ecoFOREST

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1. ORIGIN STORY

SINGLE-FAMILY HOME IN NIGRÁN, SPAIN

WHAT WAS THE PREVIOUS APPROACH?

- Typical solution: **gas boiler** for space heating, DHW and pool heating.
- No active cooling, relying on the mild Galician climate.

Traditionally, a house like this would have been designed around a gas boiler supplying underfloor heating, domestic hot water and seasonal pool heating. Cooling was omitted because of the local climate, accepting a few uncomfortable weeks each summer.

WHY WASN'T FULL ELECTRIFICATION CONSIDERED?

- **Pool heating** was seen as the main obstacle.
- Concern that **one heat pump** couldn't efficiently satisfy heating, cooling, DHW and pool loads.
- Fear of higher **operating costs** or oversized equipment.

The perception was that asking one heat pump to deliver space heating, cooling, DHW and pool heating would either compromise efficiency or require significant oversizing. Pool heating was considered the reason to keep a gas boiler in the project. There was also a concern that an all-electric solution would increase operating costs.

WHAT CHANGED?

- One **water-to-water heat pump** now covers every thermal demand.
- **HTR** recovers heat that would otherwise be rejected.
- **PV** integration further reduces operating costs.
- Full electric system with improved comfort and simplified plant room.

Advances in inverter W2W heat pumps have fundamentally changed what's possible. By combining heating, cooling, DHW and pool heating in **a single system**, the project could eliminate fossil fuels entirely. The HTR function allows recovered heat to contribute to useful loads instead of being wasted, while photovoltaic further reduces electricity consumption. **One intelligent heat pump delivering year-round comfort**.

2. THE SOLUTION

WATER-TO-WATER HEAT PUMP WITH DRY COOLER

WHAT IS THE SYSTEM, AND HOW DOES IT WORK?

- **ecoGEO⁺ B4 3-12 HTR EH** inverter water-to-water heat pump.
- **AU12** – dry cooler acting as the source and sink to extract or dissipate heat.
- Closed hydronic loop connecting the heat pump to the outdoor unit.

Rather than using a conventional air-to-water heat pump, the project uses a **water-to-water heat pump connected to a dry cooler**. The dry cooler exchanges heat with the outdoor air through a closed water loop, allowing the heat pump to operate with stable hydronic conditions while keeping the refrigerant circuit entirely indoors.

