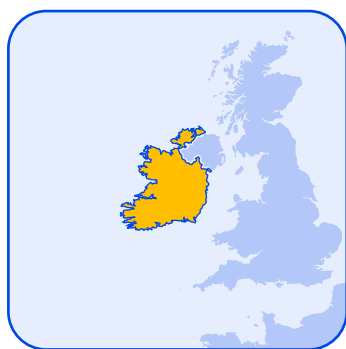


Heat Pump Optimisation for Residential Flexibility

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.



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● 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.

REFERENCES

D5.4: DEDALUS impact and social acceptance analysis, 2026