot experiences developed within the DEDALUS project and are aligned with the content of Deliverable D5.4.

Authors: Ilaria Orfino (Fondazione ICONS) and Panos Skaloumpakas (National Technical University of Athens – NTUA)

- **Austrian Pilot:** Interoperable Digital Platforms for Residential Energy Communities
- **Danish Pilot:** Digital Comfort and Flexibility Services for Social Housing
- **Greek Pilot:** Multi-vector Demand Response for Residential Flexibility
- **Irish Pilot:** Heat Pump Optimisation for Residential Flexibility
- **Italian Pilot:** Comfort-aware Energy Management for Elderly Residents
- **Romanian Pilot:** Data-driven Residential Flexibility for Student Housing
- **Spanish Pilot:** District-level Energy Optimisation for Local Energy Communities

CROSS-CUTTING FACTSHEETS

The following factsheets present cross-cutting project outputs developed within DEDALUS, addressing key social, behavioural and economic dimensions of residential demand response beyond individual pilot implementations. Each factsheet reflects the contribution of the respective partners involved in its development.

- **SSH Framework:** End-user Engagement Strategy for Residential Demand Response. Authors: Oula Terttunen and Bonnie Murphy Smart Innovation Norway
- **Incentive Design Toolkit:** Behavioural Strategies for Residential Demand Response. Authors: Gloria Corazza and Silvia Palma (EnEA)

REPORTS

Over the course of the project, DEDALUS partners produced a series of reports documenting key policy and stakeholder engagement activities, capturing discussions, recommendations and takeaways on residential demand response, its regulatory deployment and the role of human-centred digitalisation in future energy systems.

- **First Policy Roundtable on Demand Response and Its Deployment** Author: Agnes Mlicka (European Green Cities)
- **Expert Roundtable on Residential Demand Response Policy** Author: Agnes Mlicka (European Green Cities)
- **Sustainable Places 2025 - Key takeaways from the workshop “Human-in-the-loop digitalisation for Europe’s energy transition”** Authors: Chiara Fonio and Ilaria Orfino (Fondazione ICONS)

VIDEOS

Over the course of the project, DEDALUS partners produced a set of video materials, including the project presentation video, the final project video, and the recordings of the final event and the workshop launching the Educational Kit, supporting communication, knowledge transfer and wider stakeholder engagement. Below is the full list of videos available on the DEDALUS YouTube channel:

- DEDALUS Presentation Video
- Workshop "The Ins and Outs of Demand Response and Smart Living: Unpacking the DEDALUS Educational Kit" (recording)
- DEDALUS and FORTESIE Final Event (Brussels, 25 March 2026)
- DEDALUS Final Video

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²IEA, Demande Response.
Available at: <https://www.iea.org/energy-system/energy-efficiency-and-demand/demand-response>

³DEDALUS project official website.
Available at: <https://dedalus-horizon.eu/>

⁴DEDALUS Zenodo Community
Available at: <https://zenodo.org/communities/010524/>

List of Abbreviations

ABC	Antecedent–Behaviour–Consequence
AC	Air Conditioning
AI	Artificial Intelligence
API	Application Programming Interface
CO₂	Carbon Dioxide
DOI	Digital Object Identifier
DR	Demand Response
ERC-1155	Ethereum Request for Comments 1155
EV	Electric Vehicle
HE	Homomorphic Encryption
HLUC_s	High-Level Use Cases

IAQ	Indoor Air Quality
IoT	Internet of Things
KPI	Key Performance Indicator
OEM	Original Equipment Manufacturer
P2P	Peer-to-Peer
PV	Photovoltaic
RES	Renewable Energy Sources
SSH	Social Sciences and Humanities
TSO	Transmission System Operator
TSV	Thermal Sensation Vote
USG	Universal Smart Gateway

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The graphic design was developed by Marta Azevedo (Fondazione ICONS).



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