Global Research and Development

Dunkirk district cluster, an EPOS demo site.

IEA Global Technology Roadmap for Iron and Steel

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20/11/2017 - Paris

The right formula
for the steels of the future

ArcelorMittal Dunkirk: France's biggest integrated iron and steel plant

- Built in **1962**
- More than **3 000** employees
- Products: **steel slabs** and **steel coils**
- Annual capacity: **7 Mt of slabs** and **4.5 Mt of coils**

ArcelorMittal Dunkirk site description

1 Coke plant

3 Convertors
3 Ladle Treatments
3 Continuous Castings

3 Blast Furnaces

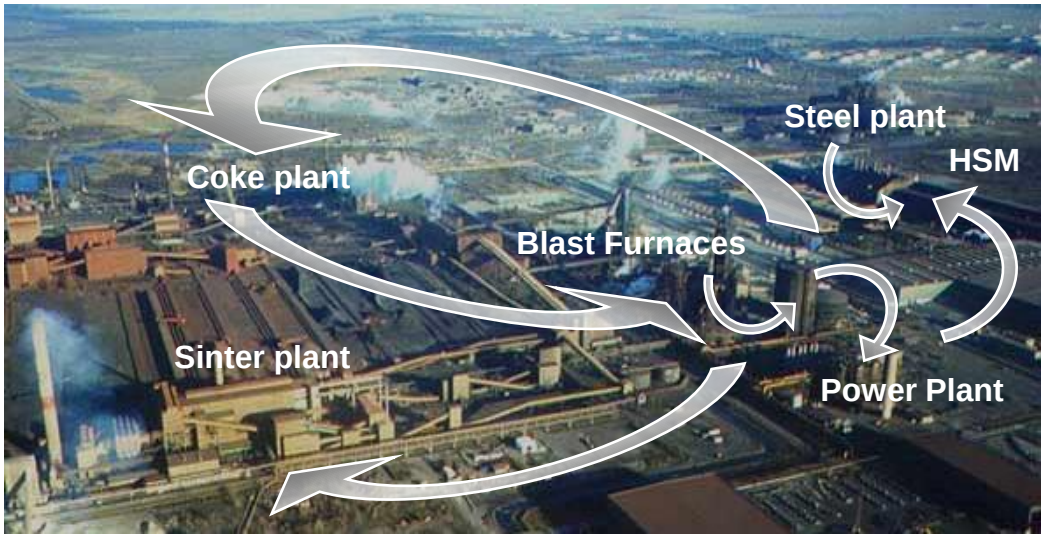
1 Hot Rolling Mill

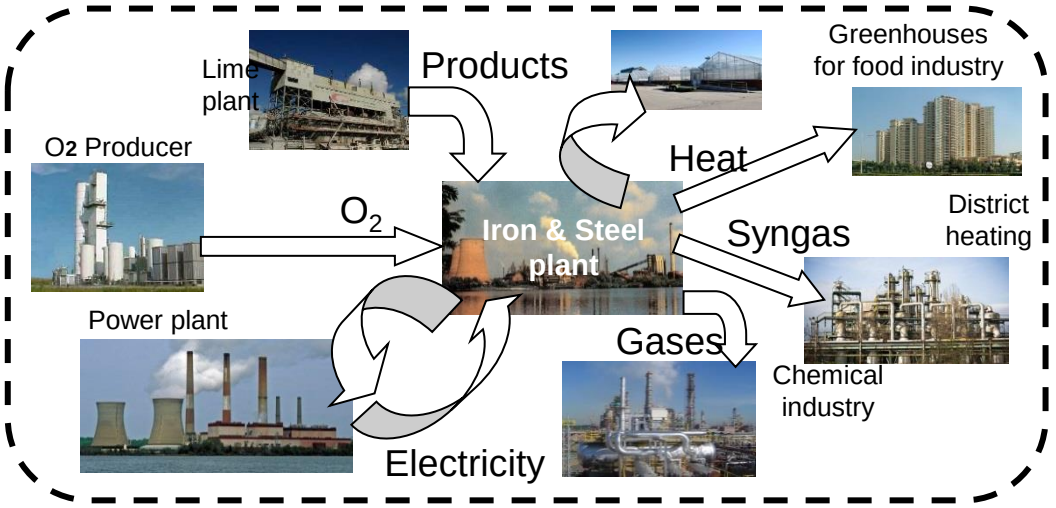
2 Sinter plants

Interest of Industrial Synergies for ArcelorMittal

We already have a global view and optimisation of energy flows inside the plant,

To continue improving our efficiency, we must now consider the whole plant in its environments (including possible synergies with Power Plant, but also with Gas manufacturers, external energy sources, external valorisation of waste heats, gases and water).





