



Industrial Heat Pumps, Second Phase

IEA Heat Pump Technology (HPT) Programme Annex 48

Task 1: French Report

Final Report

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Contents

1	Industrial energy demand and waste heat.....	1-4
2	Heat pumps in FRANCE	2-6
3	Case Studies	3-6
4	Summary.....	4-8

1 Industrial energy demand and waste heat

In France, the CEREN (Centre d'Etudes et de Recherches Economiques sur l'Energie) and ADEME (the French environmental agency) provide data about energy use in industry.

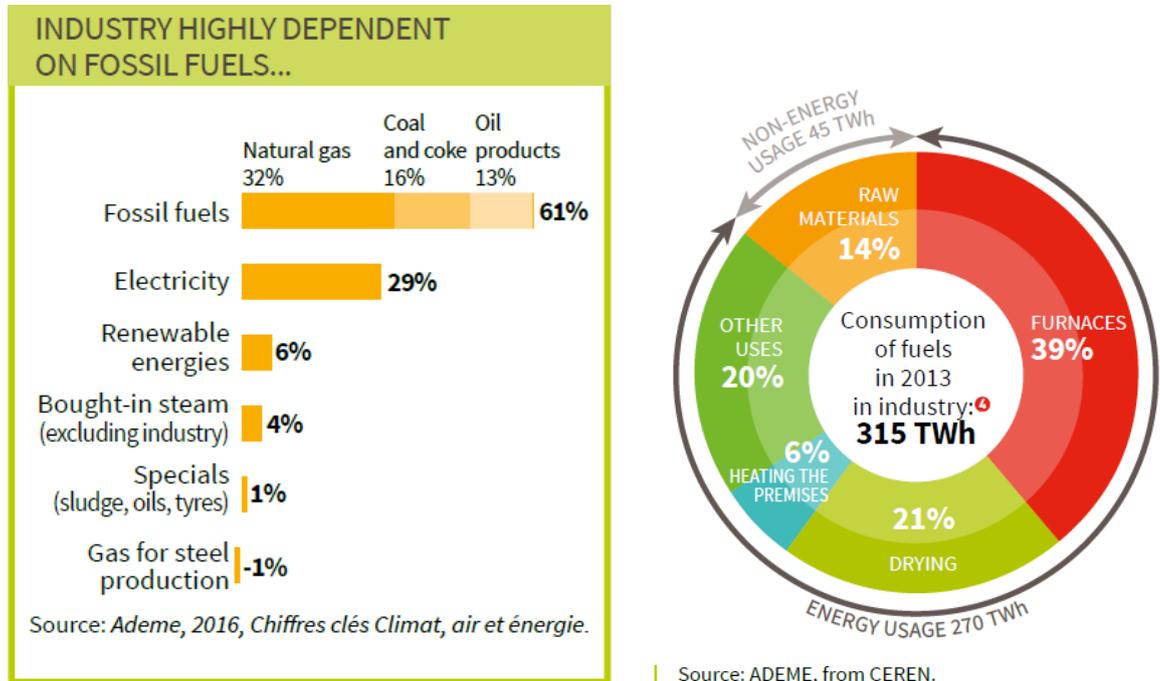


Figure 1-1: Final energy consumption in France according to ADEME <https://www.ademe.fr/sites/default/files/assets/documents/excess-heat-010559.pdf>

In Figure 1-2, one can see the most power-hungry industrial sectors.

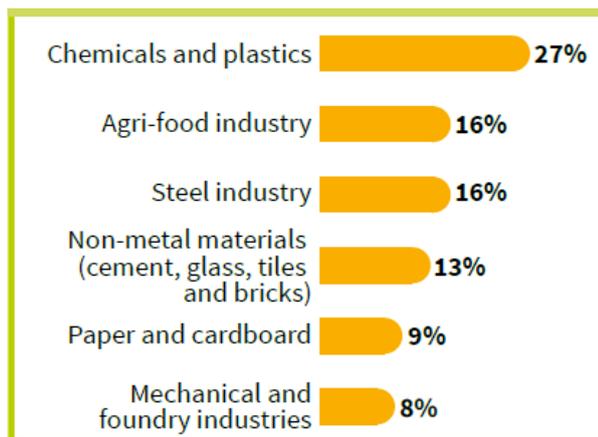


Figure 1-2: Industrial energy consumption in France by sector according to ADEME <https://www.ademe.fr/sites/default/files/assets/documents/excess-heat-010559.pdf>

Waste heat in industry is an important matter for heat pump. This waste energy can be used as a heat source within the same industrial site. ADEME and CEREN publish information about this excess heat for France.

