

Heat Pump Awards 2026

Application submission

Renewable-Assisted DHW System (RA-DHW)

Energy On Sp. z o.o. | Building Solutions Award

1. Application overview

Award category	Building Solutions
Title of the project	Renewable-Assisted DHW System (RA-DHW)
Organisation Name	Energy On Sp. z o.o., ul. Trzy Lipy 3, 80-172 Gdańsk, Poland
Exact address of the project	ul. Szafranka 18, 76-200 Słupsk, Poland
Funding	Private; EU funds
Organisations involved in the project	Energy On Sp. z o.o. - system design, installation, and commissioning. STBS (Słupskie Towarzystwo Budownictwa Społecznego) - investor, building operator, and end user. Panasonic - manufacturer of the heat pump unit (Aquarea T-CAP Gen. K).
Project ending date	05/05/2025
Project website	https://www.energy-on.pl/sok-cwu
Sector of application	Residential

2. Applicant & EHPA contact details

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EHPA member involved	Panasonic Marketing Europe GmbH (Polish branch)
Role of EHPA member	Product-related support and technical advisory services regarding the Aquarea T-CAP 12 kW, Gen. K heat pump units, including operating algorithms and installation schematics.

3. Project description and benefits

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

The STBS Szafranka 18 project introduces the Renewable-Assisted DHW System (RA-DHW), a cost-optimisation solution for domestic hot water (DHW) preparation in an existing multi-family building connected to the municipal district heating network. Problem: Decarbonising older multi-family buildings is difficult - network heat costs and EU ETS emission charges are steadily rising, while fully disconnecting a building from the network would require costly, invasive retrofitting of both the internal installation and the wider infrastructure. Goal: To reduce the cost and carbon footprint of DHW preparation without invasive building works and without

compromising residents' comfort. Solution: RA-DHW connects an air-source heat pump (12 kW) in series upstream of the district heating substation's heat exchanger, acting as the first, high-efficiency heating stage, with the municipal network remaining as the peak-load source. The system's core is a proprietary Energy Management System (EMS), which orchestrates the heat pump, PV installation (10.67 kWp), energy storage (10.24 kWh), and water tanks (1000 l) in real time, deciding when heating water from renewable sources is cheaper than network heat. Result: the cost per 1 m³ of DHW fell from PLN 36.35 to PLN 21.48 (-41%), and CO₂ emissions were reduced - without any change in how residents use hot water.

Expected or achieved benefits

The system has been logging performance data since commissioning. The figures presented in Annex 1 cover a full operational year, based on the twelve most recent complete calendar months (August 2025 – July 2026) Real-world performance The heat pump covered 58% of the building's annual DHW demand, delivering approximately 160 GJ of heat at an average annual coefficient of performance (COP) of 3.32 (44,447 kWh of heat output / 13,379 kWh of electricity input). Affordability The cost of heating 1 m³ of DHW for the entire building fell from PLN 36.35 to PLN 21.48 (-41%), translating into approximately PLN 17,300 in annual savings per building. The average cost of DHW prepared solely by the RA-DHW system was PLN 10.71 per m³ (-71.5%). Environmental impact Producing 58% of the building's DHW through the system results in a net emission reduction of 15.01 t CO₂/year. This figure is calculated as the difference between the emissions avoided on the district heat side (18.49 t CO₂, based on the regional emission factor of 115.58 t CO₂/TJ) and the additional emissions from grid electricity drawn to power the heat pump (3.48 t CO₂, based on the current national electricity emission factor). RES self-consumption 68.3% of the electricity generated by the PV installation is consumed directly on site. Of the total electricity used to power the heat pump, 52.9% comes from direct PV self-consumption. In total, 77.4% of the heat pump's electricity demand was covered either by direct PV self-consumption or by grid electricity financially offset by previously exported PV surplus under the net-billing scheme. Grid stability & symbiosis The district heating network remains the peak-load and backup source, guaranteeing residents full comfort while avoiding additional strain on the local electricity grid under conditions unfavourable to system operation. Business validation Following the success of the pilot, the investor (STBS) ordered an identical system for two additional buildings, and the solution is now operating in several dozen installations across northern Poland.

Obstacles/barriers encountered during development

During implementation of the system in an existing building, two recurring barriers were encountered, both typical of this type of retrofit: Spatial constraints - fitting the heat pump, energy storage (BESS), PV inverters, and water tanks (1000 l in total) into the building's confined existing technical space, without interrupting the hot water supply to residents during installation. Acoustic requirements - selecting the location and mounting method for the air-to-water heat pump's outdoor unit within dense urban development, in order to meet strict daytime and night-time noise limits applicable to residential surroundings. Both barriers were resolved at the design stage - through appropriate equipment sizing, correct positioning of the outdoor unit, and standard coordination with the building operator - meaning neither affected the project schedule nor residents' comfort.

