Energy efficiency in Industry : from existing technologies to innovative solutions

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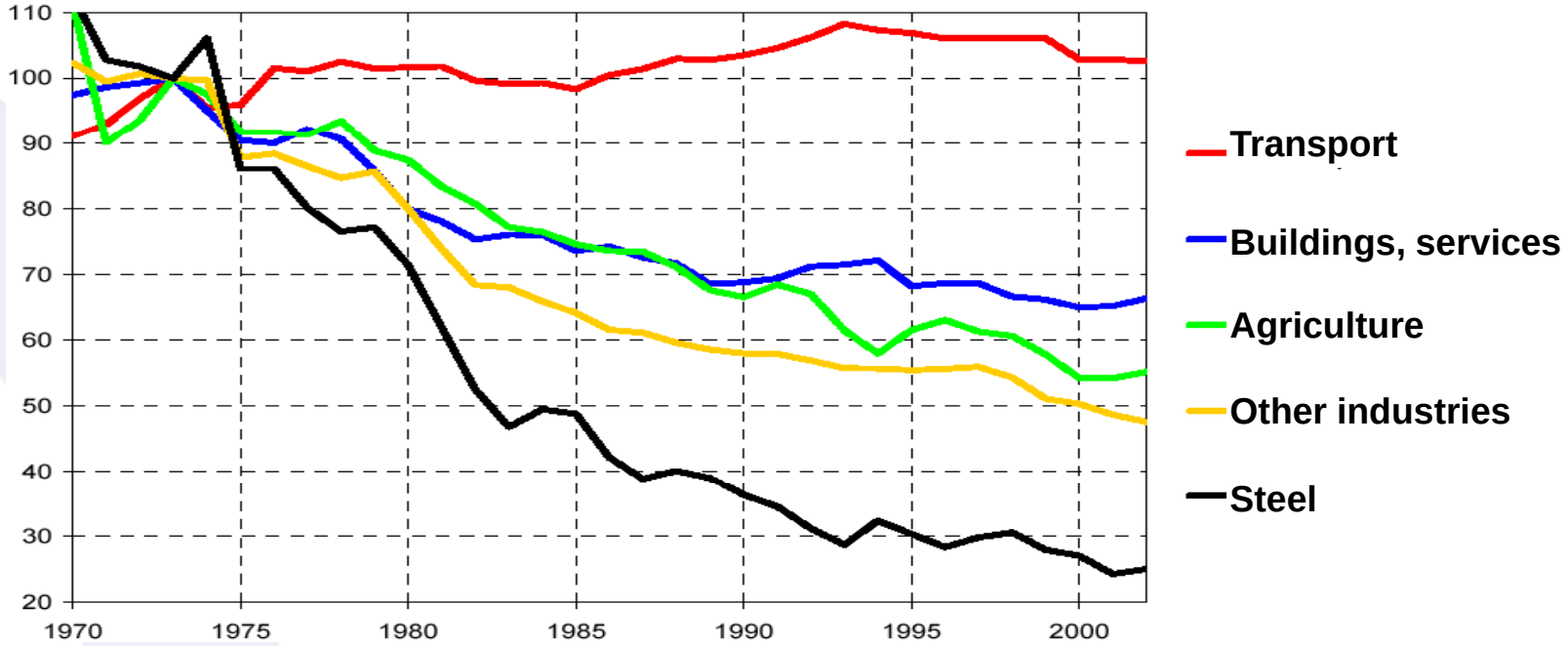
Energy Issue

Energy intensity (100 in 1973)



New challenges:

- Security of energy supply
  - Enduring pressure on hydrocarbons resources
- Acting against climate change

Ambitious objectives by 2020:

- Reducing CO2 emissions by 20%
- Reducing energy consumption by 20%
- Increasing renewable energy to 20%

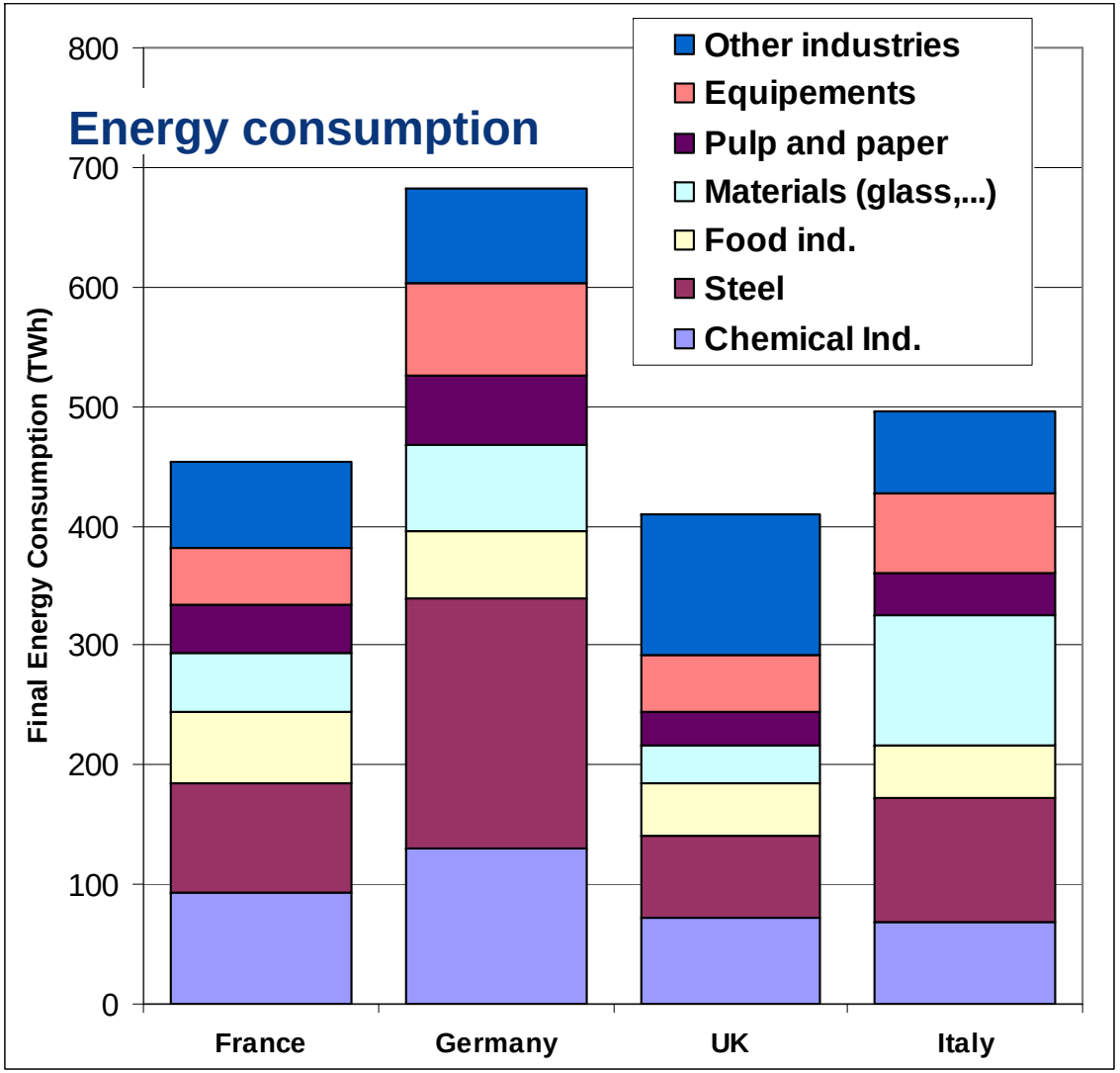
Industry : 25% to 30% of energy consumption