EPOS: Efficiency and Performance in process industry Operations via onsite and cross-sectorial Symbiosis

- Validate IS in process industry
  - in & across sectors

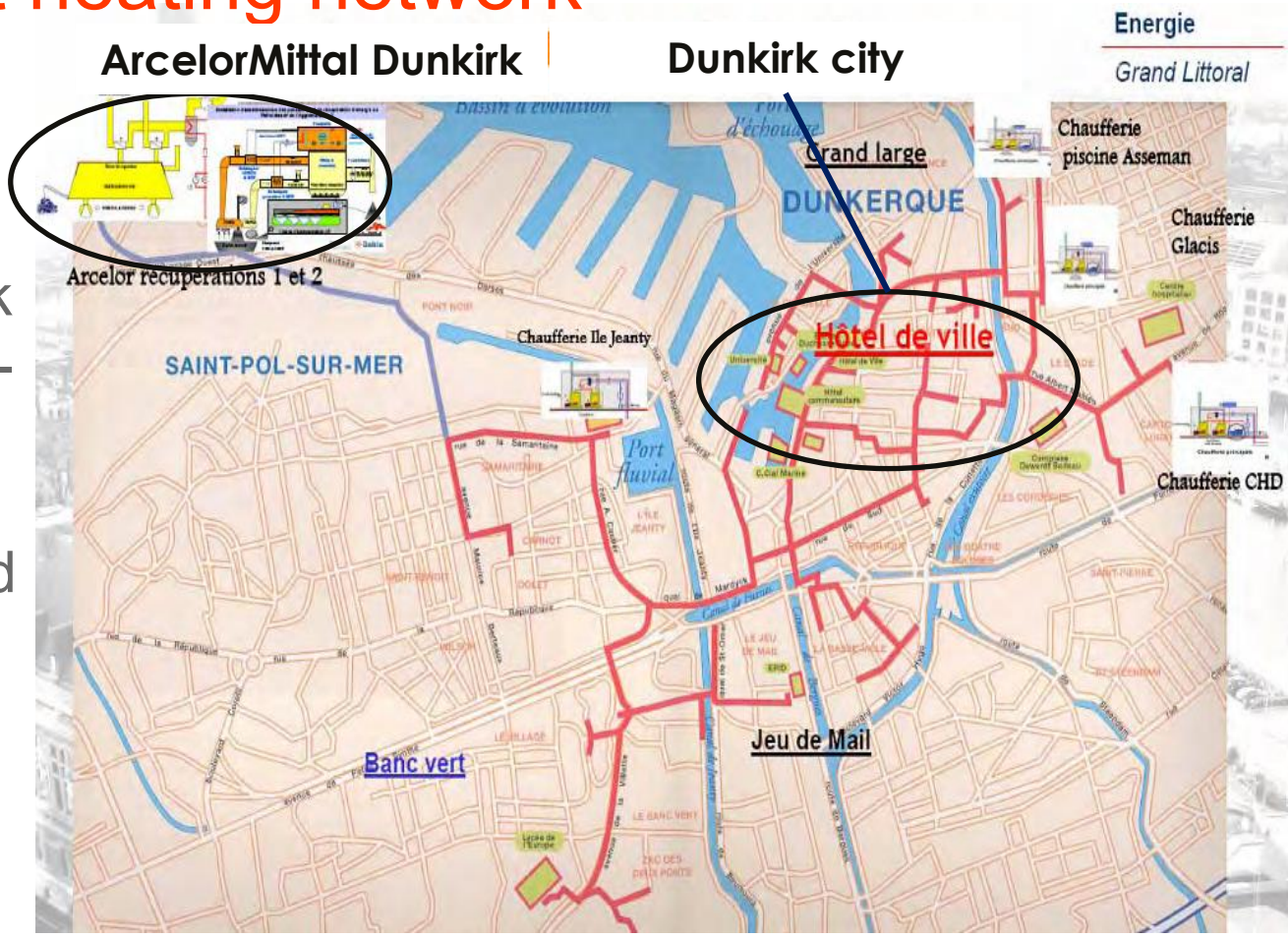
- EPOS: 5 global process industries
  from 5 key relevant sectors:

plus: 5 highly R&I minded SMEs
2 excellent science institutes

Steel partner: ArcelorMittal

Dunkirk district heating network

- Installed in 1985
- 2nd largest network in the Nord-Pas-de-Calais region
- 100 MW of installed power
- 40 km of pipelines
- 3 km between AM and district network