Why should this project win an award?

Our project deserves to win because it shows that the energy transition of the challenging district-heated multi-family housing sector does not have to be slow, invasive, or costly. Surprising symbiosis: Rather than treating the heat pump as competition for the district heating

network, we built a system in which both technologies work together - the heat pump takes over the cost-effective base load, while the network remains the guarantor of peak demand and comfort. Innovation in orchestration, not in the device: The project's true value lies not in a single heat pump, but in the proprietary EMS, which reconciles PV production, energy storage status, outdoor temperature, forecasted COP, and electricity and heat prices in real time - with the EMS architecture also enabling operation under variable-price (dynamic) tariffs - always selecting the cheapest and most efficient source. Convincing market validation: This is not a concept on paper - following the successful pilot, the investor ordered an identical system for two further buildings, and the solution is already operating in several dozen buildings across northern Poland. Hard numbers and scalability: -41% in the total cost of DHW (from PLN 36.35 to PLN 21.48/m³) and 15.01 fewer tonnes of CO₂ per year in a single building - with a technical replication potential reaching approximately 250,000 multi-family buildings in Poland, representing nearly 5 GW of heating capacity and an estimated 2.9 million tonnes of CO₂ avoided annually nationwide (based on national average emission factors for district heat and grid electricity).

4. Technical specifications

Capacity of unit(s)	12 kW (nominal power) - Panasonic Aquarea T-CAP, generation K
Energy sources used	The heat pump runs on 100% electricity. The installation has been integrated into a single energy ecosystem together with the on-site PV installation (10.67 kWp) and the BESS energy storage system (10.24 kWh) - as a result, a significant share of the electricity powering the heat pump comes directly from on-site solar generation. In the analysed year, 52.9% of the heat pump's electricity demand was met by direct PV self-consumption, while 77.4% was covered either directly by PV or financially offset by previously exported PV surplus under the net-billing scheme.
Coefficient of Performance (COP)	The measured annual average COP is 3.32, calculated as the ratio of the measured heat output delivered by the heat pump (44,447 kWh) to the total measured electricity input drawn by the heat pump, including auxiliary devices (13,379 kWh), over a full 12-month operational period in DHW pre-heating mode (August 2025 – July 2026). Operational data from the installation are provided in Annex 1. It is worth noting that the system is technically capable of heating water under nearly all weather conditions occurring in Poland, and the data presented include extreme winter conditions recorded in January and February 2026. The higher summer efficiency (peak: July, COP ≈ 4.21) is consistent with both more favourable ambient conditions and the EMS strategy of shifting heat pump operation towards thermodynamically favourable periods.
Service provided	The service provided by the system is the preparation of domestic hot water (DHW). The heat pump charges the DHW tanks, with a total storage volume of 1,000 L, integrated in series on the supply side of the existing district heating substation's heat exchanger. Depending on the EMS algorithms (which analyse, among other factors, current PV generation and forecasted COP), the system operates in one of three states: Thermal bypass - in scenarios that are economically or thermodynamically unfavourable, the EMS halts heat pump operation, and DHW preparation relies 100% on the district heating network. Pre-heating - the heat pump raises the temperature of cold mains water to an optimal intermediate level at maximum efficiency; the

	district heating substation acts as the peak- load source, further heating the water to the required temperature. Full target heating - when PV availability is high and external conditions are favourable (mainly in summer), the heat pump independently covers 100% of DHW demand, temporarily eliminating energy draw from the district substation entirely.
Refrigerant type	The heat pump uses R32 refrigerant. The system architecture is not dependent on R32 and can accommodate future heat-pump generations using lower-GWP refrigerants. The use of R32 results from the advantages associated with the split-type heat pump configuration within the system - namely, the absence of any need for frost protection under low outdoor temperature conditions, in which the system may otherwise remain idle.

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

The project uses a single air-source heat pump unit (Panasonic Aquarea T-CAP 12 kW, Gen. K). The key innovation lies in its hydraulic integration into the overall system, rather than in the unit itself:

- T-CAP technology Units in this series are capable of maintaining full output (constant heating capacity) at outdoor temperatures down to -20°C without the need for electric backup heating, and can operate independently down to -28°C outdoors. This is achieved through efficient refrigerant control via a unique twin-tube heat exchanger and a bypass solution. As the outdoor temperature drops significantly, the T-CAP system optimises pressure and increases refrigerant mass flow. An additional refrigerant injection directly upstream of the compressor allows the unit to operate at higher output without risk of overheating.
- Capability to produce water at 60°C even at an outdoor temperature of -10°C.
- The outdoor unit's fin-and-tube heat exchanger, coated with Bluefin, provides corrosion protection against adverse ambient conditions.
- Aquarea Service Cloud. This service enables professionals to remotely service customers' heating installations, perform predictive maintenance, fine-tune system settings, and respond quickly to any faults.
- The heat pump used supports integration with the wider system, owing to the availability of an additional Modbus module (straightforward integration with KNX and Modbus systems enables full two-way monitoring and control of all operating parameters), allowing the unit to be controlled via external software.
- System configuration (series): a single heat pump operates in series with the district heating network's heat exchanger, acting as the primary stage, charging the water tanks (1000 l) at optimal, low-temperature parameters. The district heating substation serves as the secondary (peak-load) stage, activated only when the EMS determines that peak-load water heating is required.

