



How to deal with technical and economical constraints to recover waste heat in France

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Context and Objective

Context

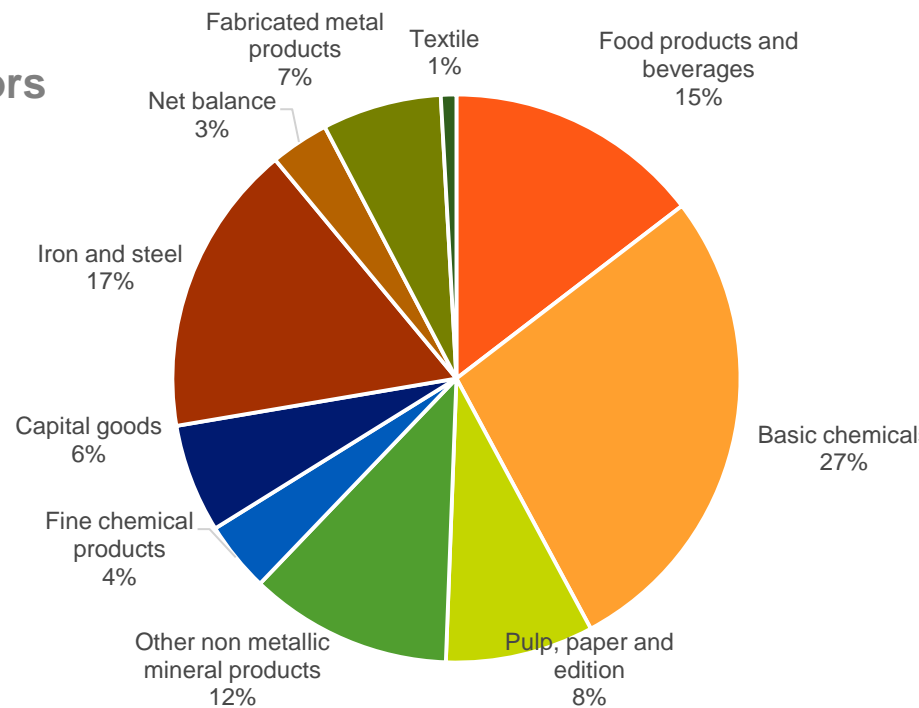
- French “Loi de Transition Energétique” (Energy Transition Bill) set targets:
 - 40% CO2 emission reduction by 2030 (compared to 1990)
 - 32% Renewable Energy in energy mix by 2030 (final energy)
- Energy Efficiency and **Waste Heat Recovery**
 - Tax reduction for heating district network
 - Incentives for waste heat recovery (e.g. **Fond Chaleur** / ADEME)
- **Some challenges to overcome**
 - **Technology**: e.g. fouling and corrosion of HEx
 - **Economics**: adequacy (quantity, quality, scheduling) of resource and need

Objective

- Provide an overview of waste heat potentials in France (from manufacturing industry, datacenters, refineries, water treatment plants and waste incineration plants),
- Analyse opportunities as well as technical and economic constraints for its recovery