1/3

of electricity

2/3

of oil, gas, coal



- **Food, steel and chemical industry main consumers**

Energy use in industry

70%

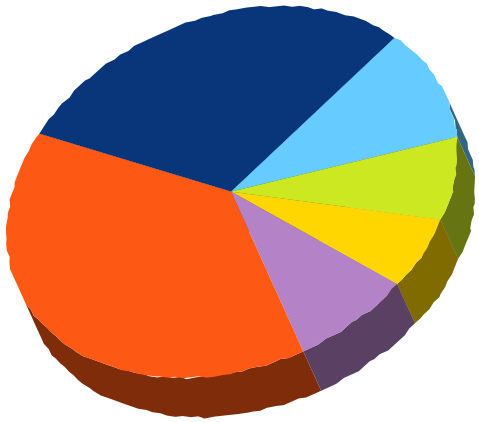
of total energy used generating heat

Good progress in efficiency, potential for improvement still high

- More profitable and safe production practices, competitiveness
- 5 to 6% / year of equipment renewal

Identifying opportunities is still complex

Energy use in industry (France)



29% Boilers

11% Motors

7% HVAC

6% Compressed air & cold

8% Raw materials

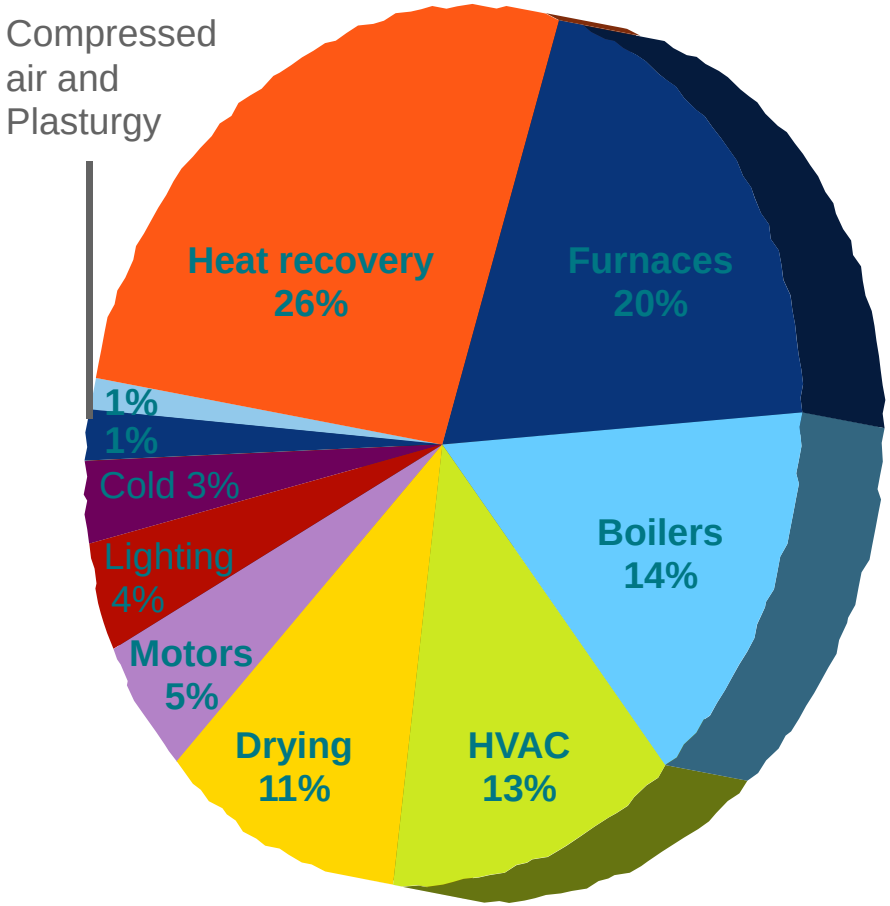
39% Furnace & dryers

Energy savings in industry : technical potential

15%–20%

energy savings **potential** with **existing technologies** and dedicated **energy management** (80 TWh in France)

- HEAT = **85%**
- **known energy savings**
  - Boilers, furnaces, drying,
  - heat recovery, HVAC

