

Heat Pump Awards 2026

Application submission

STORO: Double-duct heat pump for DHW with phase change storage

INNOVA srl | Innovation Award

1. Application overview

Award category	Innovation
Title of the project	STORO: Double-duct heat pump for DHW with phase change storage
Organisation Name	INNOVA srl
Exact address of the project	Via I° maggio 8 - 38089 Storo (TN) - Italy
Funding	Private; EU funds
Organisations involved in the project	INNOVA srl - INNOVA Engineering srl b. Lüftenegger ARCHITEXTUR (Architect) c. HTPLAN GmbH (HVAC-Planner) d. KRAFT & WÄRME Heizung-Lüftung- Sanitär GmbH (Installer) e. BMT Taxer GmbH (Depht probe drilling) f. Vaillant Group Austria GmbH (Supplier Heat Pumps & System Components)
Project ending date	30/08/2026
Project website	www.innova.it
Sector of application	Residential; Commercial

2. Applicant & EHPA contact details

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EHPA member involved	Mr Oreste Bottaro - Mr Matteo Leone Campidelli
Role of EHPA member	Mr Oreste Bottaro - CEO of INNOVA srl , Mr Matteo Leone Campidelli is the head of the R&D centre and an HVAC engineer at INNOVA Engineering

3. Project description and benefits

Project description (goal, problem addressed, and solution provided by the heat pump)

STORO is an innovative heat pump water heater designed to redefine how domestic hot water systems integrate into residential spaces. The project addresses two key challenges: reducing energy consumption and CO₂ emissions, while overcoming the space and visual impact of

conventional hot water systems, especially in modern and historic buildings where outdoor units may be restricted. STORO combines an R290 double-duct heat pump with a Phase Change Material (PCM) thermal battery, achieving high energy density in a compact footprint comparable to a standard dishwasher. Measuring 595 × 550 × 850 mm, it can be fully integrated into standard kitchen cabinetry or installed as a free-standing unit. By comparison, a conventional heat pump water heater providing a similar amount of hot water typically uses around 300 litres of storage and can be approximately 1.70 m high. The PCM storage enables 230 L of mixed hot water (V40), with target Class A+ efficiency and a nominal COP target of 3.1. Smart Grid and photovoltaic optimization functions use the PCM as a thermal battery, storing renewable energy for later use and reducing grid consumption. Multiple air-source configurations increase installation flexibility and energy efficiency. STORO transforms the heat pump water heater from a conventional technical component into a compact, connected and sustainable household appliance designed to integrate naturally into the home.

Expected or achieved benefits

STORO delivers significant benefits in terms of energy efficiency, space optimization, renewable energy integration and architectural flexibility. Its PCM thermal battery provides high energy density in a compact volume, enabling 230 L of mixed hot water (V40) within a footprint comparable to a standard dishwasher. This allows the system to achieve Class A+ energy efficiency, while the Superboost function can reduce charging time to less than 3 hours. STORO maximizes renewable energy self-consumption by using the PCM as a thermal battery, storing excess photovoltaic energy for later use through Smart Grid, SG Ready and Demand Response functions. Its R290 natural refrigerant, with a GWP of only 3 and zero ODP, contributes to lower environmental impact and supports the decarbonization of residential buildings. The flexible air-source configurations can further improve efficiency by recovering heat from stale indoor air while contributing to indoor air renewal. Finally, the built-in configuration enables complete integration into standard 600 mm kitchen cabinetry, reducing the visual and spatial impact of conventional water heaters and making high-performance heat pump technology suitable for both contemporary and architecturally

Obstacles/barriers encountered during development

The main challenge was to combine high heat pump performance with an extremely compact form factor suitable for complete built-in integration. Conventional water storage requires significant volume, while reducing the dimensions can compromise thermal capacity, efficiency and recovery time. The development therefore required extensive research into PCM thermal storage, including the selection and optimization of phase-change materials, thermal exchange processes and operating temperatures. A specific challenge was verifying the compatibility of the hydrated salt mixture with the heat exchanger materials, in order to prevent corrosion, degradation or loss of performance over time. The design and development of the propane-to-hydrated-salt heat exchanger also required dedicated studies to ensure effective heat transfer, safety, reliability and long-term durability. Integrating the PCM storage with the R290 refrigeration circuit required careful management of thermal performance, safety and reliability within a limited space. A further challenge was achieving the flexibility required for different residential installations. The system had to accommodate multiple air-source configurations, several duct and hydraulic connection layouts, and both built-in and free-standing installations without compromising performance or aesthetics. Finally, the integration of PV optimization, Smart Grid, Demand Response and adaptive inverter control required the development of proprietary control strategies capable of coordinating thermal storage, heat pump operation and electrical consumption. The project overcame these challenges through an iterative R&D process, building on the knowledge generated within the European LIFE ITS4ZEB research

project and progressively translating the research results into an industrialized, reliable and user-oriented product

Why should this project win an award?

