DECARBONISATION STUDY OF DRYING AND COOKING PROCESSES

ALLICE
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ALLICE

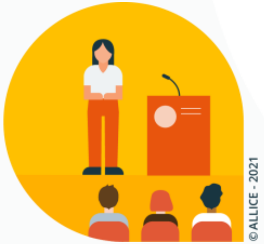
Alliance ALLICE

Federate and innovate to decarbonise industry

Our missions

- ✓ **Bringing together all the players** in the sector to innovate collectively
- ✓ **Supporting the development of a range of high-performance, differentiating decarbonisation solutions** in France and abroad
- ✓ **Supporting manufacturers** in accelerating their decarbonisation

Collective studies



Representation of the sector

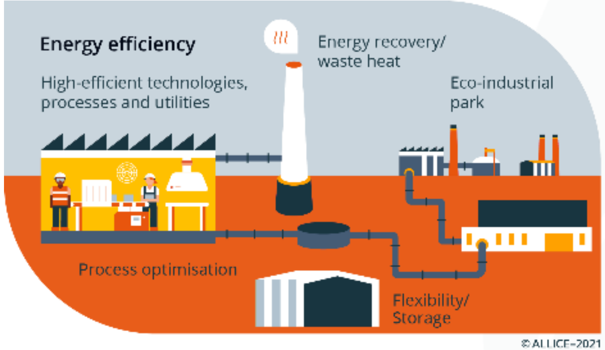
Our structure

- ✓ A **membership-based model**
- ✓ An **independent facilitation organisation**
- ✓ More than **100 members and partners**

Our areas of intervention

- Energy efficiency
- Integration of alternative energies
- Capture and recovery of CO_2
- Circular Economy
- Digital transition
- Business models and financing

#19 Decarbonation study of drying and cooking processes



- Comparison of decarbonisation solutions and their costs to **achieve 81% of CO2 emission reduction**[1]
- Guide manufacturers in decarbonising their processes

- Modelling of 3 case studies from various industries
- Estimation of CAPEX, OPEX and CO2 emissions
- Projection to 2050[2]

- Study different solutions for drying and baking processes: energy efficiency, electrification, renewable and recoverable energy
- Analysis and comparison of possible solutions
- General conclusions for industry players

[1]Complying with the French government objectives, fixed by the SNBC (Stratégie Nationale Bas Carbone)

[2]Sources: Enerdata, ADEME, ENEA consulting/Blunomy, CEREMA, CETIAT

Case studies on three various industries

Brick and tile

#1 Tile drying and firing tunnels

Mechanical

#2 Drying and polymerisation tunnels for powder paint

Food

#3 Malt drying process

Criteria	Case 1 – roof tiles	Case 2 – paint line	Case 3 – malt drying
Duration (cycle or per year)	2 x 24h (continuous)	4 200h/yr	24h (batch)
Quantity of product (T)	9T/h tiles	2,6T/h painted	150T/batch malt dried
Annual gas consumption (GWh/yr)	53	5	19
Annual electricity consumption (GWh/yr)	2,4	0,1	1,5
GHG emissions (kTCO2/yr)	11 000	1 000	3 500

