SHORT DESCRIPTION OF THE HARDWARE-IN-THE-LOOP HYBRID RENEWABLE ENERGY SYSTEM AND BUILDING DEMONSTRATOR

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The hybrid renewable energy system and building demonstrator has been developed according to the hardware-in-the-loop logic, in which real elements of the physical system are coupled to emulators controlled in real time by dynamic simulations. It consists of the following devices:

- physical systems:

- 8 photovoltaic modules (2 kW-peak) and inverter;
- electrochemical storage (lithium batteries, 16 kWh);
- 2 thermal solar collectors (6 m^2);
- 2 heat pumps (air-to-water, modulating, 5 kW, and water-to-water, on-off, 4 kW);
- 2 thermal storages (water tanks, 520 L each, with 3 internal serpentine heat exchangers);
- auxiliary components (pumps, heat exchangers, valves, controllers);
- meteorological station (air temperature, air humidity, global solar irradiance, wind direction and intensity, atmospheric pressure, precipitation);
- other sensors (electric energy meters, thermal energy meters and thermistors in various positions of the thermo-hydraulic loop);

- emulated systems:

- domestic hot water uses (tap opened by a valve, according to the requested profile);
- building envelope and space heating and cooling emitters (through an external heat exchanger and a three-way mixing valve, which controls the return temperature from the building emitters, in accordance with the dynamic simulation of the building, carried out in real time);
- wind microturbine (taking energy from the electricity grid according to the measured wind);
- micro-CHP engine (taking energy from the electricity grid and switching on an electric heater in the thermal storage);
- other electric energy uses (using electric heaters, with dimmers for modulation according to the profile of energy request).

The entire system is monitored and managed through a central acquisition and control software.

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