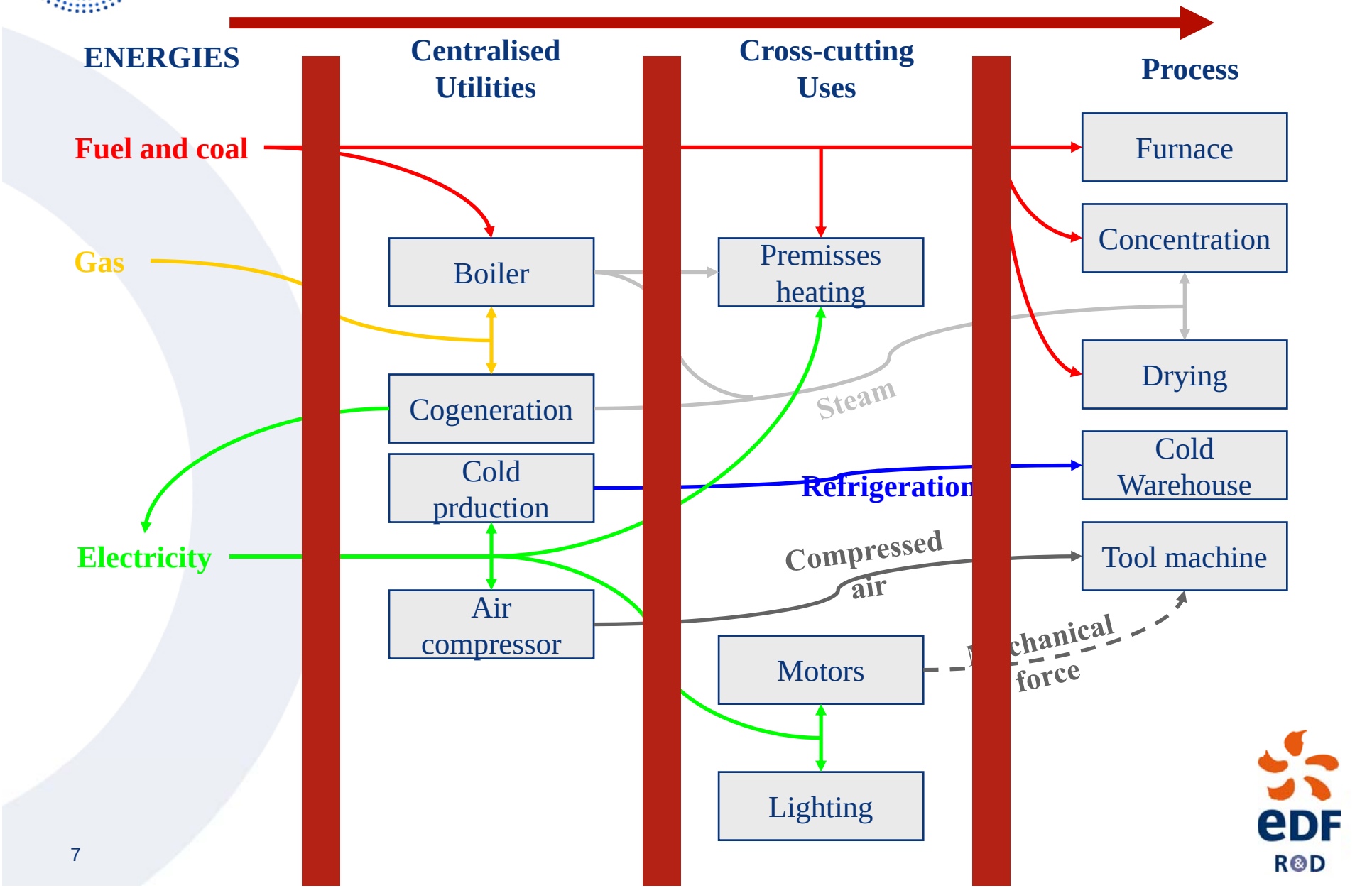


Energy savings potentials

Energy efficiency in Industry : existing approach and solutions

(2 examples)

Optimisation step by step

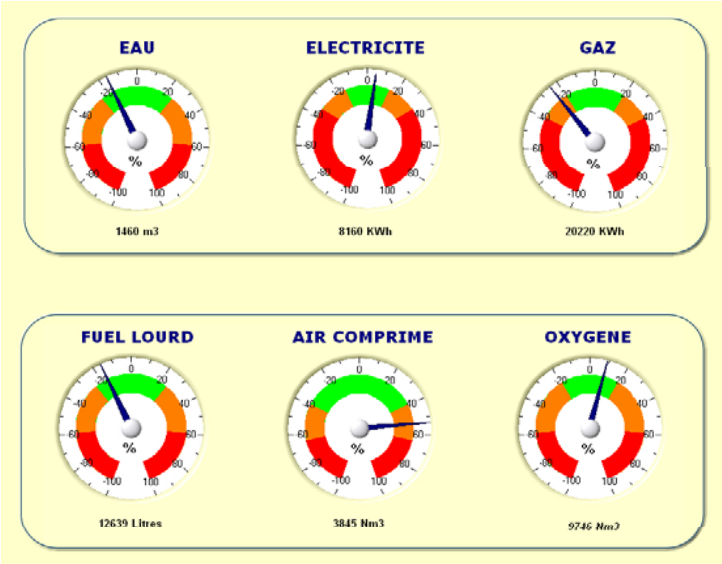


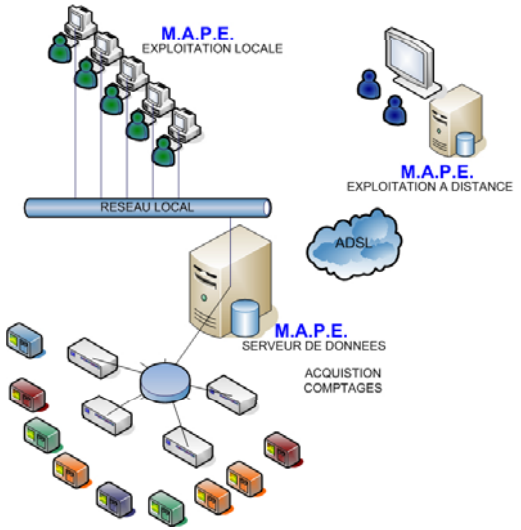
Energy Management System in industry

Example : a plant in food industry,
11 GWh electricity, 7 GWh gas

- The EMS allows the industrial:
  - To follow-up with relevance the use of his various fluids,
  - To effectively draw attention from the production teams onto Energy Management,
  - To be alerted in case of over-consumption,
  - To establish reports aiming the Direction of the plant as well as the occupants,
  - To trace the impact of a change in the production on the energy pattern.

- The annual savings represent 48 K€, amounting to:
  - 12.6 K Euro on compressed air consumption by reducing air leak (-40%),
  - 27 K Euro on (drinking) water by reducing wasting (-22%),
  - 8 K Euro on soft water used in the boiler (-25%).