Case 2 – Painting line process
Reference case

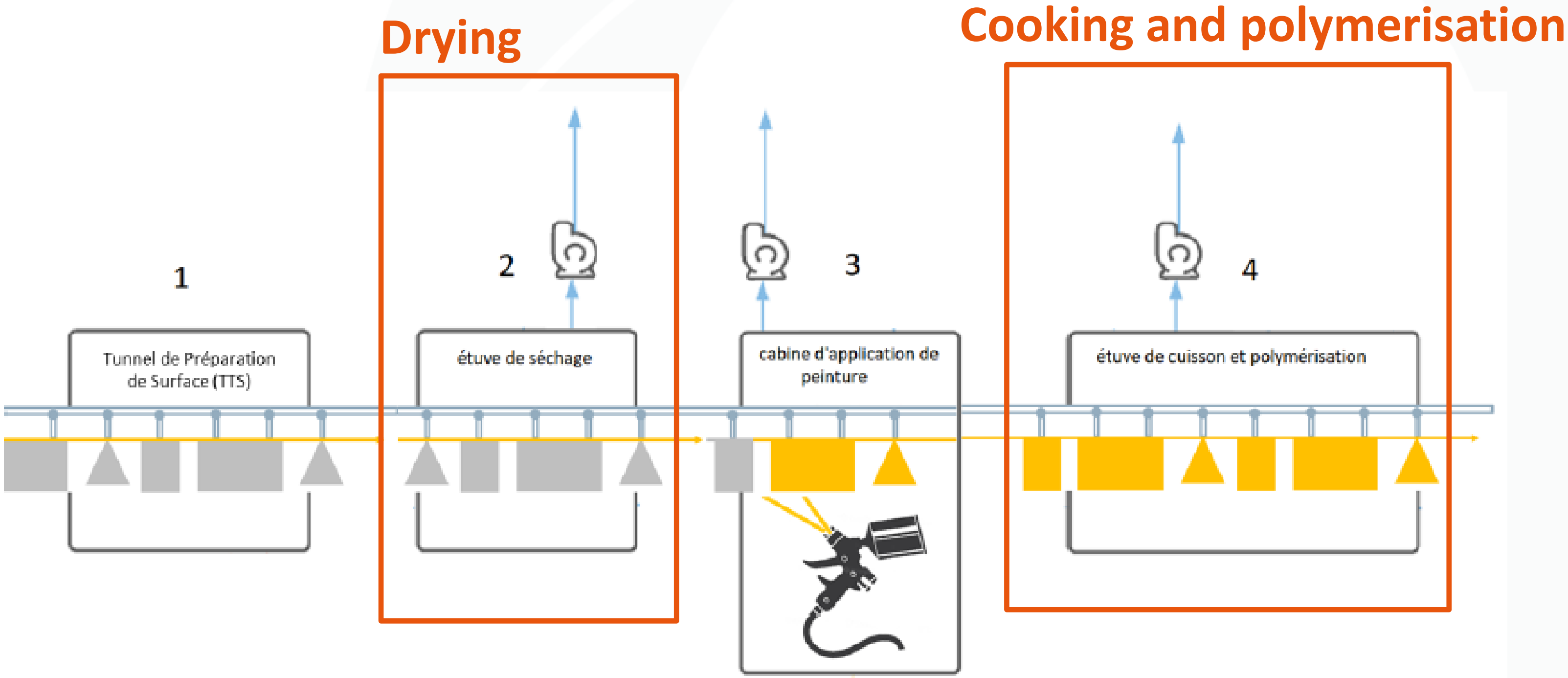


Figure 37 Schéma global d'une ligne de peinture

Modelisation of the drying phase – reference case

- **Power: 245 kW (gas burners)**
- **Temperature: 120°C**

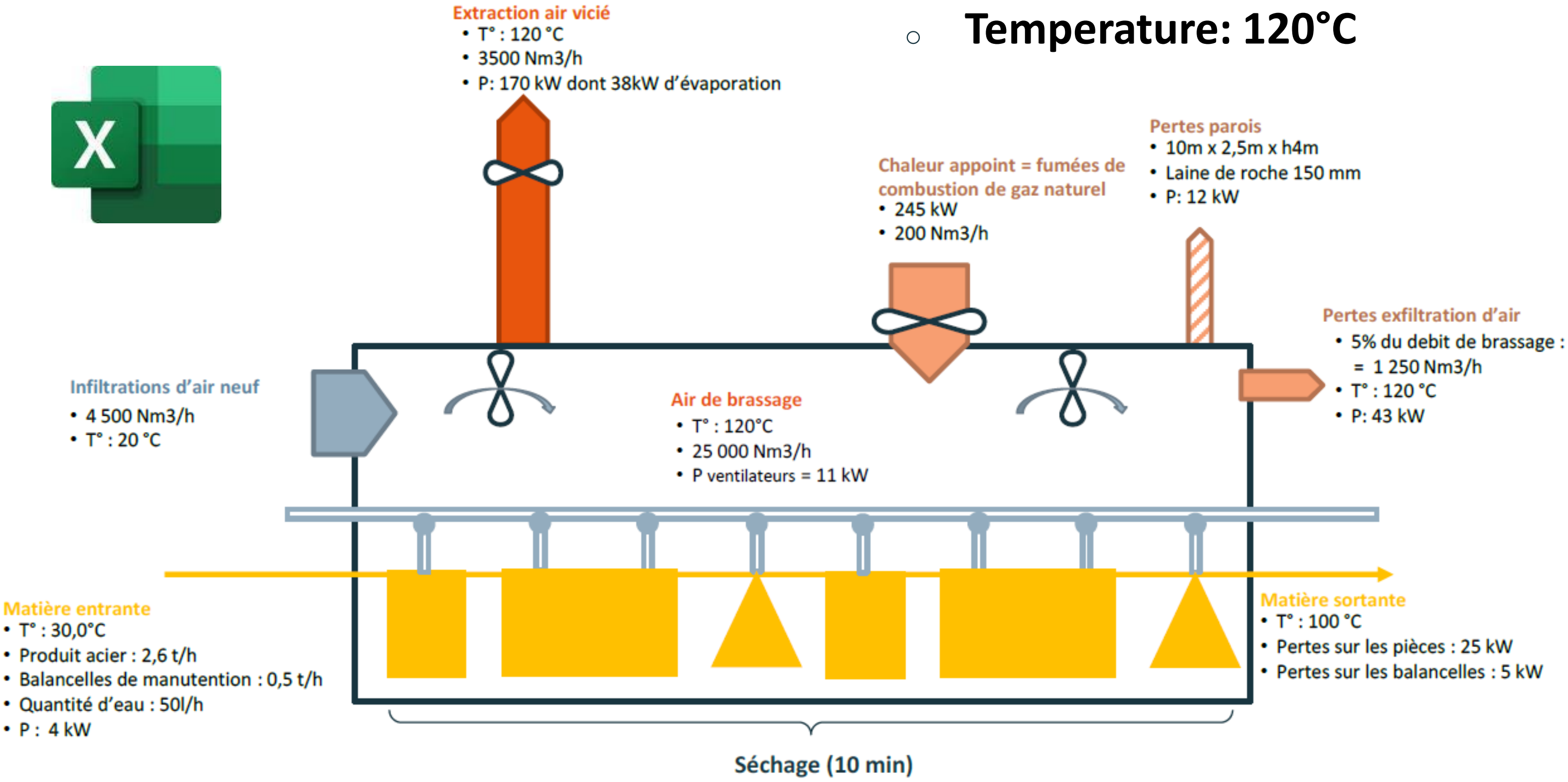


Figure 38 : Schéma simplifié d'une étuve de séchage en sortie de traitement de surface

Modelisation of the cooking phase – reference case

- Power stage 1: 300 kW gas radiants burners
- Power stage 2: 155 kW gas burners
- Temperature: 220°C
- Air circulation: 40 000 Nm³/h