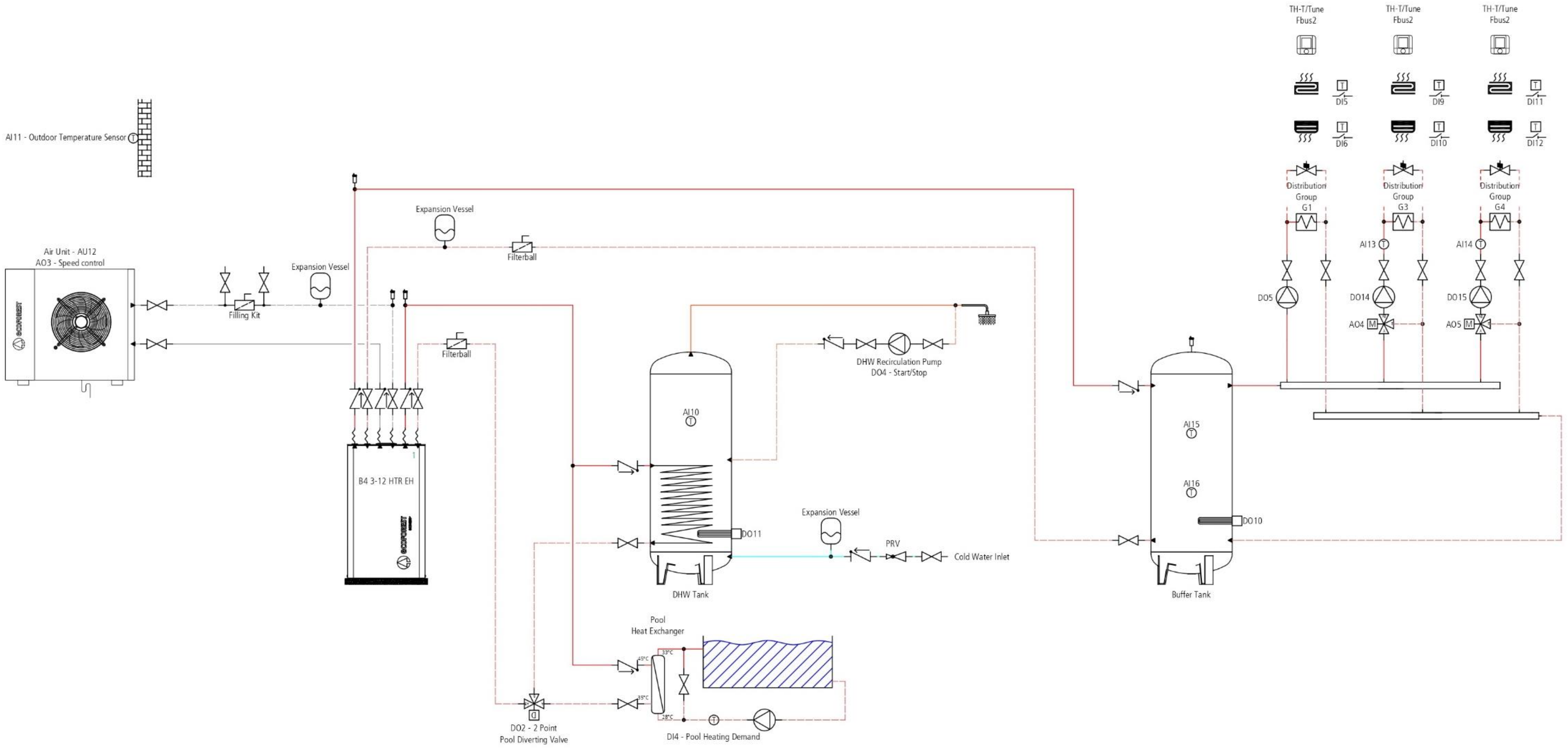
CONTEXT

- No available land for boreholes or horizontal loops.
- Refrigerant lines completely off the table.
- Mild-climate and concerns about long-term corrosion in mind.

Unlike a conventional air-source heat pump, **the refrigeration circuit remains completely indoors**. Only the dry cooler is exposed to the outdoor environment, while heat is exchanged through water rather than refrigerant. This protects the most complex and valuable component of the system from the harsh coastal environment.

3. KEY PIECES OF THE DESIGN

ALL IN ONE

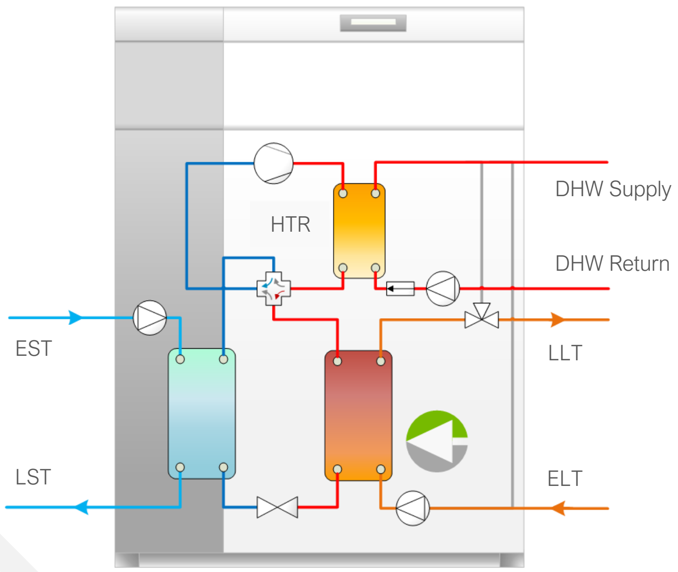


3. KEY PIECES OF THE DESIGN

HTR – HIGH TEMPERATURE RECOVERY

1. HARDWARE

Additional heat exchanger at the exit of the compressor, direct supply to the DHW tank or pool.