5. Renewable energy integration and grid response

Integration of renewable energy sources

Renewable energy sources (solar and aerothermal) are integrated through the proprietary EMS, creating an integrated local energy system:

- Hardware integration: the heat pump (12 kW) is directly integrated with the PV installation (10.67 kWp) and the BESS energy storage system (10.24 kWh); the water tanks (1000 l) serve as thermal storage.
- Maximising self-consumption: the EMS adjusts heat pump operation to current PV output in real time - on-site solar electricity is converted into heat first (buffered in the tanks), with any surplus then used to charge the battery. Result: the PV self-consumption rate reaches 68.3%; 52.9% of the heat pump's electricity demand is met by direct PV self-consumption, while 77.4% is covered either directly by PV or financially offset by previously exported PV surplus under the net-billing scheme.
- Load shifting: the system schedules heat pump operation to run most intensively during time

windows where two favourable conditions coincide - high PV output and high outdoor air temperature (the heat source). This synchronisation directly contributes to the system's higher annual COP (3.32). In addition, the EMS algorithm continuously analyses real-time electricity prices and district heat prices, shifting heat pump operation to the most economically favourable moments; when conditions are clearly unfavourable - both in price and thermodynamic terms - the system fully suspends heat pump operation, transferring DHW heating entirely to the district heating substation. The result of this optimisation is reduced OPEX - the cost of heating DHW fell by 41%.

Response to energy demand / smart grid integration

The system transforms a passive multi-family building into an actively managed energy system, responding to changes in demand through three strategies:

- **Load shifting and thermal buffering:** DHW consumption peaks (morning and evening) rarely coincide with the window of highest PV output. The EMS proactively "charges" energy during the day, buffering it electrically in the BESS (10.24 kWh) and thermally in the water tanks (1000 l), so that the evening peak is served using previously stored energy from on-site PV.
- **Cost-optimised control and smart-grid readiness:** The EMS continuously analyses current and forecasted PV generation, storage charge status, outdoor temperature (COP forecast), and the cost structure of electricity and heat, deciding in real time whether to run the heat pump or leave heating to the district network. The system is fully prepared to operate under dynamic pricing tariffs, which creates room to increase the system's share in DHW heating - particularly by using the battery storage during colder periods and taking advantage of low-cost electricity during periods of high wind-based RES generation on the grid (with the heat pump and battery charging operating in parallel).
- **Grid stabilisation (peak shaving):** In extreme scenarios (low winter temperatures combined with a nationwide electricity demand peak), the control system shifts the load to the district heating network instead of pushing the heat pump during peak electricity demand, supporting the stability of both the electricity grid and the district heating network.

In summary, the EMS control logic operates as an optimisation loop:

- **Inputs:** PV generation, available stored PV energy, electricity price, district heat price, outdoor temperature (COP), DHW demand.
- **Optimisation:** cost/emission minimisation. Because the hybrid architecture guarantees DHW temperature and comfort through the district heating backup stage, the EMS optimisation loop does not need to enforce comfort as a separate constraint - comfort is inherently secured by the system's physical design, regardless of the EMS's cost-driven decisions.
- **Outputs:** heat pump on/off, target outlet water temperature, battery charge/discharge, thermal storage charging, district heat network contribution.

6. Innovation, monitoring and replicability

General (all awards)

Why the project is innovative *(all awards)*

The project's innovation lies not in a new device, but in the system architecture and the "orchestration" of existing technologies - transforming a passive district heating substation into an actively managed prosumer energy system.

- **Hybridisation and symbiosis:** Rather than disconnecting the building from the municipal network at significant cost and risk, the heat pump and the district heating network work together in a series configuration - the heat pump takes over the cost-effective base load, while the network remains as peak-load support.
- **Algorithmic energy management:** The proprietary EMS combines clean electricity generation (PV), chemical storage (BESS), and thermal buffering into a single ecosystem, optimising self-consumption

(68.3%) and reducing the load on the network in real time. • Non-invasive "plug-and-play retrofit" model: The project demonstrates that the deep decarbonisation of older multi-family buildings does not require the high capital expenditure associated with a full-scale rebuild to a new standard - it is a repeatable, compact module added to the building's existing infrastructure.