STORO deserves to win an award because it challenges the conventional idea of what a heat pump water heater can be. The surprising part is that a system capable of delivering 230 litres of mixed hot water (V40) can fit into a footprint comparable to a standard dishwasher: just 595 × 550 × 850 mm. By combining an R290 heat pump with a high-energy-density PCM thermal battery, STORO brings a traditionally bulky technical system into the kitchen and makes it virtually invisible. But the innovation goes beyond compactness. STORO turns hot water storage into an intelligent energy asset. Its PCM acts as a “thermal battery”, allowing surplus photovoltaic energy to be stored as heat and used when needed, while Smart Grid, Demand Response and adaptive control optimize when and how the system operates. PDX also adapts to the building rather than forcing the building to adapt to the technology: it can use outdoor air, stale indoor air or ambient air, and can be built in or free-standing. In short, STORO combines advanced thermal engineering, renewable energy integration and architectural design in one product—turning a hidden technical appliance into a key element of the sustainable home. At the same time, it opens a new market perspective by bringing heat pump technology into the world of household appliances. STORO is not merely a technical system installed in a building; it is a new type of connected, energy-efficient appliance, designed to integrate naturally into the domestic environment and to become part of the future kitchen.

4. Technical specifications

Capacity of unit(s)	Approximately 2.5 kW (nominal heat pump thermal power).
Energy sources used	STORO is an electrically powered heat pump that primarily uses outdoor air as its thermal energy source. Depending on the installation configuration, it can also exploit residual heat contained in warm stale exhaust air extracted from indoor environments, such as kitchens and bathrooms. This improves energy efficiency while contributing to indoor air renewal. It may also use indoor ambient air in suitable non-habitable spaces. The system can be integrated with photovoltaic electricity, using surplus renewable energy to charge the STORO does not use gas as an energy source and does not require recycled waste heat. To further enhance system performance and sustainability, air collectors are used during the summer months to help regenerate the geothermal field and maintain long-term ground temperature stability.
Coefficient of Performance (COP)	The STORO heat pump has a COP target of 3.1 under nominal operating conditions. The actual COP depends on the operating conditions, particularly the temperature of the heat source used. STORO can use outdoor air, indoor ambient air or warm stale exhaust air as its heat source. The system is designed to maintain high efficiency through its PCM thermal storage and adaptive control strategy. In the inverter version, the thermal power is modulated according to the required load, while the PCM thermal battery enables efficient energy storage and use when most beneficial. 3,18 (B0W55)

Service provided	Domestic hot water Specifically, the system supplies: -) Low-temperature radiators in the restaurant and hospitality areas. -) Heating coils within the air handling unit to support the ventilation system. -) Low-temperature radiators in guest accommodation areas. -) Centralized domestic hot water preparation for the entire facility.
Refrigerant type	propane

Heat pump details (compressor technology, heat exchanger, system configuration)

STORO uses a single R290 heat pump connected to a PCM thermal storage system. It is available in ON-OFF or Inverter versions and uses a rotary compressor. The system includes one brazed-plate heat exchanger between the refrigerant circuit and the PCM storage. The heat exchanger is manufactured using materials protected against corrosion caused by the mixture used in the PCM system. STORO uses inorganic hydrated salts as PCM. During the solid-liquid phase change, the material absorbs and stores large amounts of latent heat, then releases it during solidification. This high energy density allows significant thermal storage in a compact volume, acting as a thermal battery that decouples heat production from domestic hot water demand and enables efficient use of surplus photovoltaic energy. Multiple heat pumps can be combined in parallel when higher capacity or increased domestic hot water demand is required; they are not configured in series.