2. SOFTWARE

2 different setpoints:

- DHW setpoint – 120 ºF
- HTR setpoint – 160 ºF

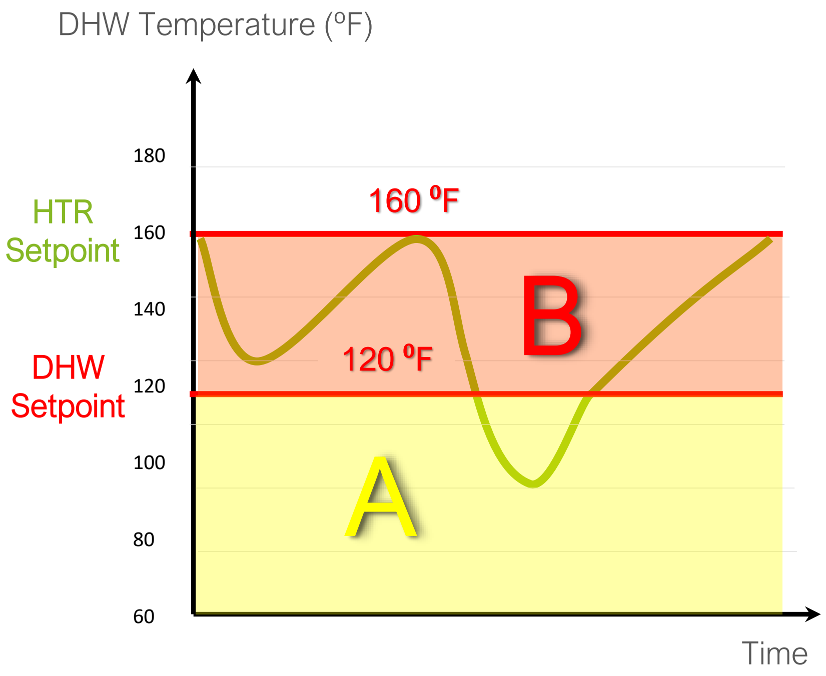
2 working areas

- Area A

The heat pump produces only DHW using the main condenser and circulator (more power available, faster heating of DHW).

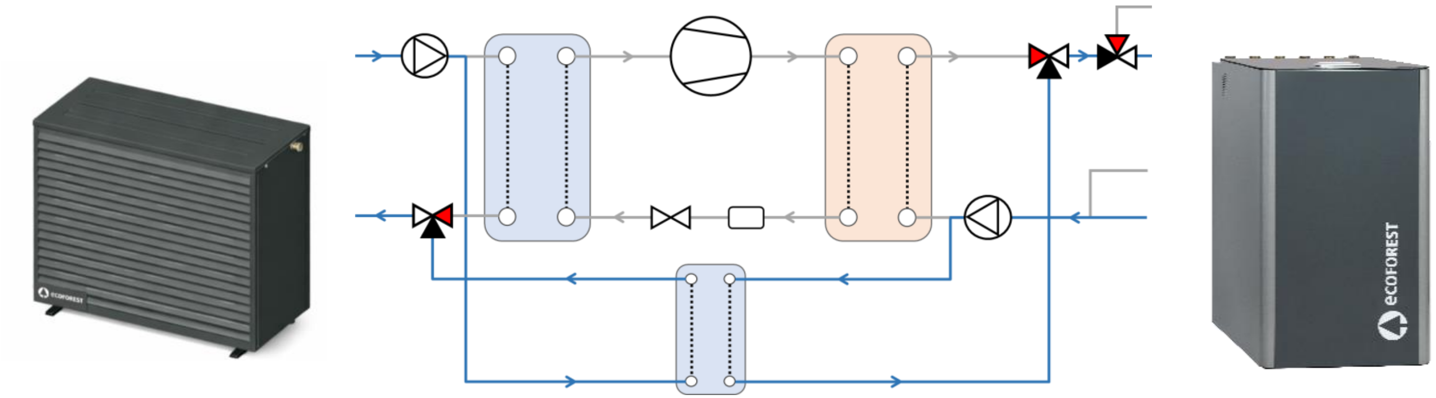
- Area B

The heat pump continues to heat the DHW with the desuperheater up to HTR Setpoint, while simultaneously satisfying the heating and cooling demands.