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

The supervisory EMS collects and archives a full set of operational parameters in real time with a sampling interval of 30 seconds, including: PV generation, energy storage state of charge (SOC), temperatures (outdoor, water tank, and network water), electricity consumption by the heat pump and auxiliary devices, and current electricity and district heat prices. The data is accessible through a dedicated application/control panel for the system. Based on this data, the Energy On team periodically calculates key performance indicators - measured annual average COP, the system's share in DHW coverage, the unit cost of DHW, and CO₂ emission reduction - the same figures used to prepare this application (see the monthly table in question 21). The results are used to: (1) continuously verify the economic viability of system operation, (2) fine-tune EMS control parameters (e.g. switching thresholds between the heat pump and the network), and (3) report annual savings and environmental impact to the investor (STBS).

For Large Heat Pump or Building Solutions Award

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

Non-invasive modernisation: The project demonstrates to property managers that a drastic reduction in OPEX (-41%) and CO₂ emissions does not require multi-million investments in deep thermal retrofitting or geothermal boreholes - a compact module "plugged into" the existing infrastructure is sufficient. A model for symbiosis with district heating: The solution shows that hybrid prosumer micro-hubs and district heating networks can operate in a mutually beneficial relationship - the district heating company retains the customer by supplying heat for DHW peak demand and full space heating (CH) demand, while the building benefits from lower costs and reduced emissions. Proven market readiness: The success of the pilot set the standard for the investor (STBS), who, after verifying the results, replicated the same model in two further buildings. In addition, investors in several dozen other buildings across northern Poland have implemented this solution on their own. This provides strong evidence of repeatability and readiness for wider replication.

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

This is one of the system's key strengths. The project has very high scaling potential due to its modular architecture - the system is not a bespoke, custom-built solution, but a repeatable, plug-and-play modernisation module, adapted only in terms of individual component sizing. • Territorial expansion: In Poland, more than 300,000 multi-family buildings are connected to (largely coal-based) district heating networks; the estimated technical deployment potential covers approximately 250,000 of them - a market representing nearly 5 GW of clean heating capacity and an estimated 2.9 million tonnes of CO₂ reduction annually nationwide. This is aligned with the objectives of the EPBD in Poland and is also relevant across Central and Eastern Europe, where similar district-heated residential building stock is widespread. • Adaptation to other sectors: The EMS logic and hydraulic architecture remain unchanged regardless of scale and can be applied wherever DHW heating is required - only the equipment sizing (heat pump capacity, buffer tank, and BESS capacity) changes. Without any additional R&D work, the system can be adapted to facilities with constant, high DHW demand: hotels, hospitals, student dormitories, swimming pools, and similar buildings. This is no longer just

theory - following the results of the Szafranka 18 pilot, the investor immediately decided to replicate the system in further buildings.

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

Technical: Availability of suitable indoor space (within the existing heating substation or another technical room), together with an outdoor unit location meeting acoustic requirements. This is addressed through a site audit and inventory of existing conditions carried out at the design stage. Regulatory/formal: In Poland, there is an ongoing legislative debate concerning technical requirements for the installation of battery energy storage systems, including in multi-family residential buildings. The current shape of the proposed legislation would exclude some multi-family buildings from the possibility of installing battery storage inside the building. Should the regulation come into force in its proposed form, we are technically prepared to install energy storage units outdoors to ensure regulatory compliance. Financial: Despite a relatively low CAPEX compared to deep thermal retrofitting, the initial investment can be a barrier for smaller housing communities or cooperatives. This is offset by a relatively short payback period resulting from significant OPEX savings, as well as by available subsidies (e.g. the "OZE Grant" programme, thermomodernisation bonus, preferential RES loans) and possible ESCO-based financing models.

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

The project has market-validated commercial potential in three directions: • Territorial expansion: The model of hybridising existing district heating substations using heat pumps, renewable energy sources, and energy storage can be deployed at scale across Central and Eastern Europe - in Poland alone, the addressable market covers approximately 250,000 multi-family buildings connected to municipal district heating networks. • Licensing of control algorithms: The project's unique commercial value lies in the proprietary EMS, which optimises the interaction between the heat pump, PV, energy storage, and the district heating substation. The software, together with the series-configuration hydraulic scheme, can be licensed to other ESCO and installation companies. • Sector-wide scalability: The system's architecture scales beyond residential buildings, opening commercial markets for hotels, hospitals, student dormitories, and other facilities with constant, high DHW demand, supporting an attractive payback period through OPEX reduction.

For Innovation Award

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

No answer provided.

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

No answer provided.

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

No answer provided.

Commercial potential *(Innovation Award only)*

No answer provided.