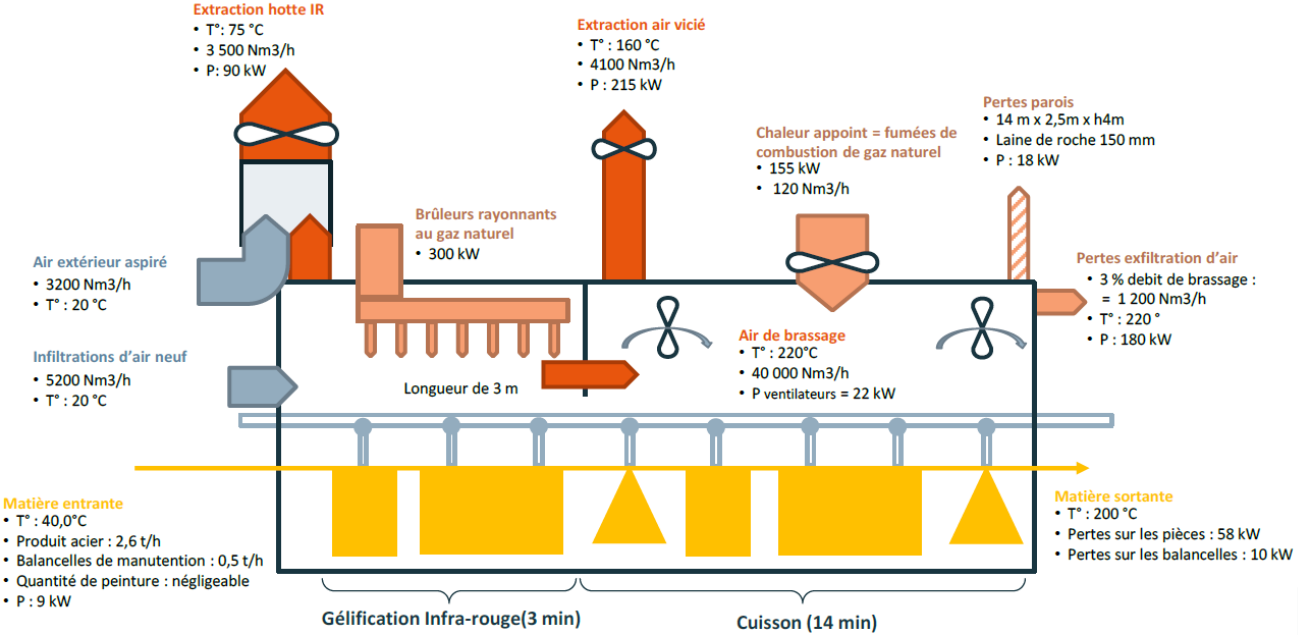


Figure 39 : Schéma simplifié d'un four de cuisson de peinture poudre mixte IR / Convectif

Decarbonisation solutions considered

Solutions	Case 1 – roof tiles	Case 2 – paint line	Case 3 – malt drying
Energy efficiency* (SoEE)	X	X	X
Guarantees of Origin (SoGO)	X	X	X
Electrification (SoElec)	X	X	
Hydrogen (SoH2)	X	X	
Solar (SoSol)		X (CSP)	X
District heating network (SoRés)			X
Biomass			X

Energy efficiency is applied to all solutions considered, as it is the 1st decarbonation lever to activate and the best option to reduce GHG emissions as well as costs.*

Energy efficiency case (global energy consumption reduction)

- Optimised (= reduced) silhouettes and air extraction (-3%)

1. Capture of kiln fumes to dryer (-6%) (1)
2. Surface treatment preheating with dryer vapours (-4%) (2)
3. Installation of a HT heat pump (3) (no more burners used for the drying phase)

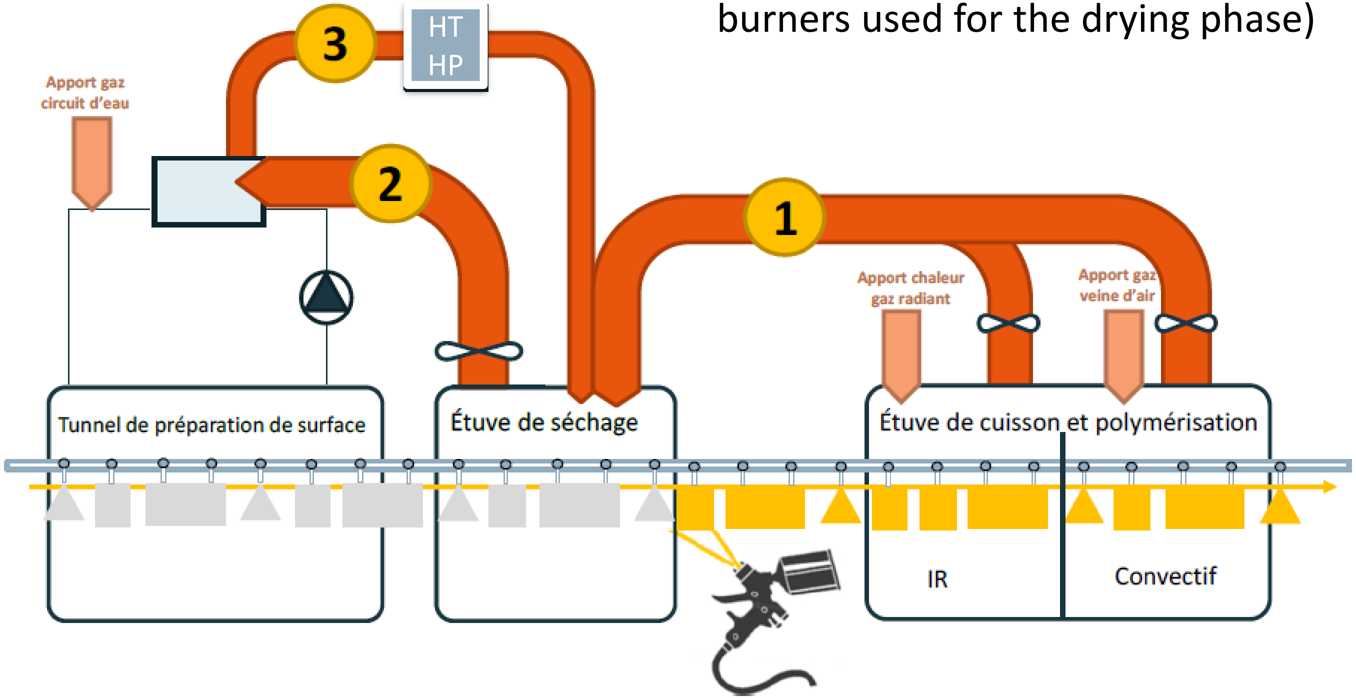


Figure 43 : Schéma d'ensemble du procédé de peinture optimisé

Scenarios & cumulated costs report

- Grey: Very weak environmental commitment, sometimes falling short of the commitments made by France.
- Blue: Commitment in line with current policies.
- Green: Strong commitment, sometimes going further than those already taken.