The definition given by ADEME for excess heat or waste heat is the following: this is the heat generated by a process that is not used for the main purpose of the process and that is not recovered.

In France in 2016, the total waste heat from industrial activities was 109.5 TWh, i.e. 36% of fuel consumption. About 50% of this heat is over 100°C as given in figure 1-3. It means that 50% is wasted below 100°C and then can be considered as a good source for industrial heat pumps.

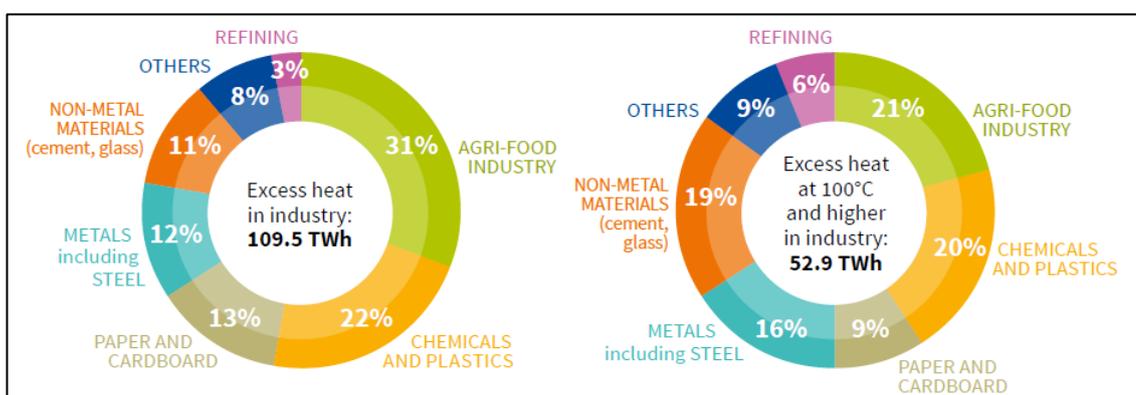


Figure 1-3: Distribution of waste heat in France (ADEME)

ADEME also provides information about the origin of waste heat.