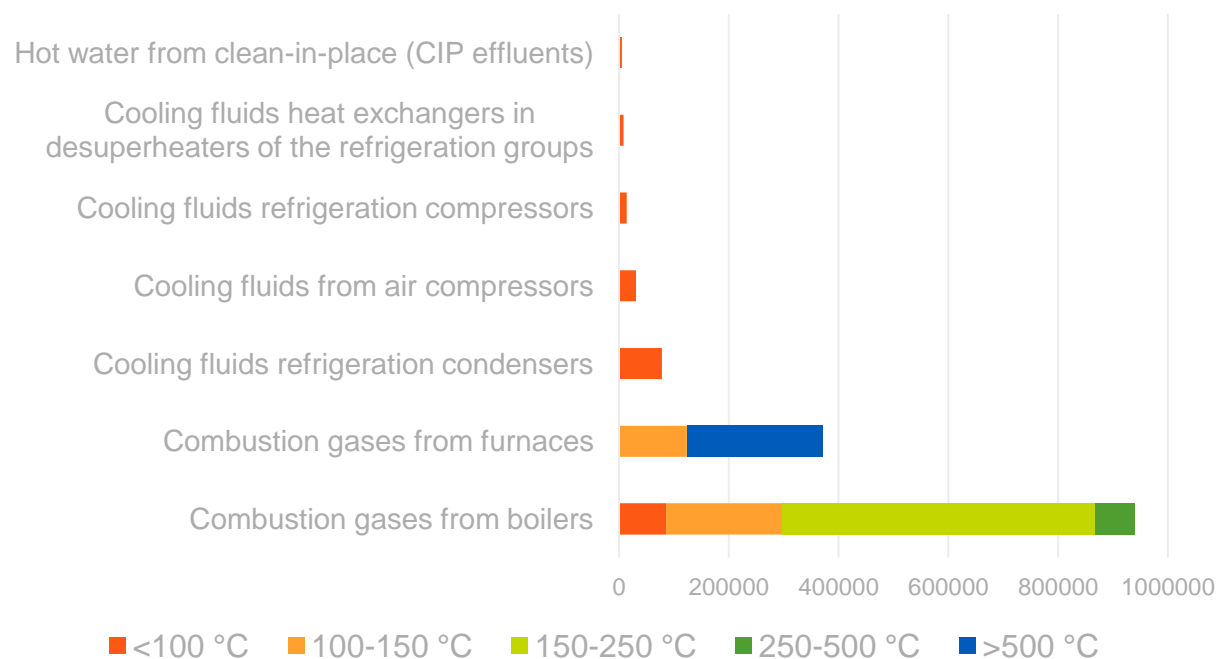
Energy Consumption in French Industry

- **Manufacturing Industry: 432 TWh** (estimation 2013)
- **Energy consumption database, including unique information on thermal equipment characteristics at the plant level**
 - CEREN (Centre d'Etudes et de Recherches Economiques sur l'Energie)
 - Based on questionnaires sent to 1,000 sites each year (large sites) + 6,000 phone interviews (SMEs)
 - France covered every 4 years
- **Structured according to 140 Industrial sectors**
 - Energy type (electricity, gas, fuel)
 - Energy use (furnaces, boilers, dryers..)
 - New sectors added:
 - 150 data centers: 6-7 TWh,
 - 126 waste incineration plants
 - 60 wastewater Treatment plants: 2.4TWh
 - 7 Refineries: 38 TWh
- **Grand total: 480 TWh**



Waste heat potential in France

- Waste heat characterized by energy value: temperature, availability, **sector**
- Hot effluents
 - Combustion gases from furnaces, boilers
 - Steam from dryers
 - Cooling fluids from air/refrigeration compressors
 - Cooling fluids from refrigeration condensers
 - Hot water for cleaning
 - Sensible heat from specific products



Waste heat potential in France

- **103 TWh** (estimation 2013), vs 109 TWh in 2009.

- **Availability:**

- 68% is available 24/7
- 20% is available 24/5
- 9% is available 16h / day

- **Data centers**

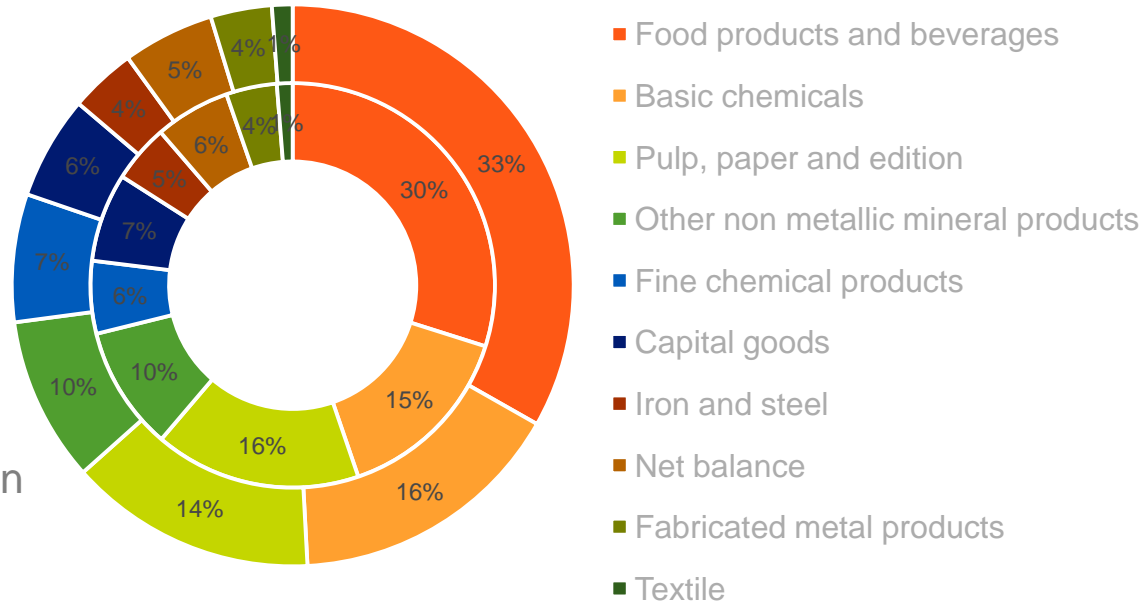
- Waste heat is about **3.6 TWh**
- about **50%** of energy consumption
- Available 24/7

