HEAT PUMP
WATER HEATERS

TASK 4 : R&D

FRENCH REPORT

2018
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In France, a Heat Pump Water Heater is a heat pump with the condenser connected with the hot water tank. For domestic use only.

Market supported by individual new built houses but increasing share on retrofit market.
Heat Pump Water Heaters in France
Reference Products

AMBIENT AIR HPWH
Historically reference product
Simple and cheap to install
Heat Pump Water Heaters in France

Reference Products

OUTSIDE AIR HPWH

New reference product
More efficient than ambient air product
The return flow water from the low temperature heating system (underfloor or equivalent low temperature system) is used as the cold source of the evaporator.
The evaporator, constituted by an unglazed solar collector, is installed on the roof or façade.

It is well adapted for new individual houses in sunny regions, like South of France.

However, refrigerant pipes length is quite important. The installation cost could be very high.
Heat Pump Water Heaters in France 
R&D 

REFRIGERANTS

Usual refrigerant is R134a which will be banned in Europe in few years.

Two alternative refrigerants: R290 (propane, GWP=4, highly inflammable A3)
R1234yf (HFO, GWP=20, lightly inflammable A2L)

DROP-IN
(regulatory impossible)

DESIGN OPTIMIZATION

COMPARABLE PERFORMANCES WITH ALTERNATIVES
Heat Pump Water Heaters in France
R&D

COMPONENTS

Micro-channel condenser
- better performances (heat transfer to the tank)
- reduction of refrigerant load

Control strategy
- variable speed compressor
- control optimization and DHW need learning
GREY WATER AS A COLD SOURCE

Decentralized system:
French institute CEA-Ines studies a direct HPWH system, without any storage.

- **Step 1**: cold water is pre-heated by grey water.
- **Step 2**: pre-heated water is heated in the condenser of the HPWH.

The grey water coming from a shower is directly used as a cold source for the HPWH heating the water for the same shower.

The heating process is initiated with cold water: during few seconds, cold water is redirected in the evaporator, until grey water can be collected.
GREY WATER AS A COLD SOURCE

BUILDING SCALE

Two types of configuration to recover energy from grey water at building scale:

One configuration without any storage, with a system like a Powerpipe®.

One configuration with storage (PAC F7®).
GREY WATER AS A COLD SOURCE

DISTRICT SCALE

Heat recovery on district or city scale.

Grey water flow is a permanent heat source compared to the building scale solution, but the flow remains very fluctuating.
The objective is to design water heaters, in particular heat pump water heaters, well-adapted to photovoltaic production in terms of storage capacity, functioning temperatures, control strategy.

A possibility is to create a heat pump water heater totally autonomous, namely off-grid. It implies the introduction of a battery.
CONCLUSION

French market of HPWH increases ➔ new houses mainly but also retrofit the direct electrical water heaters. Very small market in collective buildings.

Products on the market are as cheap as possible ➔ 1st generation of HPWH and its performance is not as high as we can expect for a thermodynamic product.

A great part of R&D works is dedicated to performance improving without significant increase in the investment cost.

Another important concern that govern R&D projects is the evolution of regulations, in particular on the refrigerants.

THANK YOU