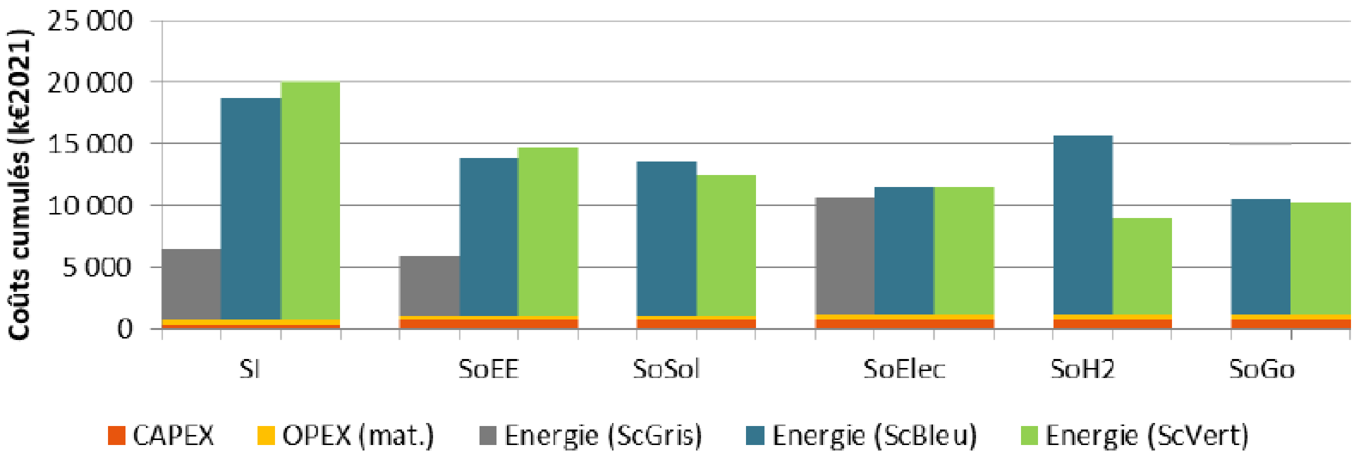


Figure 53 : Comparaison des coûts cumulés, des différentes solutions du cas 2

Scenarios & cumulated CO2 emissions report

- Grey: Very weak environmental commitment, sometimes falling short of the commitments made by France.
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- Green: Strong commitment, sometimes going further than those already taken.

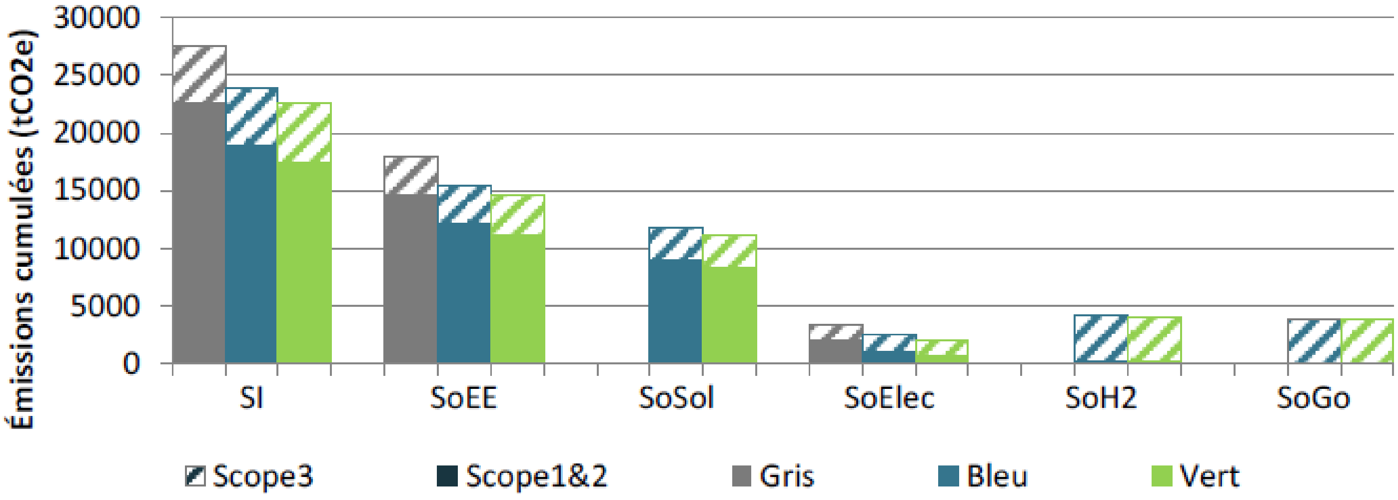
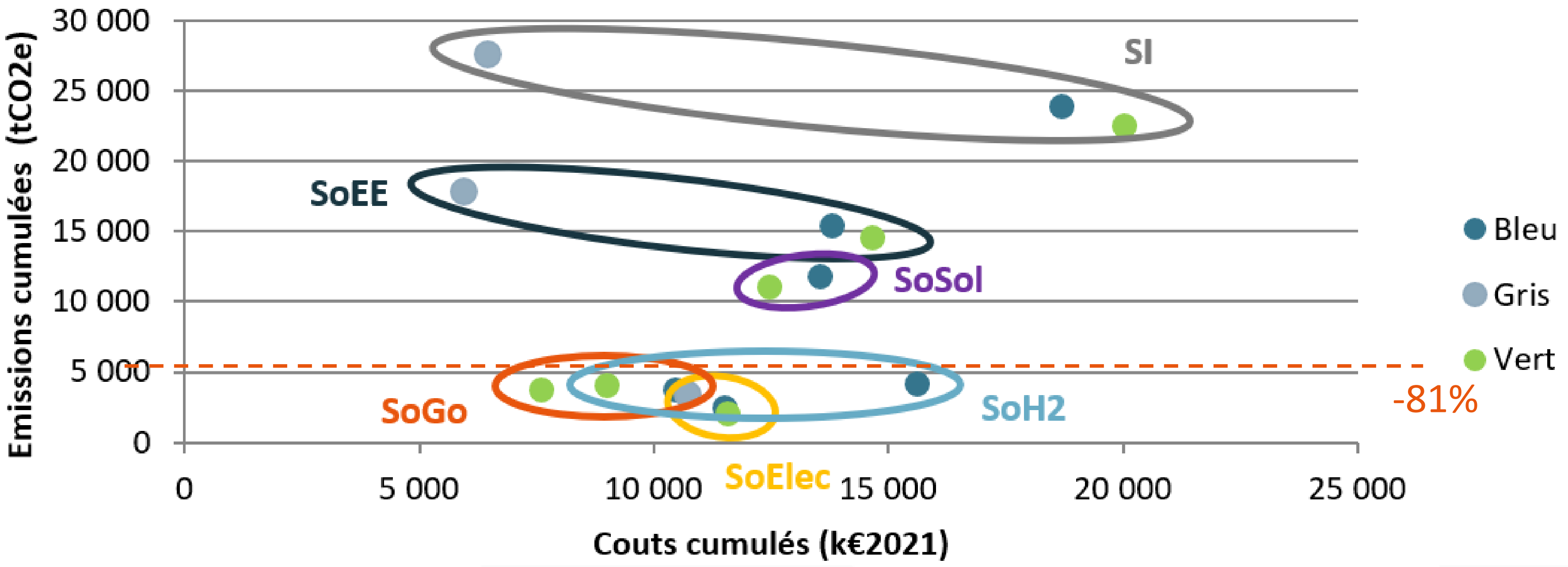