Energy efficiency in clean rooms

Example : result of software study (sectors concerned : microelectronics, pharmaceutical industry, food industry and the particular case of Air Handling Units dedicated to personnel comfort).

- As a conclusion, we observe that energy efficiency in clean rooms is still low in spite of the huge amount of potential savings.

- It is possible to save up to 50% of the energy combining:
- In activity:

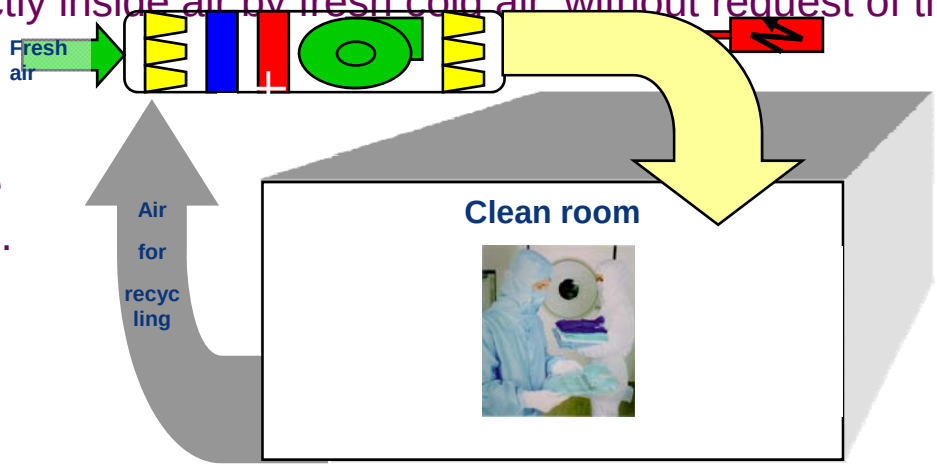
— A heat exchanger to extract calories from exhaust air and to transfer them to fresh air,

— Free cooling, to cool directly inside air by fresh cold air, without request of the electric chiller.

- When unoccupied:

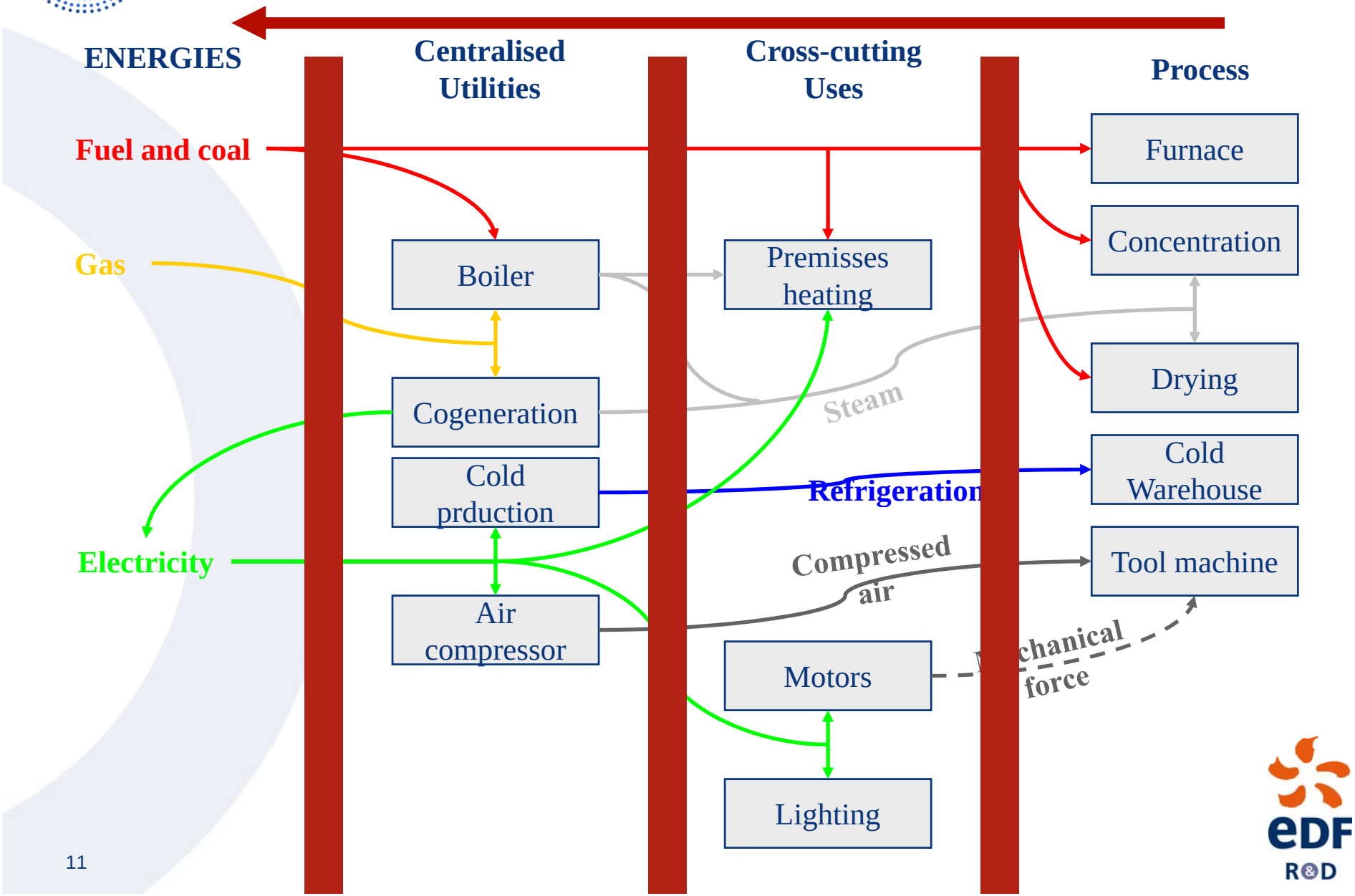
— reducing fresh air inlet

— enlarging the temperature and humidity setpoint ranges.