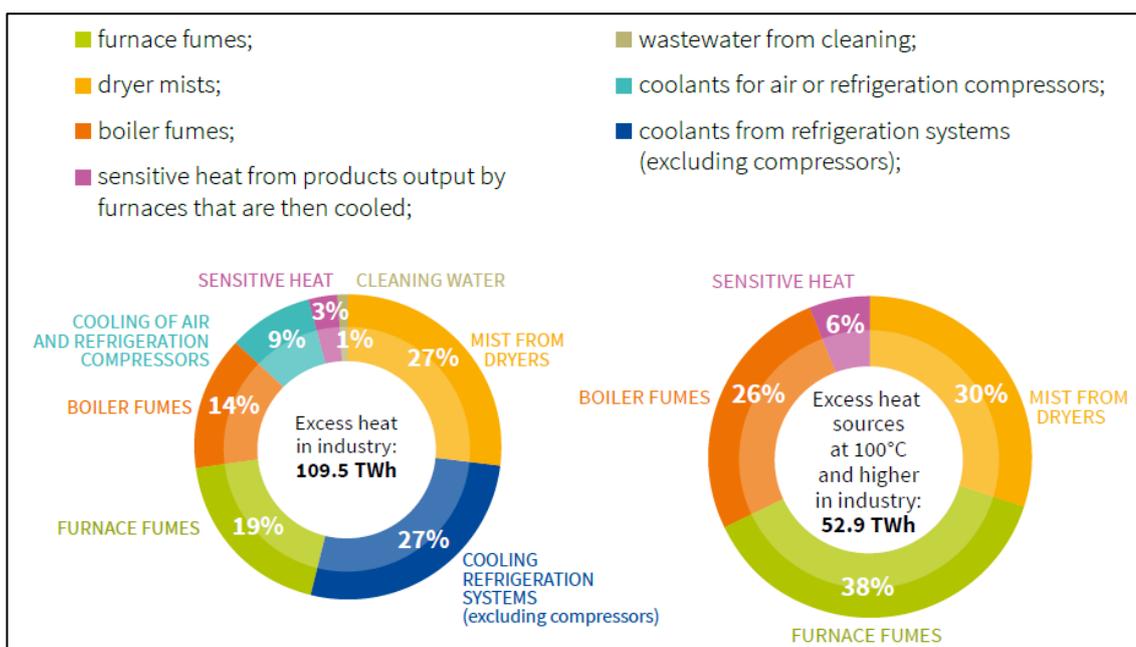


Figure 1-3: Origin of waste heat in French industry (ADEME)

2 Heat pumps in FRANCE

We could find heat pumps cases in industry in France but no statistical data on the industrial market and its evolution. The European Heat Pump Association (EHPA) provides a yearly report about the sales for the domestic and tertiary heat pumps but not on the industry market. Industrial heat pumps as well as heat pumps for urban networks, are included in the large buildings segment.

Recently EDF R&D carried out a study on the French market for industrial heat pumps. This work was published at the [2nd conference on High Temperature Heat Pumps](#) (*Assessing High Temperature Heat Pumps Market, Jean-Marie Fourmigué, Marc Berthou, Pierre Primard*). The study evaluates a potential of heat pump comprised between 14 TWh and 30 TWh of heat produced by industrial heat pumps. This study only considered heat recovery from industrial processes with reuse in the same industrial site. Considering that industry can also benefit from heat sources taken outside the site or from natural sources, the potential should be greater.

3 Case Studies

In the frame of the Annex 48, we selected industrial heat pumps cases. Information was found from different sources:

- Internal EDF documents
- EDF R&D developments
- Manufacturer having references in France
- Internet researches
- French workshop and conferences

The excel files annexed to this document give the following information. Partial information is provided in most cases.

- Type of Industry
- Application (process)
- Place
- Year of commissioning
- Heat pump manufacturer, Contractor, Consultant, End user

Heat pump technology

- HP technology (Mechanical, Absorption)
- Refrigerant
- Compressor type
- Heating and cooling capacity

- Heat source and heat sink nature (water, air, mists) and input/output temperature
- Evaporation and condensation temperatures
- Use of storage

Effects

- Costs for heat pump and installation
- Annual operating hours
- Annual maintenance costs
- Annual operating costs
- Energy savings
- CO₂ emission reduction
- Energy cost savings
- Additional effects (COP and ROI)

Statistical analysis of the cases as given in Figure 3.1 must not be relevant as these numbers are small and these cases may not be representative of the sales in France. Actually, it's very difficult to find data of sales from the manufacturers. Manufacturers are often subjected to NDA by their customers who consider their heat pump project as part of their competitiveness.

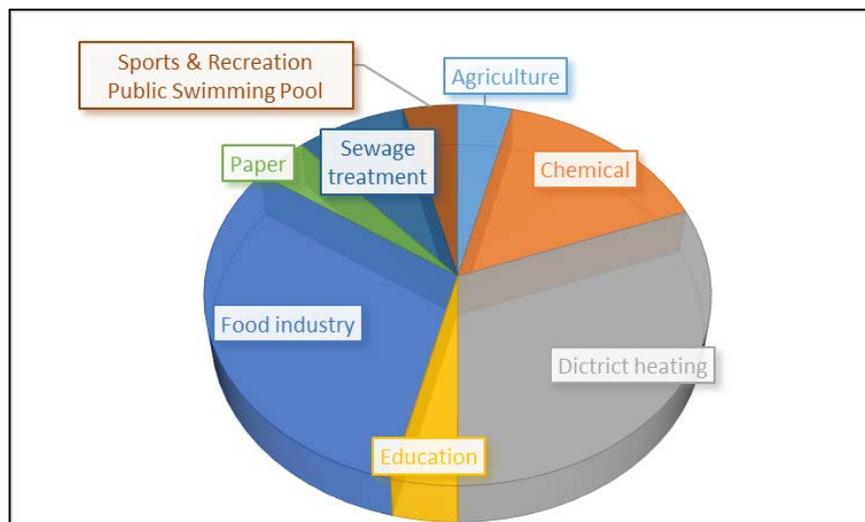


Figure 3-1: Pie chart of the 30 cases in France sorted by sectors

The heat sources used in these cases are from natural sources (sea and river water, geothermal) and from industrial waste heat (condenser waste heat, process cooling water, exhaust air).