Figure 54 : Comparaison des émissions cumulées de GES, pour les des différentes solutions du cas 2

Results for case #2: GO appears as the best solution… electrification and hydrogen are promising



Conclusions and outlook

- **Energy efficiency is the main source of gains (CO_2, €)**
  - Setpoint control / optimisation
  - Energy recovery

- **Availability of resources**
  - GO contracts: a limited solution
  - Renewable energy solutions not always applicable (case 1 : biomass & H2 / case 2 : biomass)

- **Energy costs: an EU ETS brake**
  - Cost of allowances for Gas EU ETS too low to encourage decarbonisation
  - For non-EU ETS manufacturers: decarbonisation solutions = savings

Electrification vs Renewable Energy: two key factors

- Energy efficiency of systems
- The energy source

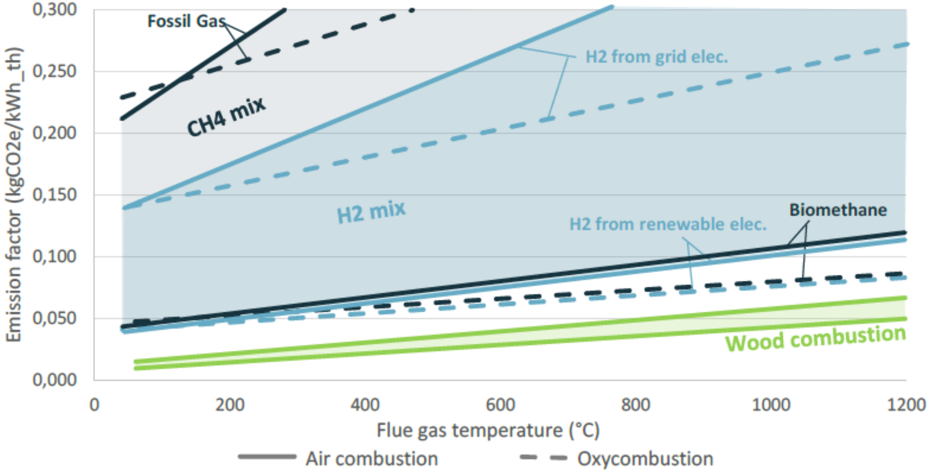


Figure 4 : Typical GHG emission factors for thermal energy generated by different fuels (source CETIAT)

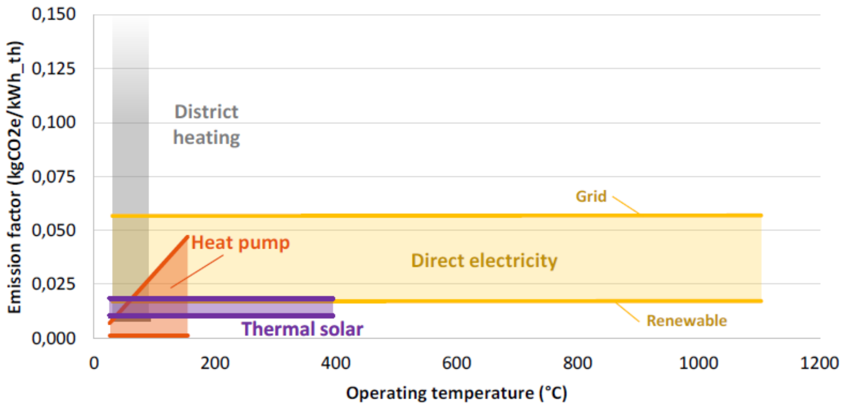


Figure 5 : Typical GHG emission factors for thermal energy generated by different systems and energy sources (source CETIAT)

This performance depends mainly on the temperature levels involved

THANK YOU

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Got any questions?

Don't hesitate to contact us!

