

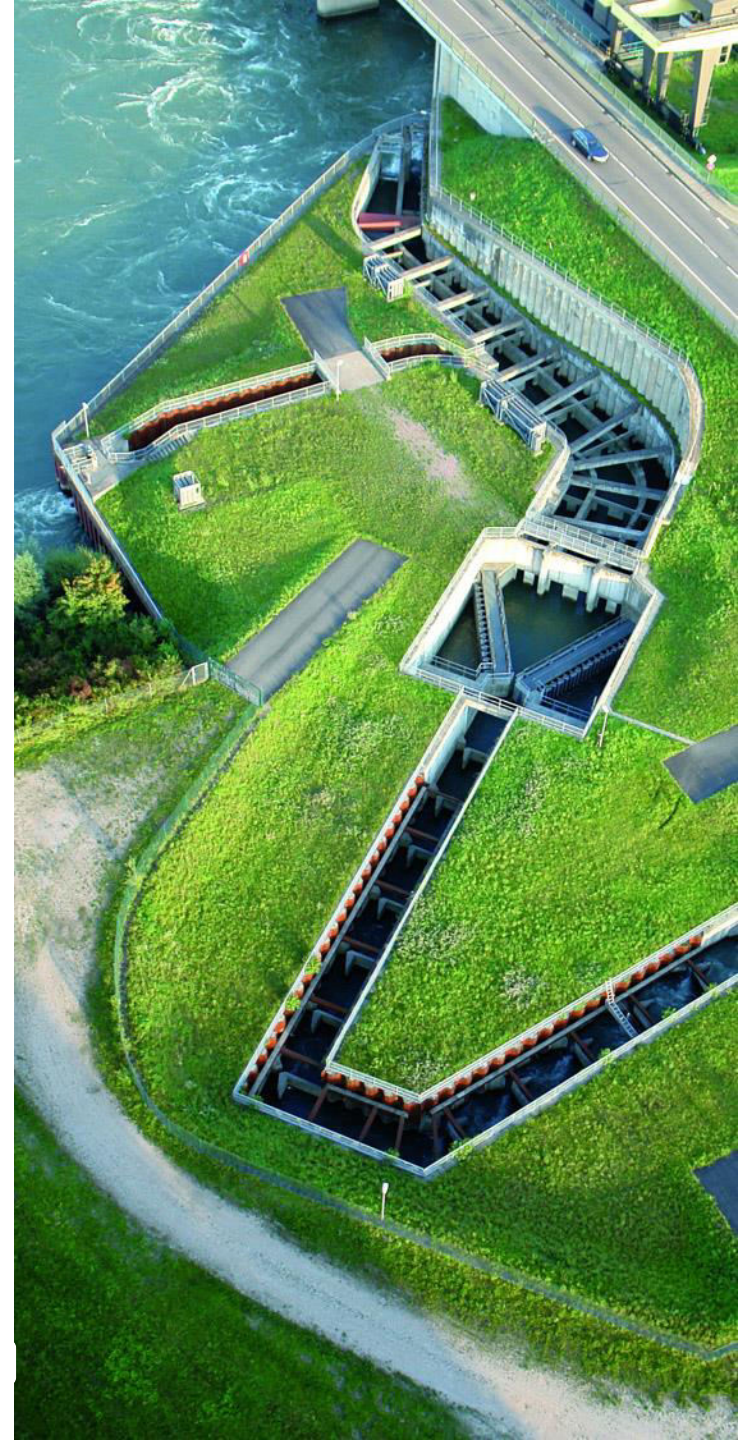


# HEAT PUMP WATER HEATERS

## TASK 4 : R&D

FRENCH REPORT

2018



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# Heat Pump Water Heaters French Market

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



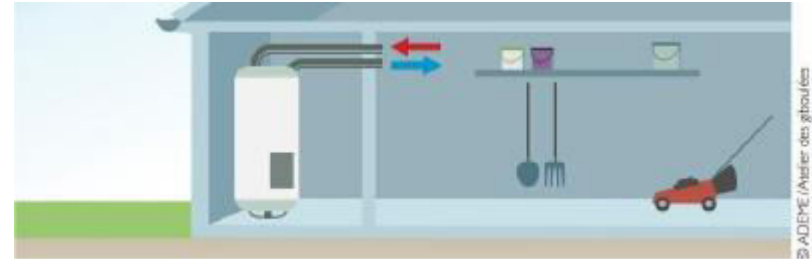
Market supported by individual new built houses but increasing share on retrofit market.