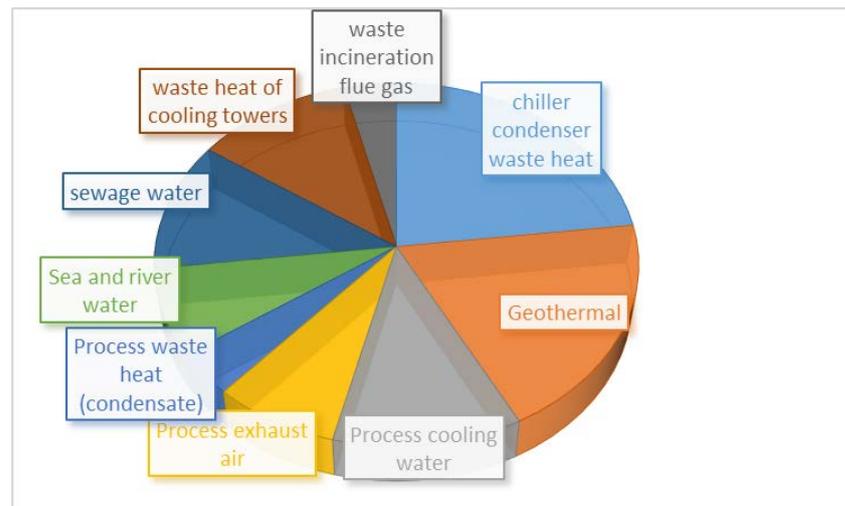


Figure 3-2: Heat source for heat pumps 30 cases in France

In Figure 3-3, the COP Vs. Supply Temperature is given for 25 cases. There is not clear evidence of the influence of the supply temperature on the COP that ranges from 2.5 to 7 (for a both cooling and heating case).

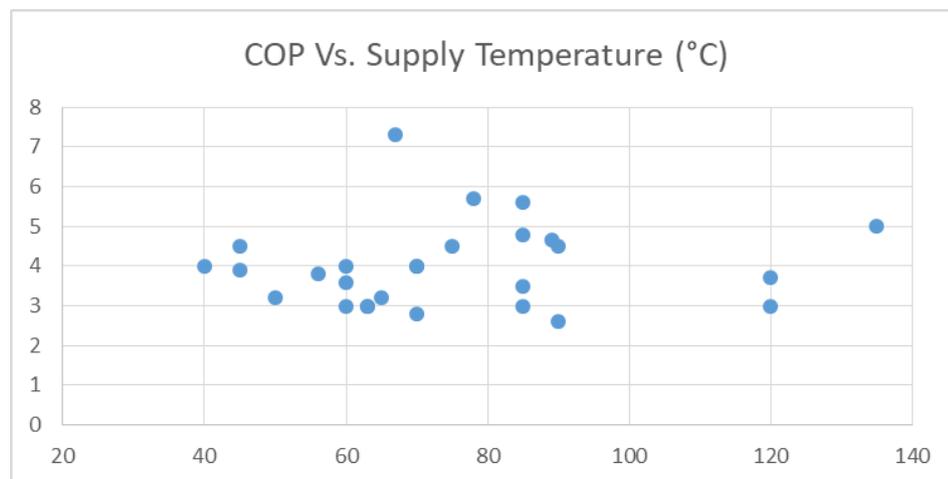


Figure 3-3: COP for compression heat pumps (25 data points)

4 Summary

- IHP plays an important role in France in heating district network and food industries.
- For heating district network, the main sources of energy are geothermal and sewage water
- The food industry is the largest industry sector for industrial heat pumps
- The main heat sources in industry are cooling towers and chillers condensers
- There is no clear correlation between the COP and the supply temperature