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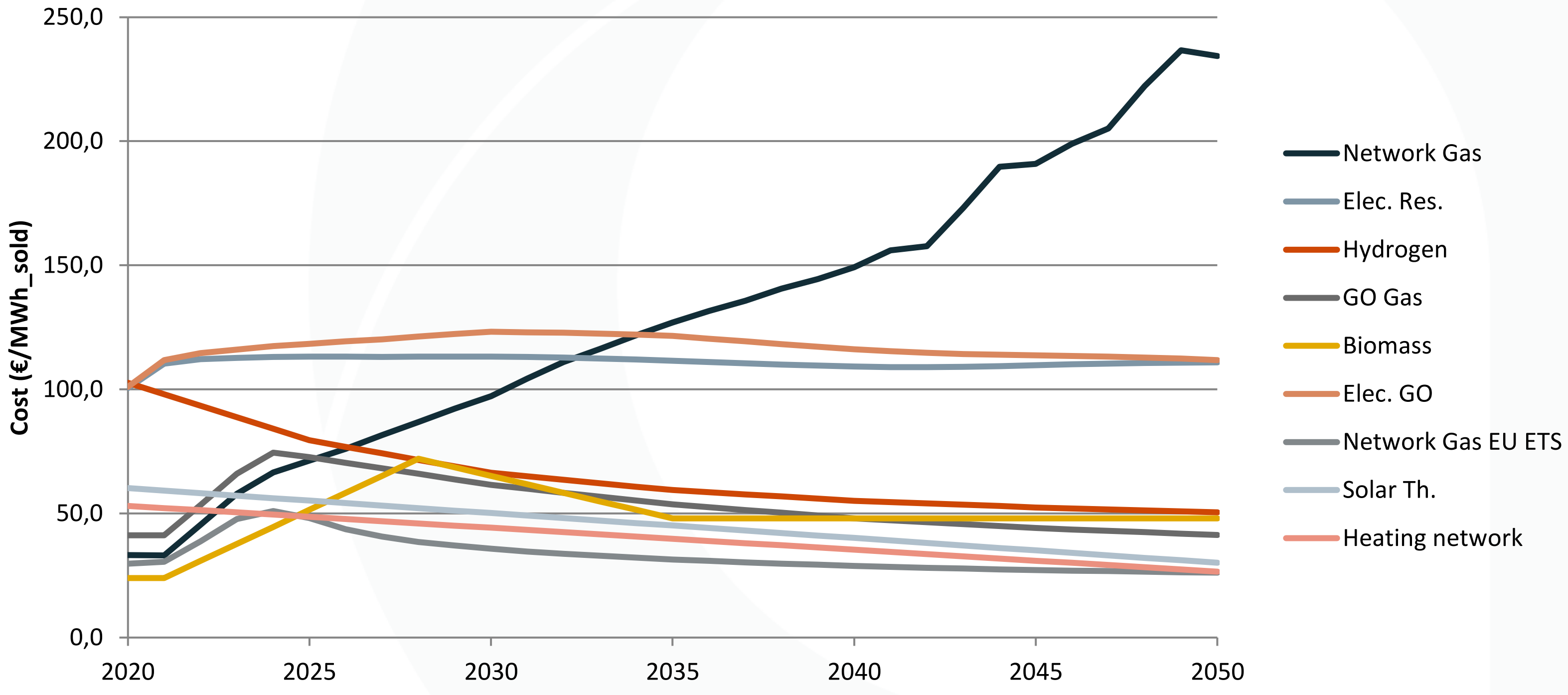
Scenarios for energy costs and emissions