- **Waste incineration process**

- **4.4 TWh** at low and medium Temperature
- Available 24/7

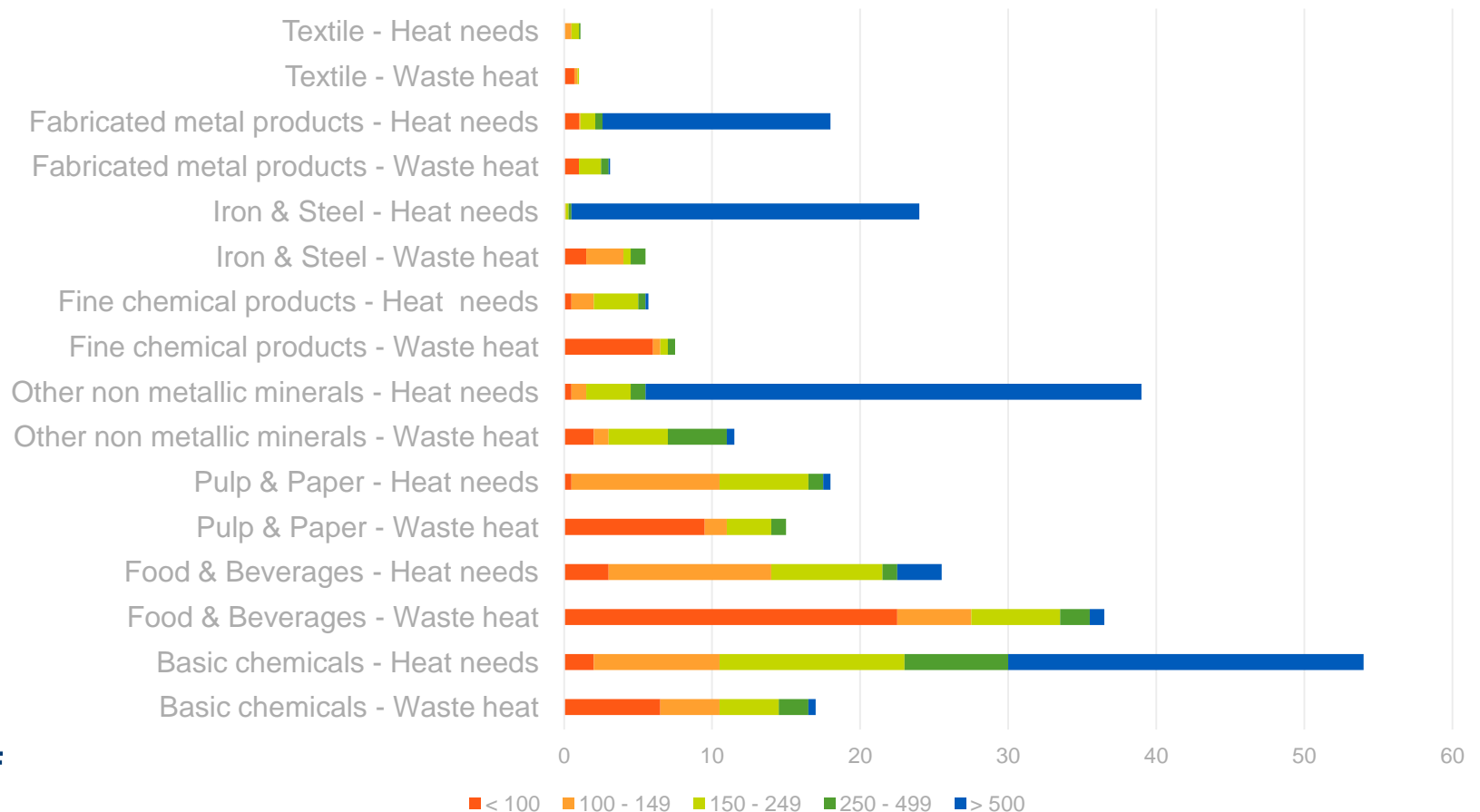
- **Waste incineration process**

- **2.4 TWh** at low Temperature
- Available 24/7



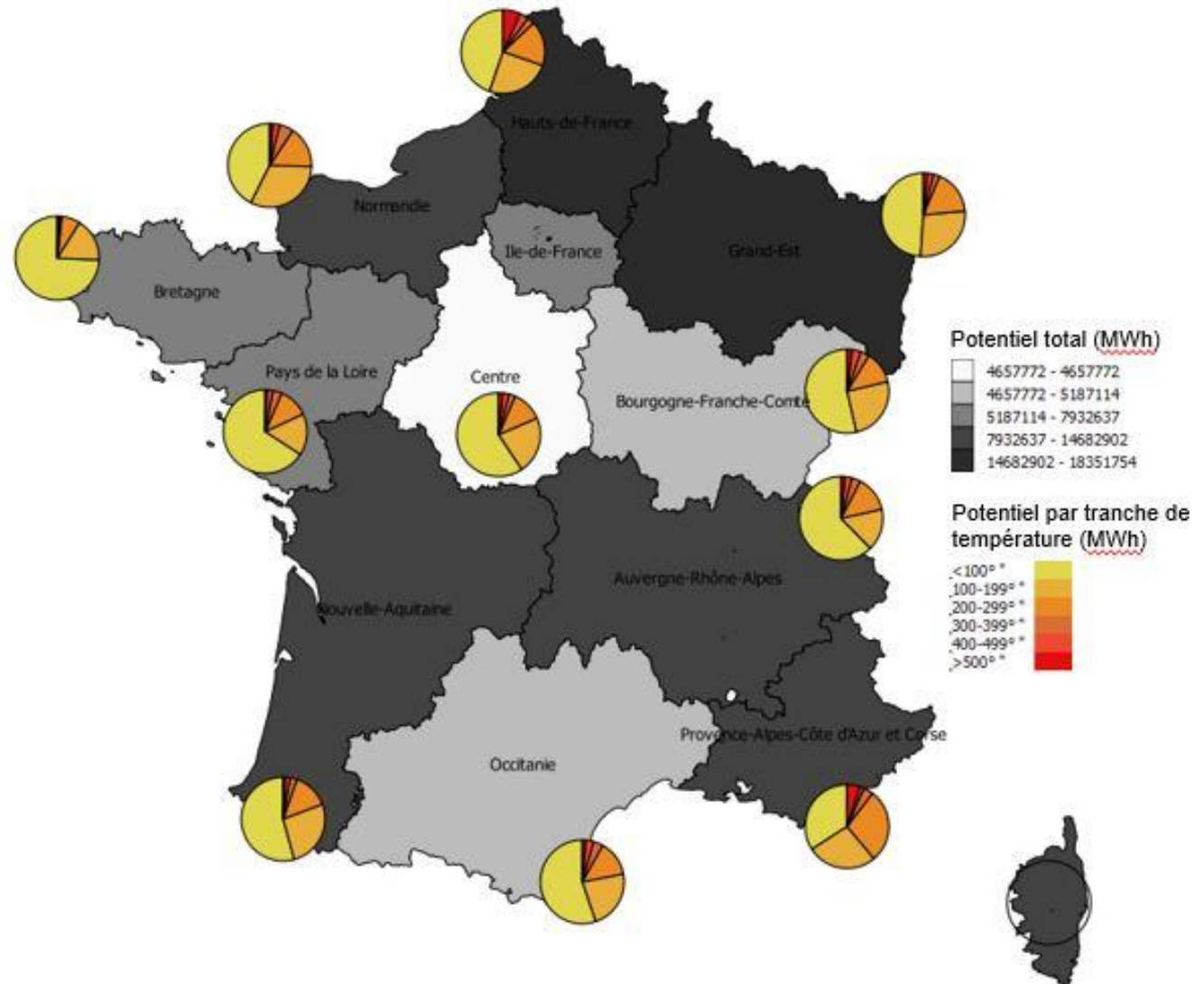
Waste heat vs heat needs by sector and Temperature

- Waste heat sources break down in 3 types
 - Heat loss that can be avoided (through energy efficiency measures)
 - Heat can be re-used on site to substitute local demand
 - Heat to be re-use off-site (e.g. district heating network, power production, etc..)