# Heat Pump Water Heaters in France

## Reference Products

### AMBIENT AIR HPWH

Historically reference product  
Simple and cheap to install

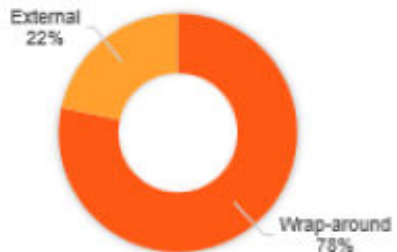


### REFRIGERANT FLUID AMBIENT AIR



R134a  
100%

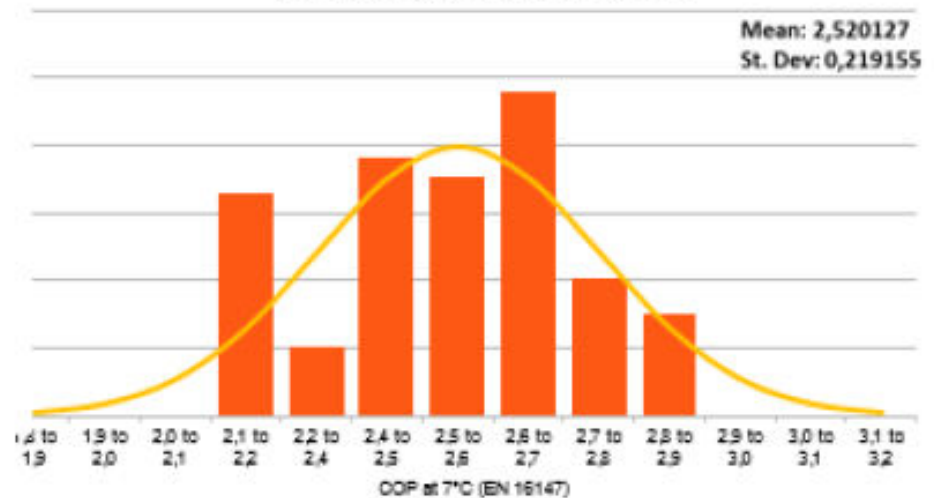
### Condenser type ambient air



External  
22%

Wrap-around  
78%

### COP DISTRIBUTION AMBIENT AIR

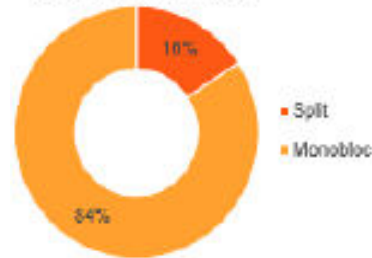


# Heat Pump Water Heaters in France Reference Products

## OUTSIDE AIR HPWH

New reference product  
More efficient than ambient air product

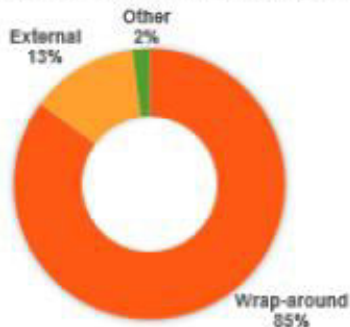
Share of split models