5. Renewable energy integration and grid response

Integration of renewable energy sources

Storo is designed to integrate directly with photovoltaic (PV) renewable energy systems through its Smart Grid / SG Ready control logic. When surplus solar electricity is available, the system automatically activates the heat pump to charge the PCM thermal battery and produce domestic hot water. The PCM acts as a thermal battery, enabling STORO to capture and store surplus photovoltaic energy during periods of high solar production and shift its use to a later time, when solar energy is no longer available or demand is higher. In this way, PDX does not simply consume renewable electricity when it is generated: it moves renewable energy through time, converting it into stored thermal energy that can be used when needed. This temporal shift increases the building's photovoltaic self-consumption, reduces electricity drawn from the grid and limits the need to export surplus solar energy. The proprietary control algorithm, Wi-Fi/App connectivity and Demand Response capability optimize charging according to PV availability and domestic hot water demand. In the Inverter version, the heat pump also modulates its output to match the required load. By combining efficient heat pump technology, PCM thermal storage and intelligent renewable energy management, STORO improves overall system efficiency, reduces operating costs and supports the decarbonization of residential buildings.

Response to energy demand / smart grid integration

STORO is designed as an intelligent thermal energy storage system that responds dynamically to changes in energy demand and electricity availability. Its PCM thermal battery decouples domestic hot water production from the exact moment of consumption. Through its proprietary control algorithm, STORO can anticipate expected demand, charge the PCM when electricity is

most advantageous and store thermal energy for later use. This is particularly valuable during periods of high hot water demand, when the stored energy can cover consumption peaks without requiring the heat pump to operate at maximum power or drawing additional electricity from the grid. The system incorporates SG Ready logic and Demand Response (DR) functionality, enabling it to participate in smart-grid and load-management strategies. It can shift electrical consumption away from periods of high grid demand, avoid or reduce power peaks, and prioritize operation when renewable electricity or more favourable energy conditions are available. In this way, STORO contributes to the building's energy flexibility by adapting its charging cycles to both user needs and grid conditions. In the Inverter version, the variable-speed compressor continuously modulates the heat pump output according to the required thermal load, avoiding unnecessary energy consumption, reducing sudden power demand and improving part-load efficiency. Wi-Fi/App connectivity enables intelligent monitoring and management, while the PCM storage provides a flexible energy reserve that can be charged in advance and used during peak-use periods. STORO therefore acts as a thermal buffer between the building and the electricity grid, transforming domestic hot water production into a flexible load. It supports renewable energy self-consumption, peak-load management, grid balancing and more efficient energy use without compromising user comfort.

6. Innovation, monitoring and replicability

General (all awards)

Why the project is innovative *(all awards)*

STORO is innovative because it combines technologies that are normally developed and used separately into a completely new type of domestic hot water appliance. A key innovation is its exceptional compactness compared with conventional heat pump water heaters and storage boilers. STORO integrates a high-energy-density PCM thermal battery with an R290 heat pump in a form factor comparable to a standard dishwasher. Measuring just 595 × 550 × 850 mm, it can provide 230 L of mixed hot water (V40) while occupying significantly less space than traditional systems. This compactness is particularly valuable in the renovation and energy upgrading of existing buildings, where technical rooms are often small, already occupied or difficult to modify. By fitting into a standard 600 mm kitchen niche, STORO makes high-efficiency heat pump technology suitable for homes where conventional systems would be impractical. The PCM stores thermal energy through phase change, while a dedicated R290-to-PCM heat exchanger efficiently transfers heat from the refrigeration circuit to the hydrated-salt PCM. The system can operate with outdoor air, indoor ambient air or warm stale exhaust air, and can be installed free-standing or fully integrated into cabinetry. Its proprietary control algorithms, Inverter technology, PV optimization, SG Ready and Demand Response functions manage the PCM as a thermal battery. STORO therefore represents a new product paradigm: a compact, connected and architecturally integrated heat pump designed specifically for the space constraints of existing buildings.

Monitoring approach (performance, cost, and carbon targets) *(all awards)*

STORO continuously monitors its operation through its control system and Wi-Fi/App connection. The system collects information such as hot water demand, operating conditions, heat pump activity and the charging status of the PCM thermal battery. This information is processed by the proprietary control algorithm to adapt the system to actual needs. In the Inverter version, for example, the compressor power is adjusted according to the required load, avoiding unnecessary energy consumption. The system can also use information on

photovoltaic production and Smart Grid signals to decide when it is most efficient to produce and store hot water. Excess PV energy can therefore be stored in the PCM and used later, reducing electricity taken from the grid. The collected data is used during development and operation to check performance, optimize energy consumption and identify possible improvements. It also helps evaluate the effectiveness of the system in terms of energy efficiency, renewable energy self-consumption and operating costs. In this way, STORO does not simply monitor its performance: it uses the available data to actively adapt its operation and make better use of energy when it is available and needed.