Waste heat potential by administrative region

- Not evenly distributed, according to:
 - industrialization level
 - Types of industry



Integration of technical and economic constrains

Use case 1: Municipal waste incineration plants and urban heating needs

■ French law:

- Up to 65% of (after 2008) MWIP heat produced by waste incineration should be valorized
- Up to 60% for older installation

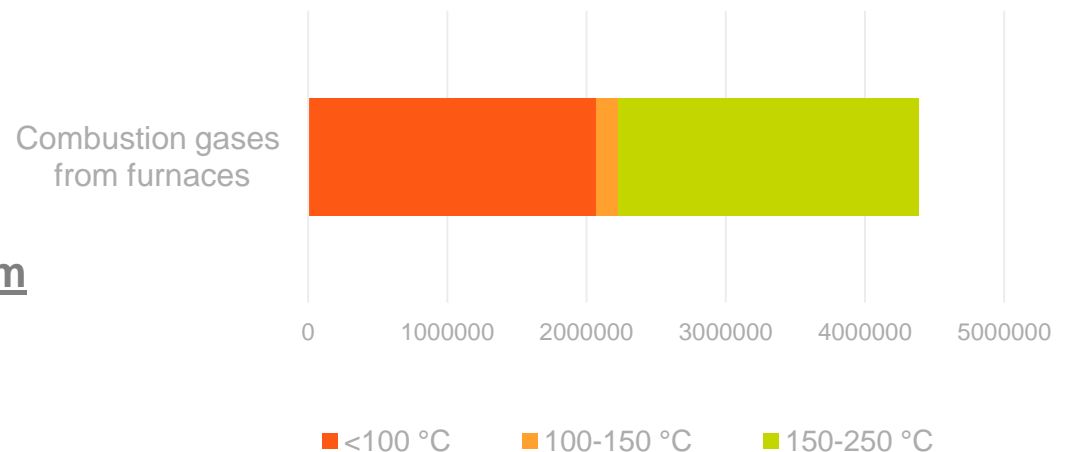
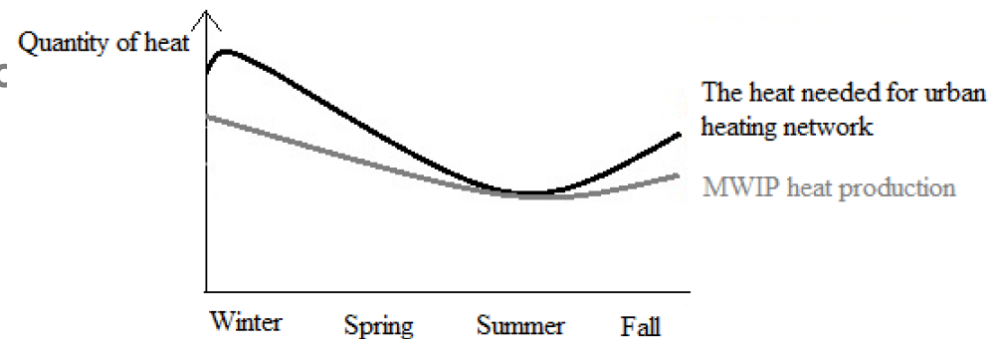
■ Paris Paris Region urban heating network

- 17 cities,
- 300+ miles,
- 146 MW_{th} - 210t steam/h;
- 146 MW_{th} - 220t steam/h,
- 105 MW_{th} - 180t steam/h

■ Use of MWIP

- Wet process (60C, acid)
- Dry process (150C)