Energy efficiency in Industry : innovative approach and solutions

Complex Energy flow mapping



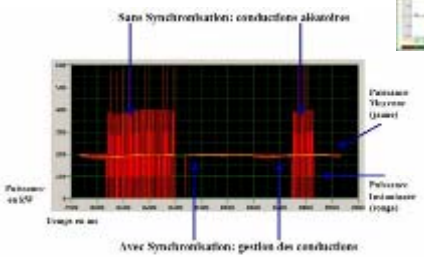
ECLEER research topics on main barriers

Energy assessment and strategies

(efficiency opportunities global, sub sectors and sites)

Tools and methods for energy audits

(analysis and process rethinking, system oriented energy design, etc)



Energy managem't systems

Smart equipment

Reduce energy demand thru energy mgmt

Induction heating systems

Use highest performing energy systems

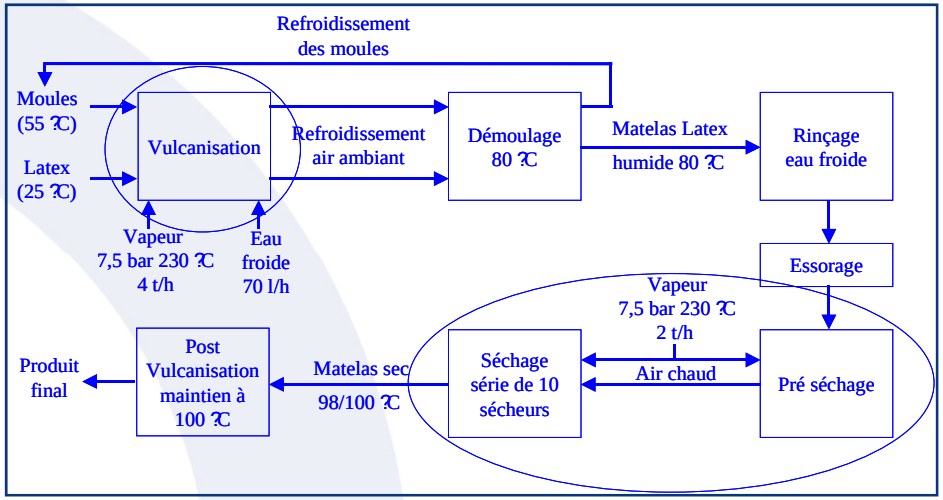
Cold production

High performance technologies for heat recovery

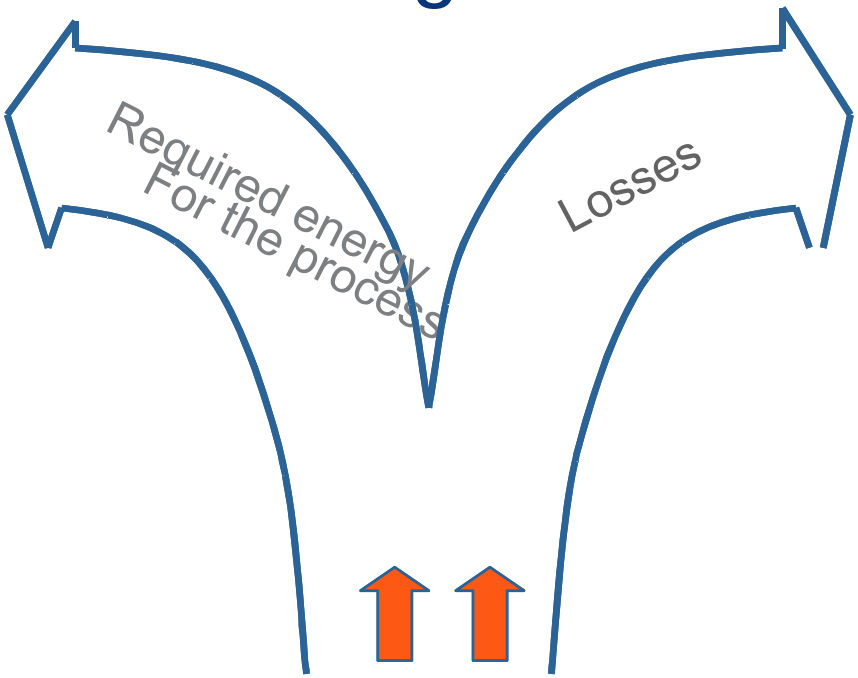
Heat recovery, process integration

Energy management and energy integration

New approach : energy Minimal Required, simplified methodologies



Product manufacturing