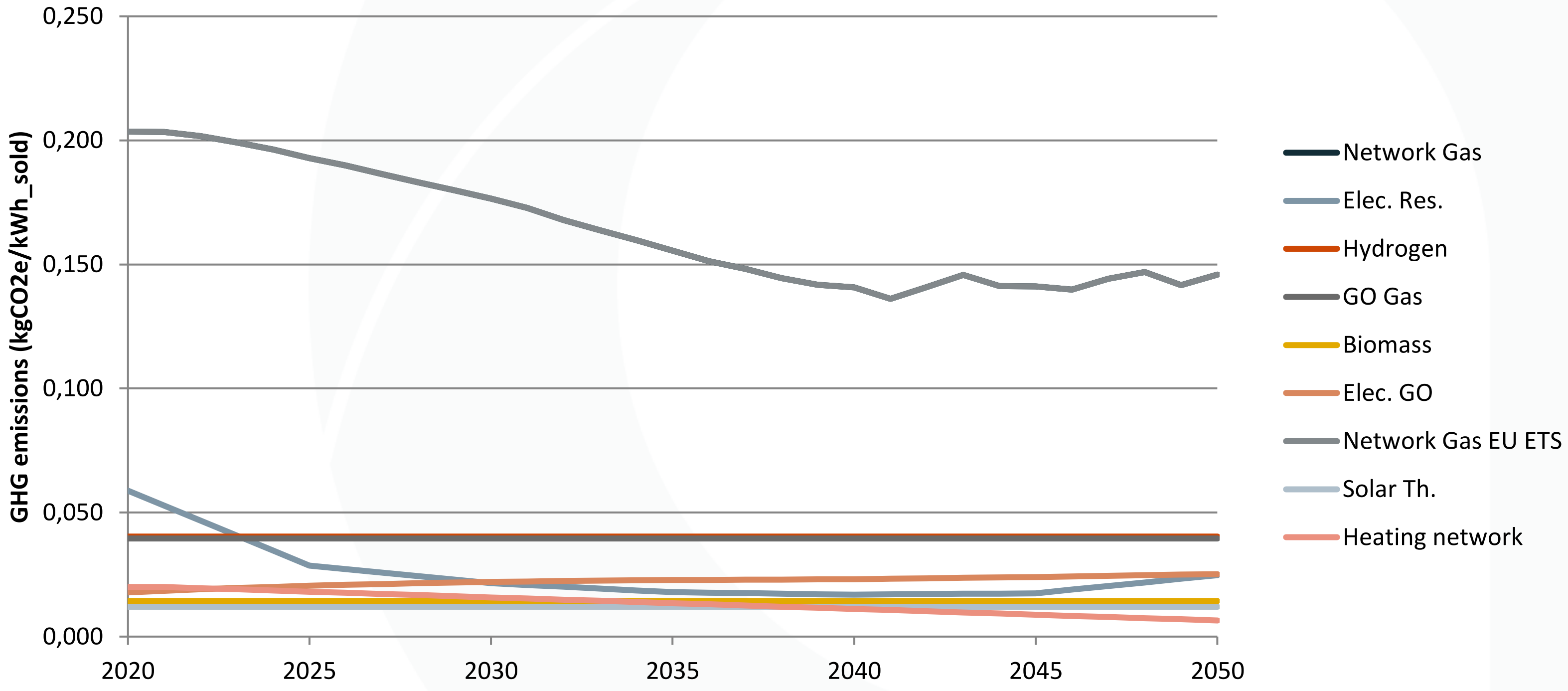
Energy costs



- **Sources: Enerdata, ADEME, ENEA, CEREMA, CETIAT**

Scenarios for energy costs and emissions

Emissions



- **SCOPES 1, 2 and 3**

Case 1 - Brick and tile process
Reference case

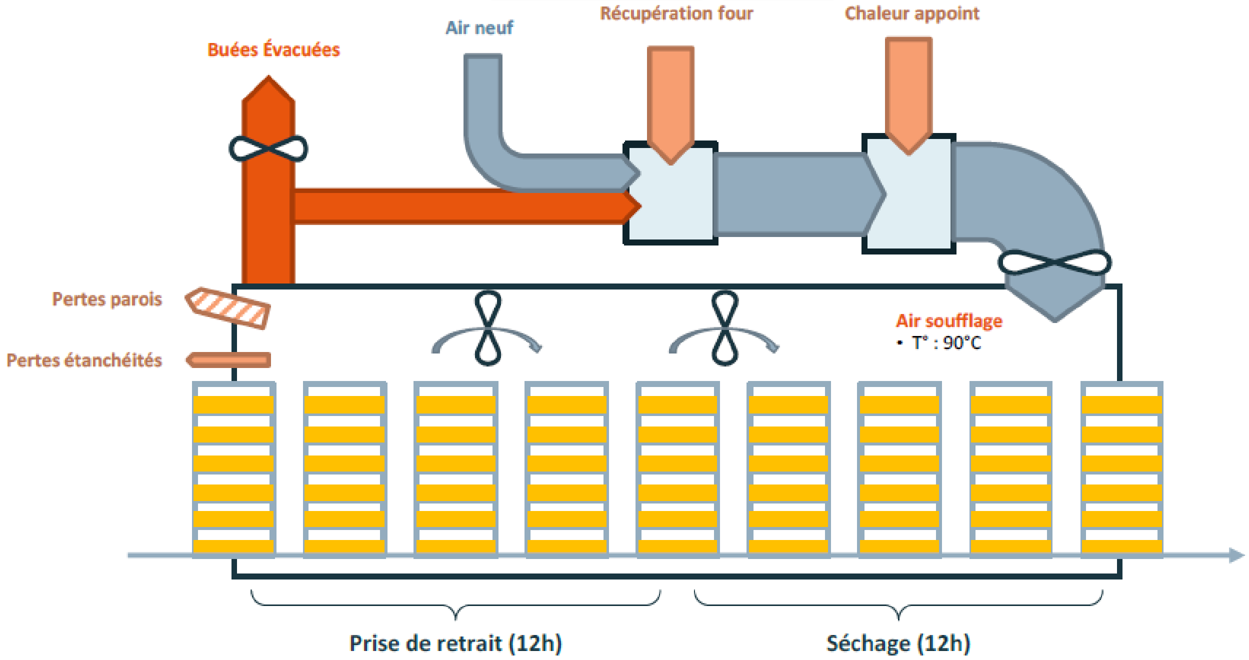


Figure 17 : Schéma de principe de l'opération unitaire de séchage du cas 1 (ligne de séchage de tuiles)

- **2-stage process**
  - **Drying (1500 kW)**
  - Baking (6000 kW)
- **Features**
  - 9 t/h of final product
  - **Drying at 90°**
  - Baking at 1000°C
- **Total consumption**
  - **Electricity: 2,4 GWh/yr**
  - **Gas: 53 GWh/yr**