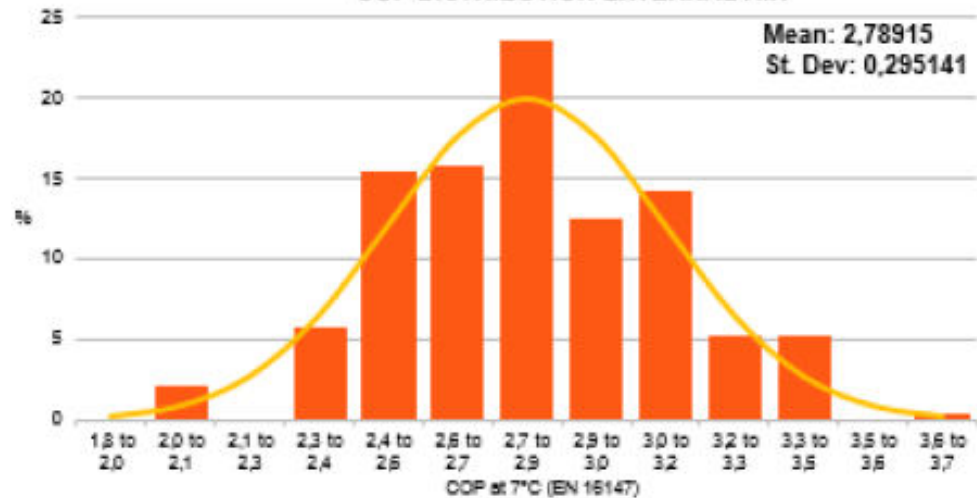
REFRIGERANT FLUID EXTERNAL AIR



CONDENSER TYPE EXTERNAL AIR

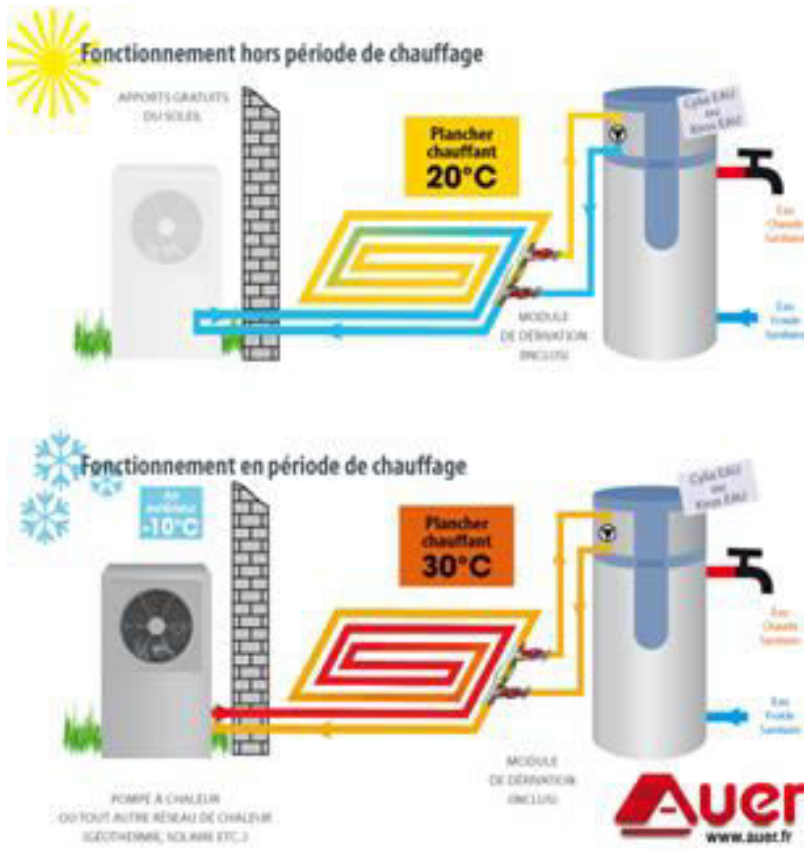


COP DISTRIBUTION EXTERNAL AIR



# Heat Pump Water Heaters in France Innovative Products

## HEATING RETURN FLOW HPWH



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.

# Heat Pump Water Heaters in France Innovative Products

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## SOLAR HPWH



**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.

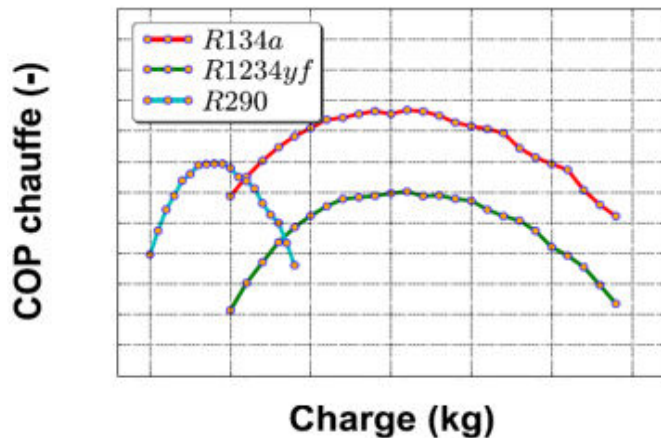
However, refrigerant pipes length is quite important. The installation cost could be very high.