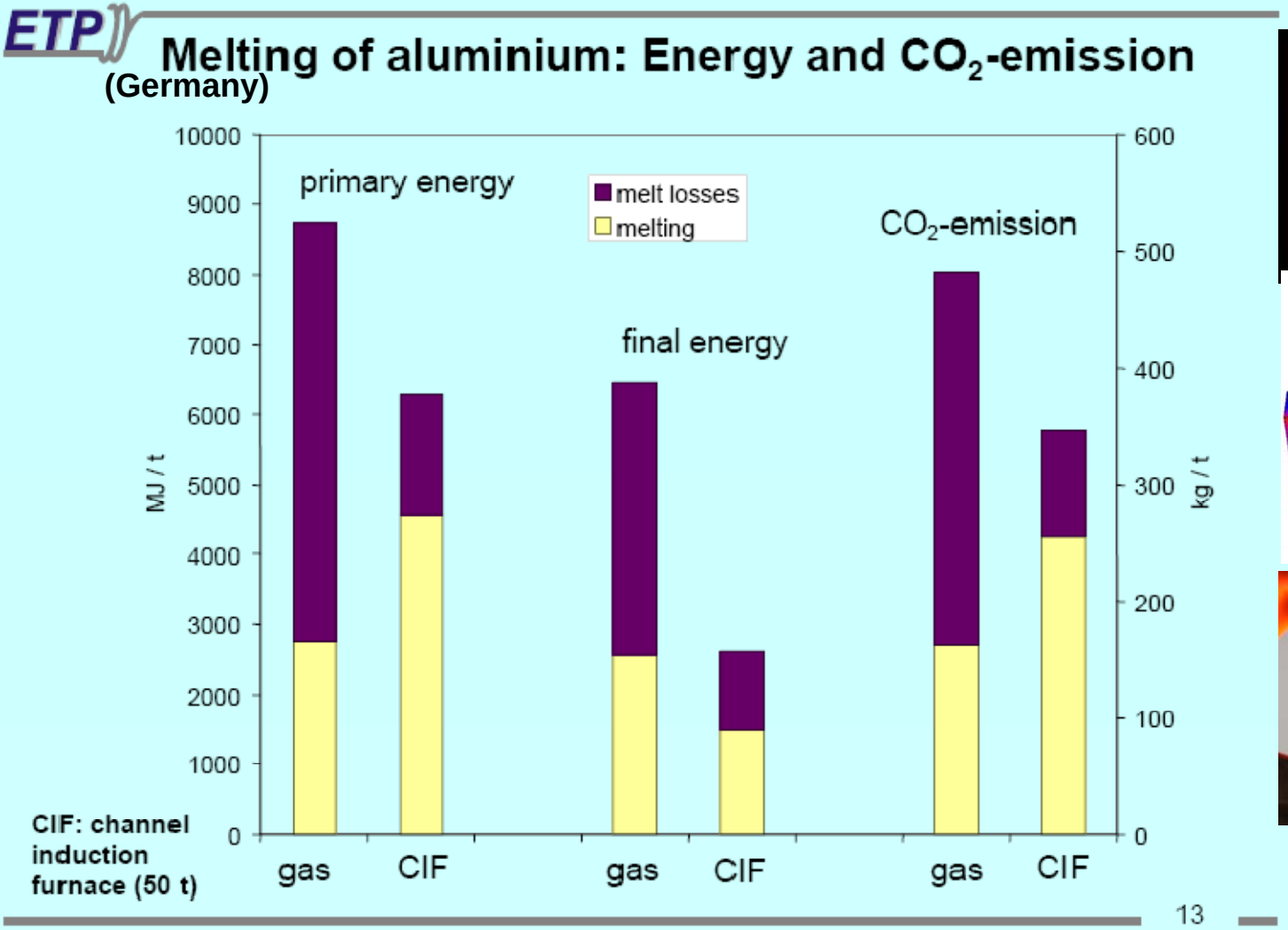


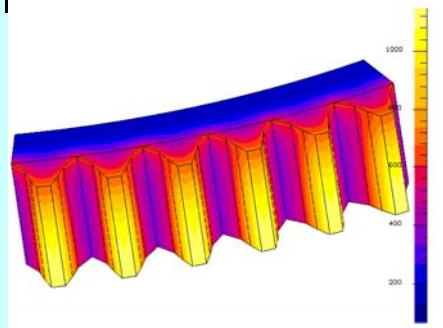
Method to accelerate and simplify the access to the energy efficiency solutions.

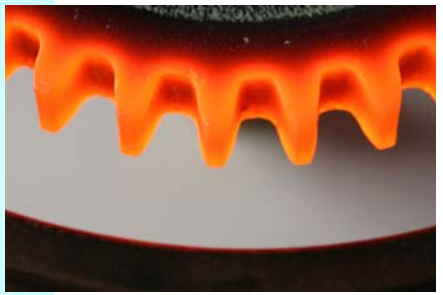
For instance, AEEP method (Energy and Exergy analysis of the process) has been experimented on several manufacturing processes, based on real and detailed audit data collected in the industry → tools for SME

High efficiency systems Example of Induction heating

Example of Melting of aluminium (in german electrical context)





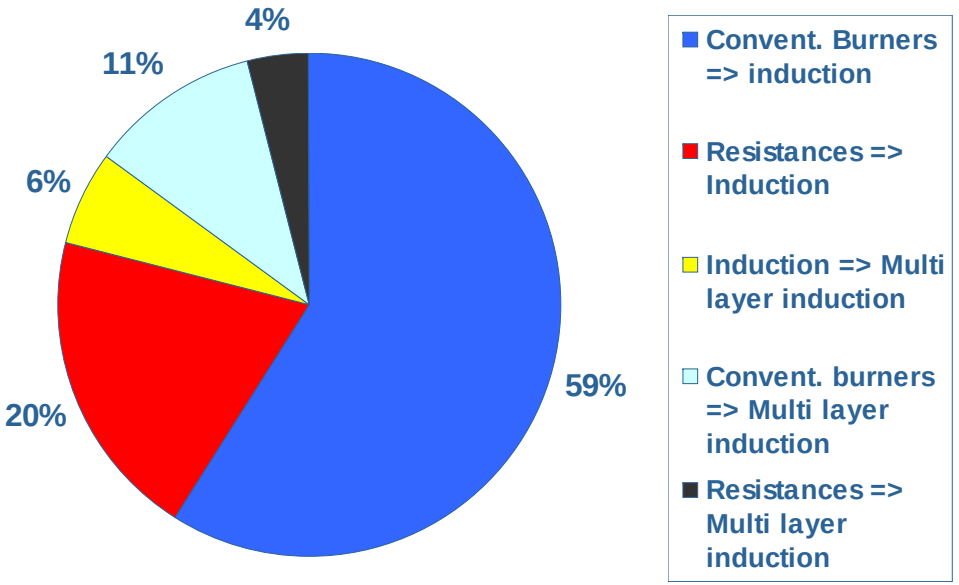


Induction heating tomorrow

In France, the size of energy saving potential based on induction in the current markets is around 3 TWh/year.

This may be achieved with the replacement of conventional heating processes by the induction technology.