For Innovation Award

Technology/technique developed solely for this project *(Innovation Award only)*

The most important development is the combination of an R290 heat pump with a PCM thermal storage system in a very compact appliance. A dedicated brazed-plate heat exchanger was developed to efficiently transfer heat from the refrigerant circuit to the hydrated-salt PCM, while ensuring compatibility and long-term reliability.

The PCM system was specifically selected and optimized to work with the heat pump and to provide the required domestic hot water performance within the limited dimensions of the appliance. The integration of the PCM thermal battery with the R290 circuit, compressor, heat exchanger and hydraulic system was a key part of the R&D work.

A further R&D challenge was the selection and optimization of the appropriate hydrated-salt formulation for the PCM system. The mixture had to provide the required phase-change temperature and thermal storage capacity, while ensuring suitable heat transfer performance, stability over repeated charge-discharge cycles and compatibility with the heat exchanger materials. This selection was essential to achieve the required performance within the limited volume available in STORO

STORO also incorporates proprietary control strategies developed for the system. These manage the heat pump and PCM charging according to hot water demand, operating conditions, photovoltaic production and Smart Grid signals. In the Inverter version, the variable-speed compressor is modulated according to the actual load.

What is particularly specific to the project is therefore not one isolated component, but the way these technologies have been combined into a completely different type of product: a compact heat pump water heater designed as a built-in or freestanding household appliance rather than as a conventional building-plant component.

The development builds on the R&D experience gained through the LIFE ITS4ZEB project, but STORO required further development and optimization to turn those principles into a compact, market-oriented product.

Differentiation from state-of-the-art solutions & market maturity *(Innovation Award only)*

STORO differs from current heat pump water heaters mainly in the way it combines energy efficiency, thermal storage and compactness in a product designed as a household appliance. Conventional heat pump water heaters are generally relatively bulky and are treated as technical equipment, often requiring a dedicated utility space. STORO integrates the heat pump with a PCM thermal battery, achieving 230 L V40 in a footprint comparable to a dishwasher. This allows the system to be installed either fully built-in or freestanding, making it much easier to integrate into homes and renovation projects. The PCM also changes the way the system operates. Instead of producing hot water only when it is needed, STORO is capable of storing a greater amount of thermal energy and using it at a later time. This allows surplus photovoltaic electricity to be stored as heat and enables the system to respond to Smart Grid signals, using thermal storage as a form of energy flexibility. A further key difference is the product positioning.

STORO transforms what has traditionally been a bulky building-plant component into a household appliance that can be integrated into the kitchen or living environment, either concealed or visible. This opens a new market perspective for heat pump water heating.

Regional benefits (energy savings, emissions, jobs, infrastructure) *(Innovation Award only)*

STORO can bring both direct and indirect benefits to the region, particularly by supporting the transition towards more efficient and electrified buildings.

Directly, the technology can reduce the energy consumption associated with domestic hot water production and increase the use of locally produced photovoltaic electricity. By storing surplus renewable electricity as thermal energy in the PCM, STORO can reduce electricity taken from the grid and help lower associated CO₂ emissions.

The project can create a concrete opportunity for local industrial development as STORO moves towards commercial production. The product brings together heat pump technology, PCM thermal storage, electronics and smart controls, creating opportunities for local companies to contribute to manufacturing, assembly, engineering, installation and after-sales services.

The transition from a conventional technical component to a new type of household appliance could also create new business opportunities beyond the traditional heating sector. It opens the possibility of collaboration with companies working in appliances, kitchens, building renovation and energy management, helping to create new local value chains around an emerging product category.

STORO can also strengthen local expertise in technologies that are becoming increasingly important for the energy transition, including heat pumps, thermal storage, photovoltaic integration and Smart Grid management. This knowledge can support the development of other products and services and increase the competitiveness of companies operating in the region.

As the product is commercialized and adopted in more buildings, these benefits can extend beyond manufacturing to installers, designers, energy consultants and maintenance providers. In this way, the project can contribute to the creation of a broader local ecosystem around energy-efficient buildings and renewable energy technologies.

For Large Heat Pump or Building Solutions Award

Why the project serves as a model for others *(Large Heat Pump or Building Solutions Award)*

No answer provided.

Potential for expansion to other locations/industries *(Large Heat Pump or Building Solutions Award)*

No answer provided.

Barriers to replication elsewhere *(Large Heat Pump or Building Solutions Award)*

No answer provided.

Business opportunities for expansion, licensing, or commercial production *(Large Heat Pump or Building Solutions Award)*

No answer provided.