# Heat Pump Water Heaters in France R&D

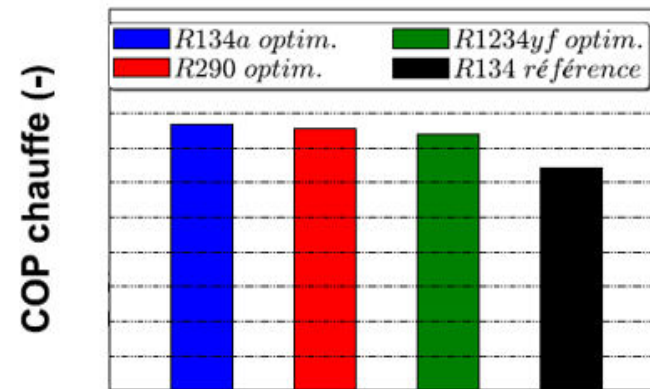
## REFRIGERANTS

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



# Heat Pump Water Heaters in France R&D

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## COMPONENTS

### Micro-channel condenser

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

### Control strategy

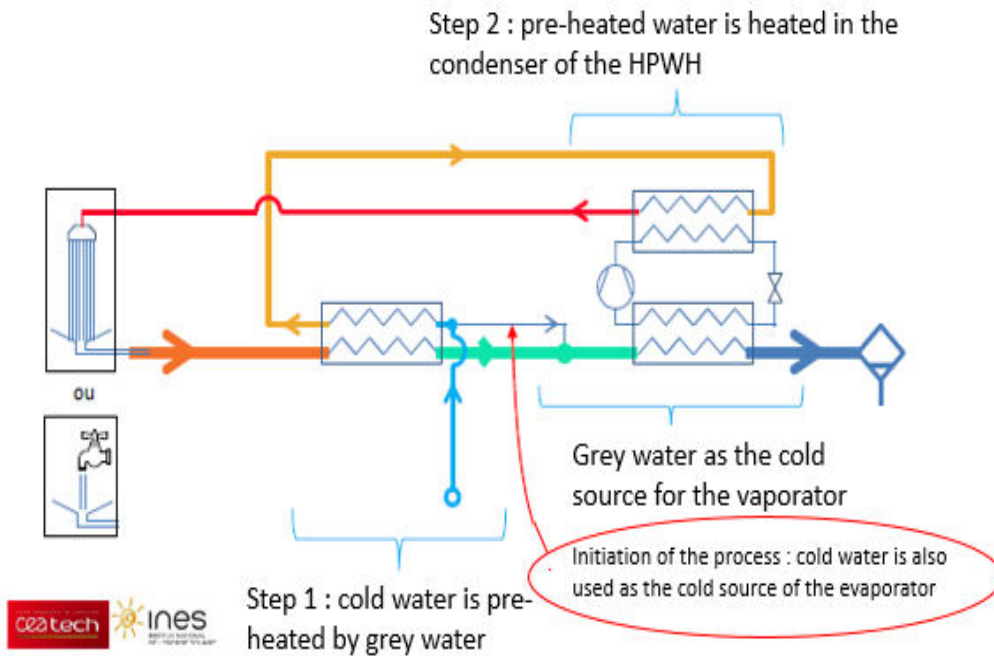
- variable speed compressor
- control optimization and DHW need learning

# Heat Pump Water Heaters in France R&D

## GREY WATER AS A COLD SOURCE

Decentralized system :

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



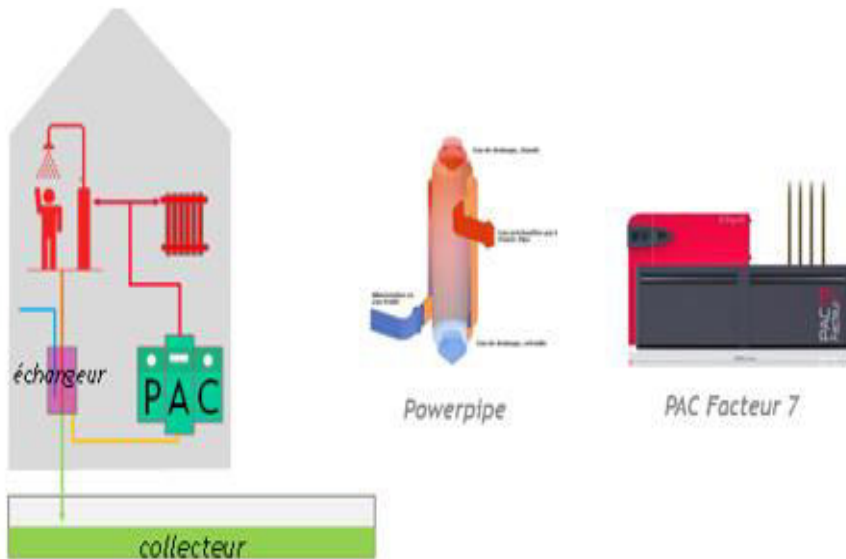
The grey water coming from a shower is directly used as a cold source for the HPWH heating the water for the same shower.