3. KEY PIECES OF THE DESIGN

DEFROST



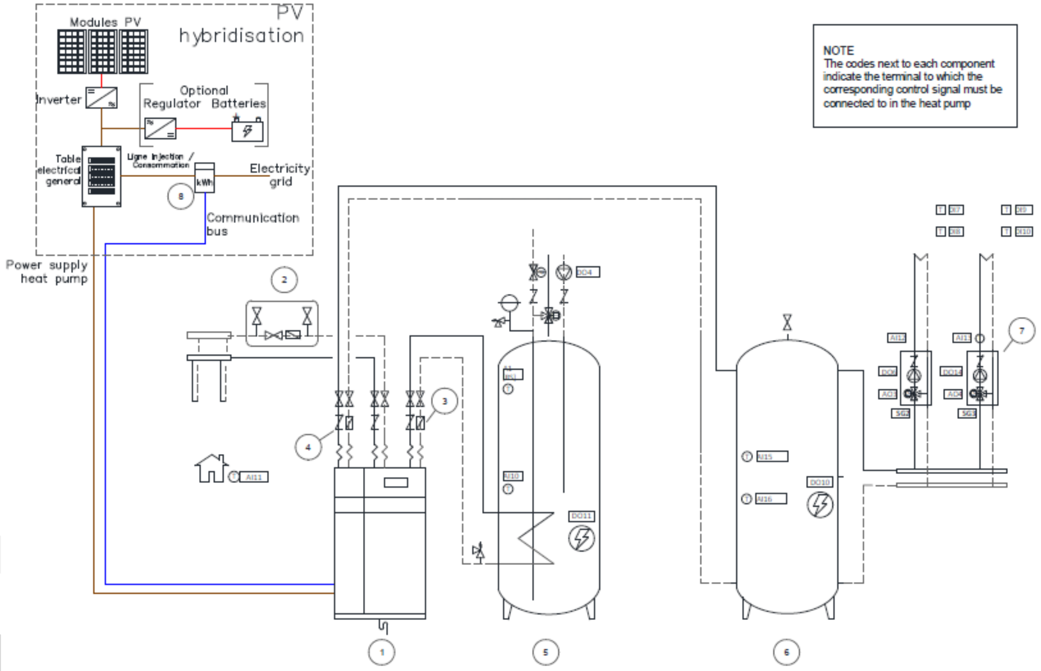
- A secondary heat exchanger is used to defrost the dry cooler.
- The Seasonal Performance (SPF) increases considerably as the compressor is switched off during the process.
- It is not necessary to activate an electrical resistance.
- Reduces the defrosting time. It is not necessary to reverse the cycle to carry out defrosts.
- Possibility of selecting the energy source with which the defrost is carried out (DHW, production system, buffer tank or pool).

3. KEY PIECES OF THE DESIGN

PV INTEGRATION

STORAGE ASSET

A bidirectional energy meter is used to enable the reading of the grid's meter. The goal is to achieve a zero-balance value with the network – zero consumption and zero injection.



HOW DOES IT WORK?

The system shifts setpoints based on solar surplus, effectively using thermal mass (building, the buffer tank, or ice storage).

	DHW	Heating	Cooling	Pool
Standard setpoint	120 ºF	120 ºF	50 ºF	80 ºF
Surplus setpoint	140 ºF	130 ºF	41 ºF	95 ºF

4. CHALLENGES

INSTALLATION, SPACE, MATERIAL AND COST

WHY THIS ARCHITECTURE INSTEAD OF A CONVENTIONAL AIR-TO-WATER HEAT PUMP?

INSTALLATION: In a coastal environment, protecting the most complex components was a priority. By locating the entire heat pump indoors, only the dry cooler is exposed to salt-laden air. Maintenance is performed inside the mechanical room, while the outdoor unit is simply a fan and heat exchanger.

SPACE: The site couldn't accommodate a conventional geothermal collector. Replacing the ground loop with an AU12 eliminates drilling and excavation while requiring only a small outdoor footprint, making the concept applicable to many urban and suburban homes.

MATERIAL: Relying on one piece of equipment can be viewed as a risk. That's why the heat pump includes a 6-kW electric heat as back-up. If for whatever reason there's an issue with the AU12 or the heat pump, the EH will supply DHW and heating.

COST: Assuming a spark gap of approximately 3 between electricity and natural gas, a seasonal performance factor of around 3.0 is sufficient to achieve operating-cost parity with a gas boiler. This project delivers an SPF of 4.2 across all annual thermal loads – including heating, cooling, DHW, pool and defrost – providing a comfortable margin above that threshold. Integration with the photovoltaic system further lowers operating costs by prioritizing operation during periods of solar surplus, increasing self-consumption and reducing dependence on grid electricity.

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