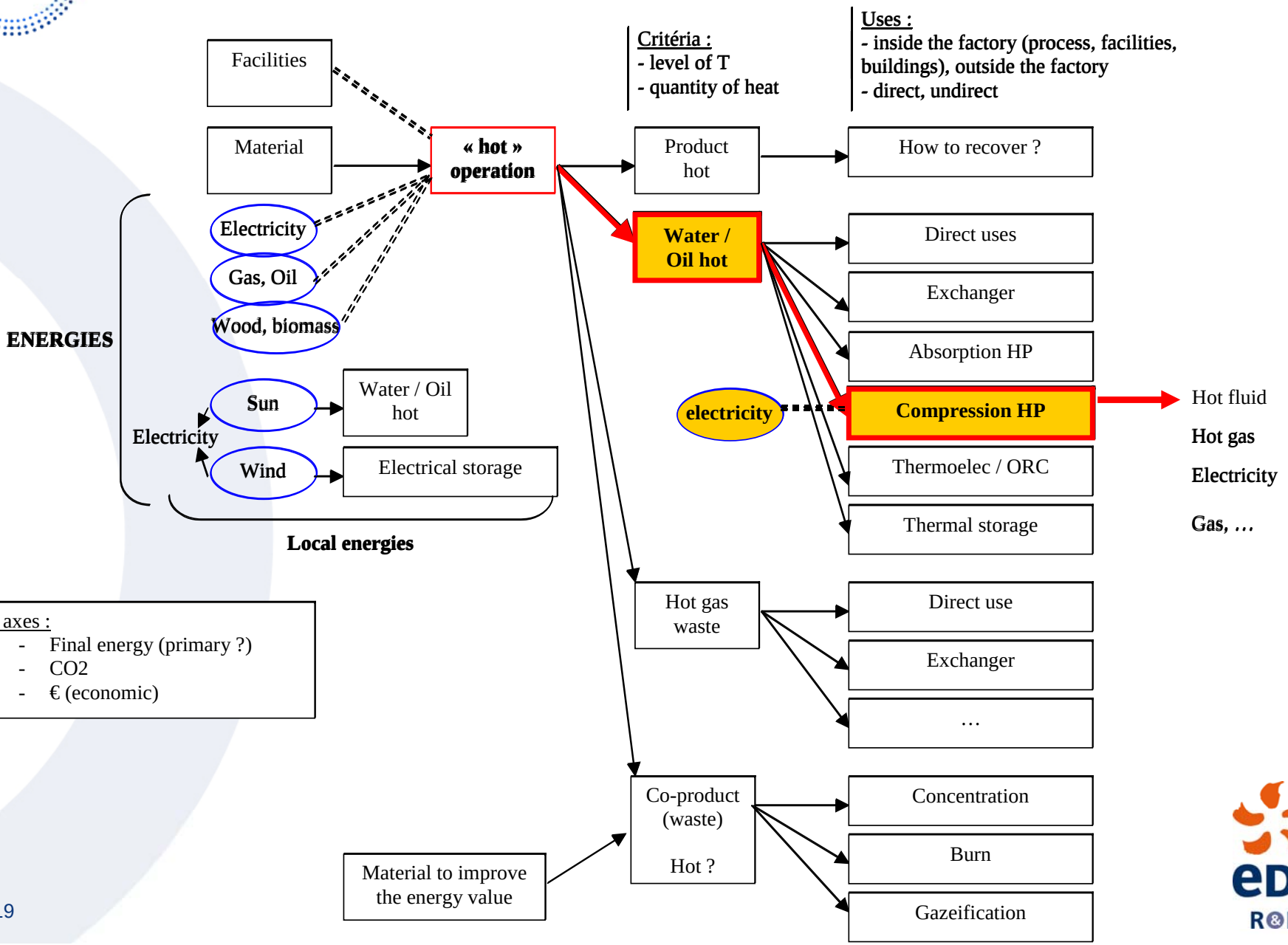
The burners substitution represents 59% of the potential



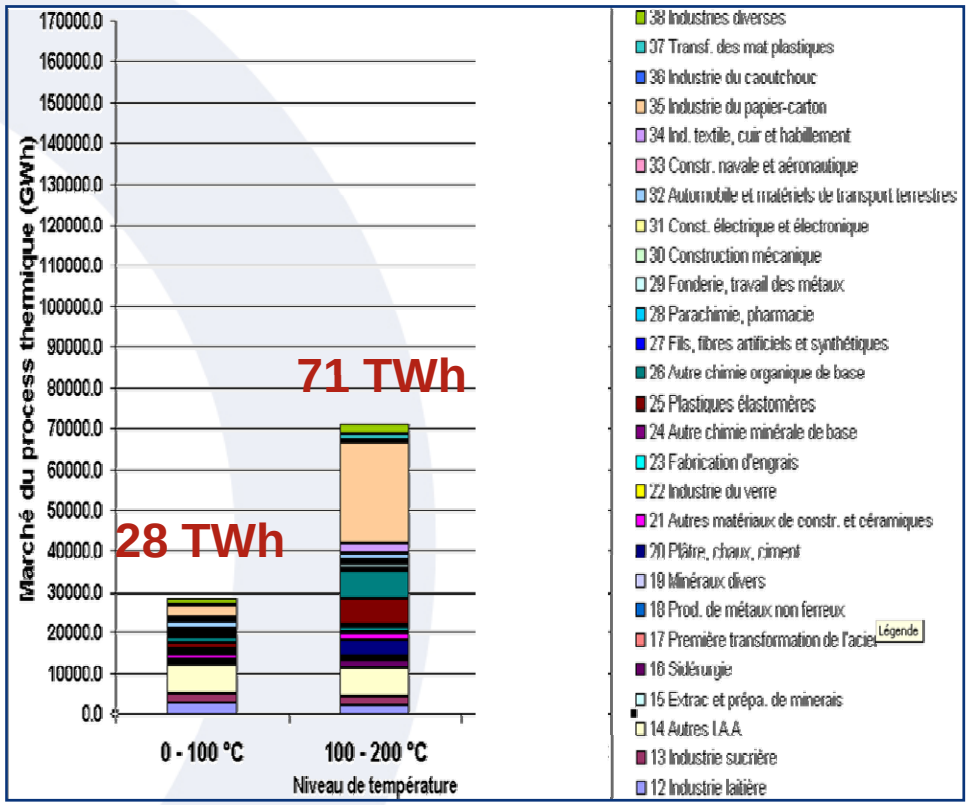
- The concept of "**flexible heat induction**", the development of generator/ inductor communications offering greater load adaptability, will decrease the energy consumption and make the equipment much more generic
  → less costly and capable of taking on new applications.
- This technological breakthrough will come on to the market under next 5 years and may significantly increase the induction penetration.