The heating process is initiated with cold water : during few seconds, cold water is redirected in the evaporator, until grey water can be collected.

# Heat Pump Water Heaters in France R&D

## GREY WATER AS A COLD SOURCE

### BUILDING SCALE



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

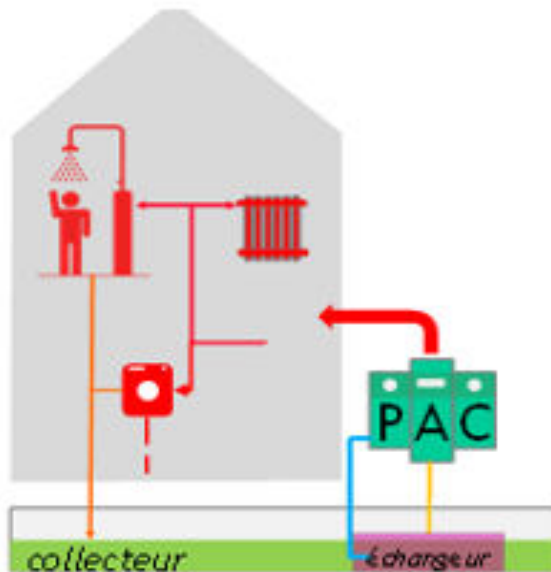
One configuration without any storage, with a system like a Powerpipe®.

One configuration with storage (PAC F7®).

# Heat Pump Water Heaters in France R&D

## GREY WATER AS A COLD SOURCE

### DISTRICT SCALE

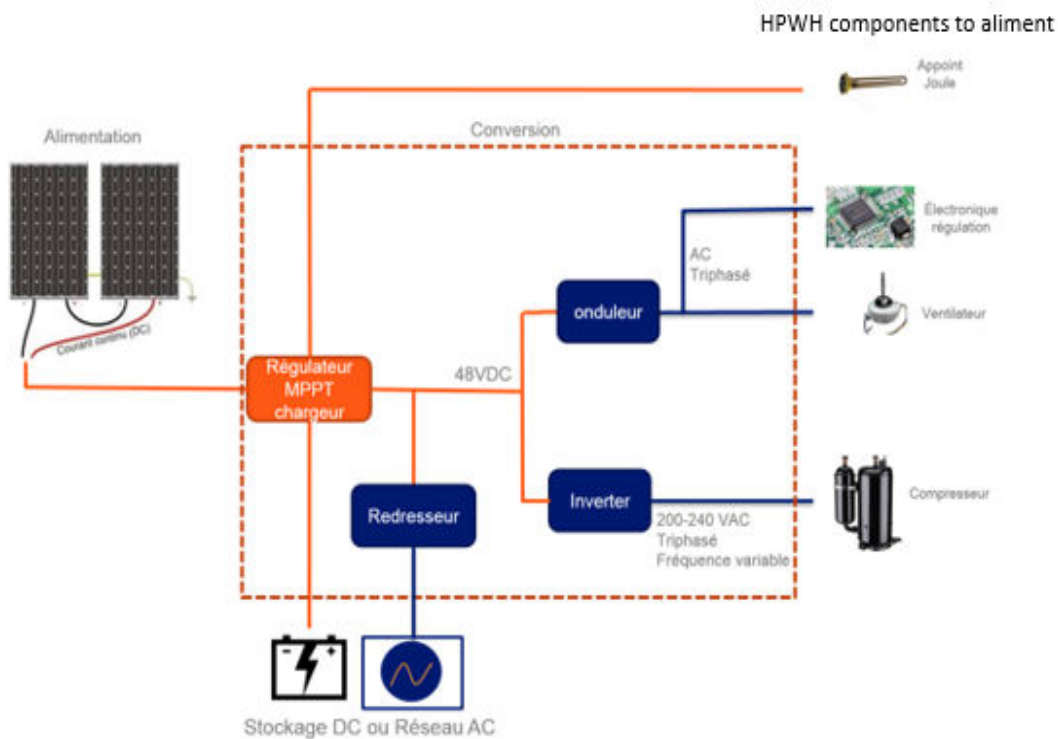


Heat recovery on district or city scale.

Grey water flow is a permanent heat source compared to the building scale solution, but the flow remains very fluctuating.

# Heat Pump Water Heaters in France R&D

## SELF-CONSUMPTION OF PHOTOVOLTAÏC PRODUCTION



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

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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 → 1<sup>st</sup> 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