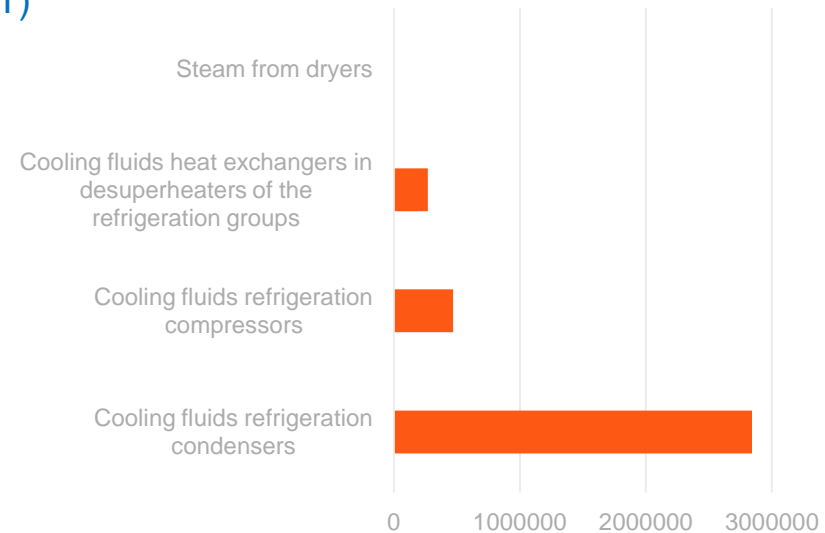
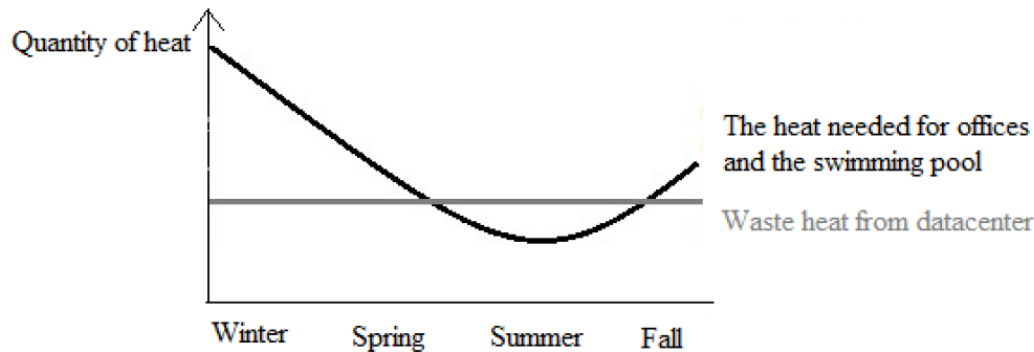
Risk: corrosion of piping system



Integration of technical and economic constrains

Use case 2: Datacenter, swimming pool and offices symbiosis

- Waste heat from datacenters
 - 3.6 TWh , mostly cooling fluids from condensers (low T)
- Paris:
 - Heat network supplied by a 10,000 m2 data center
 - Heating a swimming pool and offices
 - Boiler as back-up



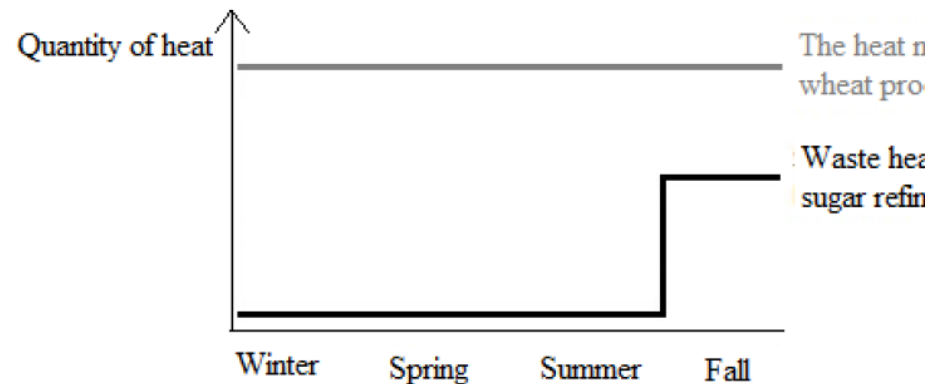
Risk: lack of heat needs

Integration of technical and economic constrains

Use case 3: Sugar plants and wheat starch processing plant symbiosis

- Sugar (from beets) production highly seasonal
 - 2.1 TWh – 150-200C
 - Waste heat available 3 months / year
- Symbiosis with wheat starch processing plant
 - Using this waste heat 3 months / yr
 - Boiler the rest of time

Risk: lack of resource > need back up



Conclusions and perspectives

- **Waste heat is about 1/4th of French Industry energy consumption**
- **Large potential but heterogeneity** between business sectors, effluents types and geographical implantation of industrial sites.
- Despite the highlighted potential, **few examples** exist today.
- **Importance of ROBUST FEASIBILITY study:**
 - Technical constraints (e.g. design of existing sites, corrosion and fouling of materials)
 - Concomitance between heat production and heat demand on short-term (daily variation), mid-term (seasonal variation) and even long-term (project sustainability and profitability) : quality, quantity and regularity requirements
- **Importance to prepare contract between stakeholders (industrials, municipalities, investors, ...) and B Plan**

EDF Has developed a tool to evaluate the opportunities of waste heat recovery and industrial symbiosis at local scale.