Heat recovery, heat pumps and MVR

Recovery of heat



France : heat needs inside the process (27 sectors) → potential for High Temperature Heat Pump

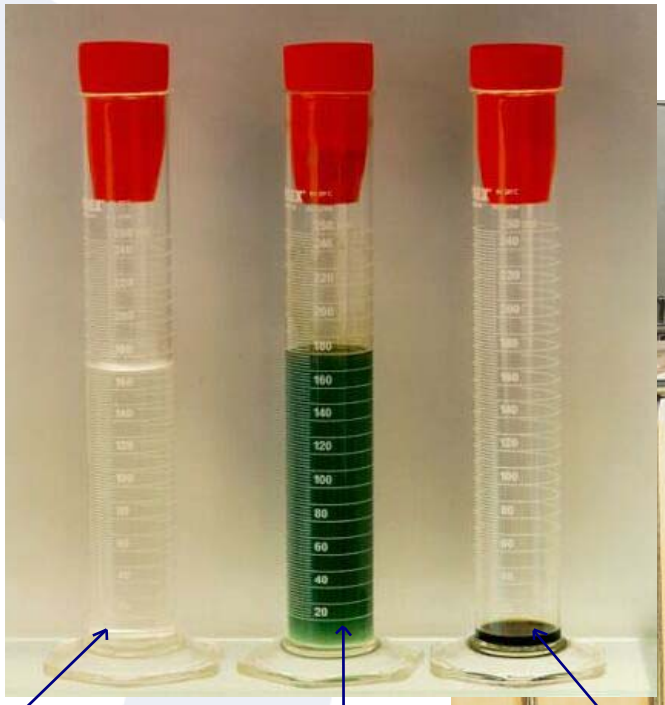


Priorities :

- 3 main sectors
  - Paper
  - Food
  - + metal, cars, plastic, textile
  - Chemical
- Buildings warming

- Technical challenges after 80°C
- Compatibility of compressors (lubrification) with low GWP fluid

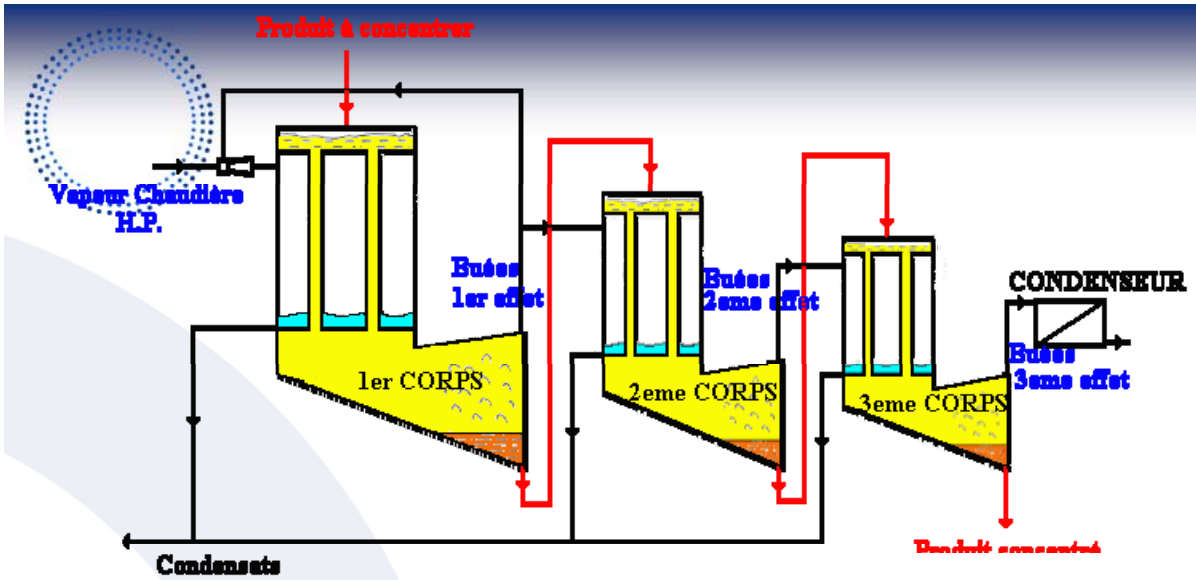
MVR (Mechanical Vapour Recompression)



Re-usable water

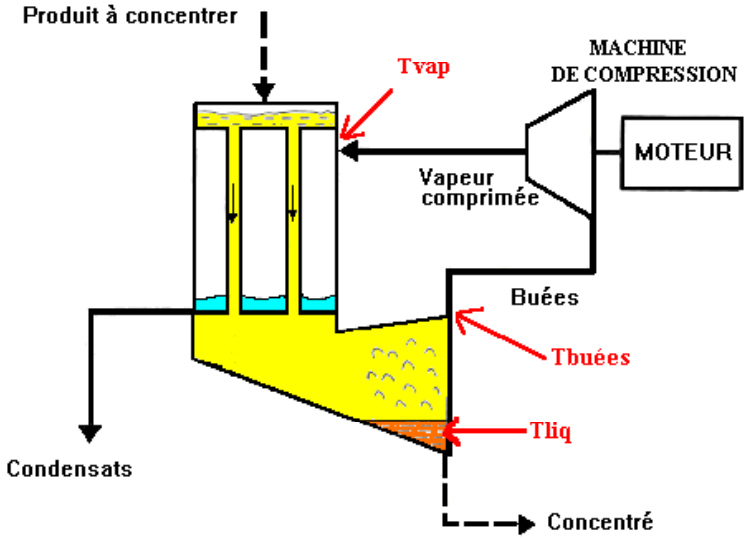
Product to be concentrated

condensat



Multiple effects evaporation with thermocompression

Evaporation simple effect with MVR



- 6 effects : 120 kg vap/tee (100 kWh), 5 kWh/tee
- 1 effect with MVR : 0 to 20 kg vap/tee (8 kWh), 25 kWh/tee

Which breakthroughs tomorrow ? Which research efforts ?

Near future : more constraints on energy price and resources, CO_2 emission and pollution.

New breakthroughs should be discovered and promoted. We have to

- Develop new methodologies and simplified tools : to analyze and re-concept the process, simplified the methods to accelerate the penetration of solutions (specially for SME)
- Develop and promote the integration of advanced high performance technologies (like electrical technologies) in the process industry considering the energy sources substitution and promoting the use of renewable energy resources for reducing the CO2 emissions. Competition between technologies
- Increase the heat recovery and reduce the exergy losses by a better process integration and by using high performance energy conversion technologies such as high temperature heat pumps.
- Identify, characterize and quantify energy saving sources in the industrial sectors in order the quantify energy saving markets and opportunities.

EDF R&D

Thank you for your attention