Case 1 - Brick and tile process

Reference case

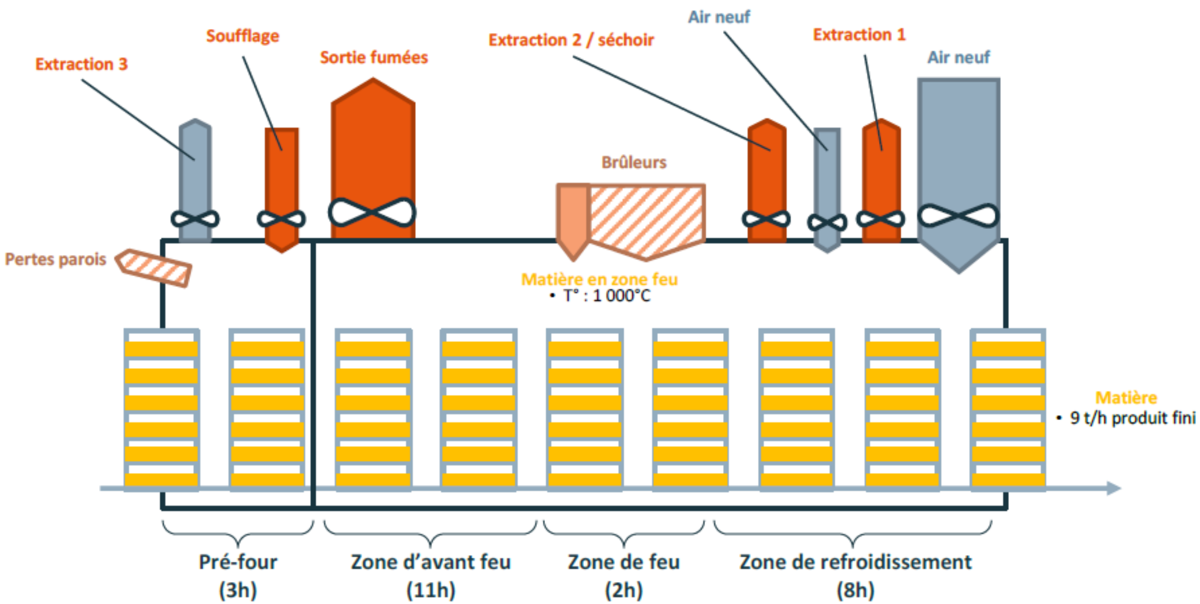


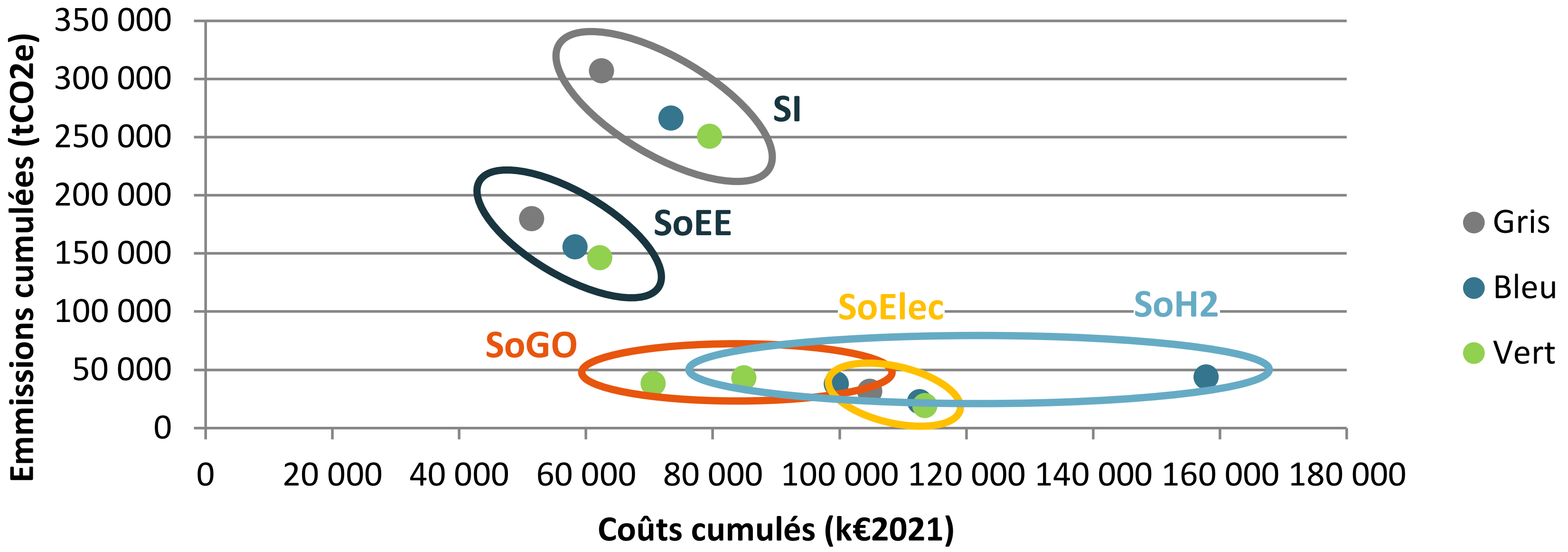
Figure 18 : Schéma de principe de l'opération unitaire de cuisson du cas 1 (ligne de cuisson de tuiles)

- **2-stage process**
  - Drying (1500 kW)
  - **Baking (6000 kW)**
- **Features**
  - 9 t/h of final product
  - Drying at 90°
  - **Baking at 1000°C**
- **Total consumption**
  - **Electricity: 2,4 GWh/yr**
  - **Gas: 53 GWh/yr**

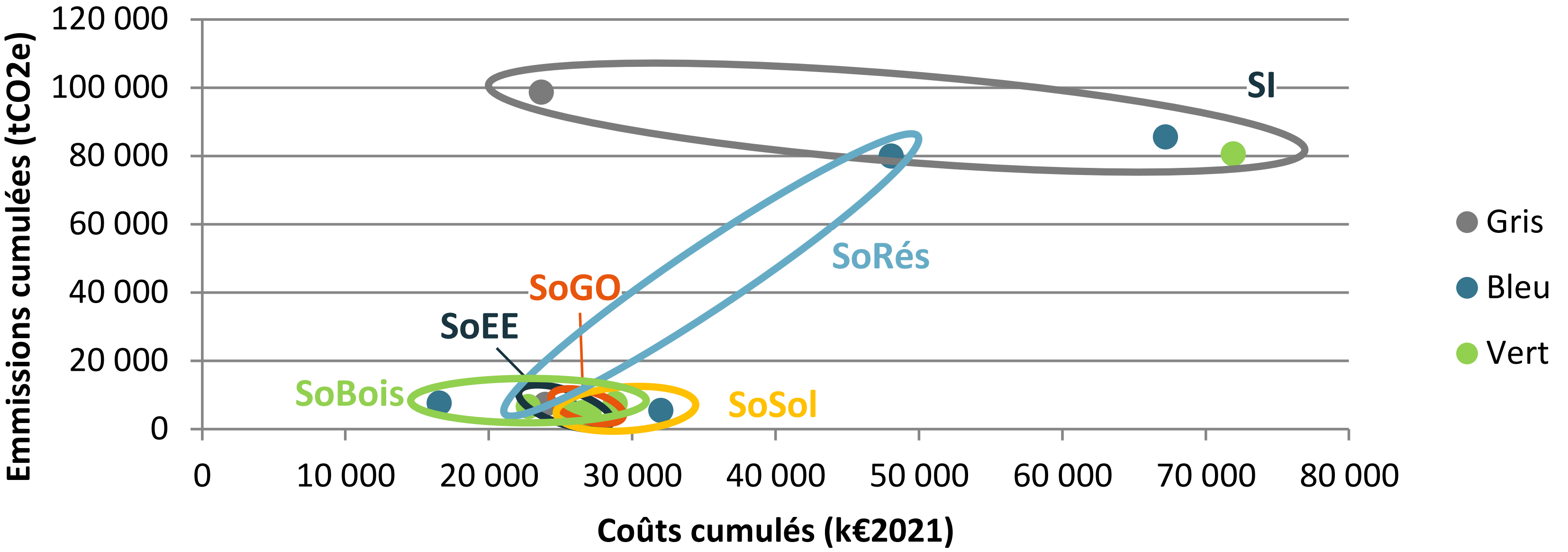
Energy efficiency solutions – detail by use case

- **Case #1 roof tile**
  - Drastic increase in convection to improve exchanges.
- **Case #2 painting line**
  - Reduced silhouettes and air extraction
  - Capture of kiln fumes to dryer
  - Surface treatment preheating with dryer vapours
  - Installation of a HT heat pump
- **Case #3 malt drying**
  - Switching to double tray
  - Optimising instructions
  - Installation of a HT heat pump

Results for case #1: GO appears as the best solution… electrification and hydrogen are promising



Case 3 - Kiln drying
Cross balance



Our areas of intervention

The levers for the industry's decarbonisation