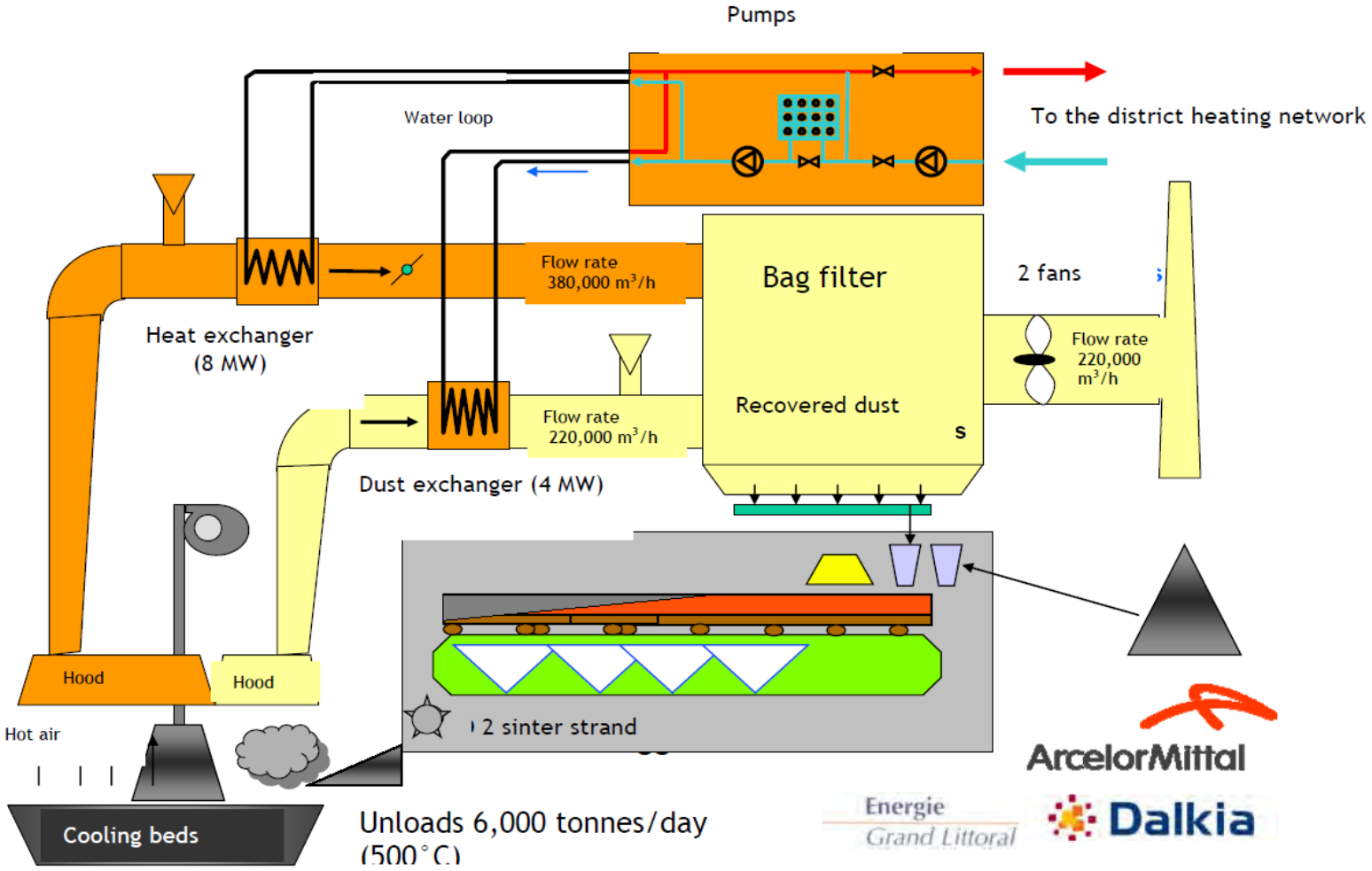


District heating network in Dunkirk

Dunkirk District heating – Creation Context

Stakeholder	Main Needs & Motivations
ArcelorMittal	• Improve relationship with neighbouring • Reduce dust emission
CUD (Dunkirk Urban Community)	• Political will to combat energy insecurity (short to long term) • Global strategy for GHG emission reduction and raise of renewable energies in the energy-mix. • Be independent from fossil fuels
Utility provider	• Create new local business
Consumers	• Get minimised and controlled energy prices

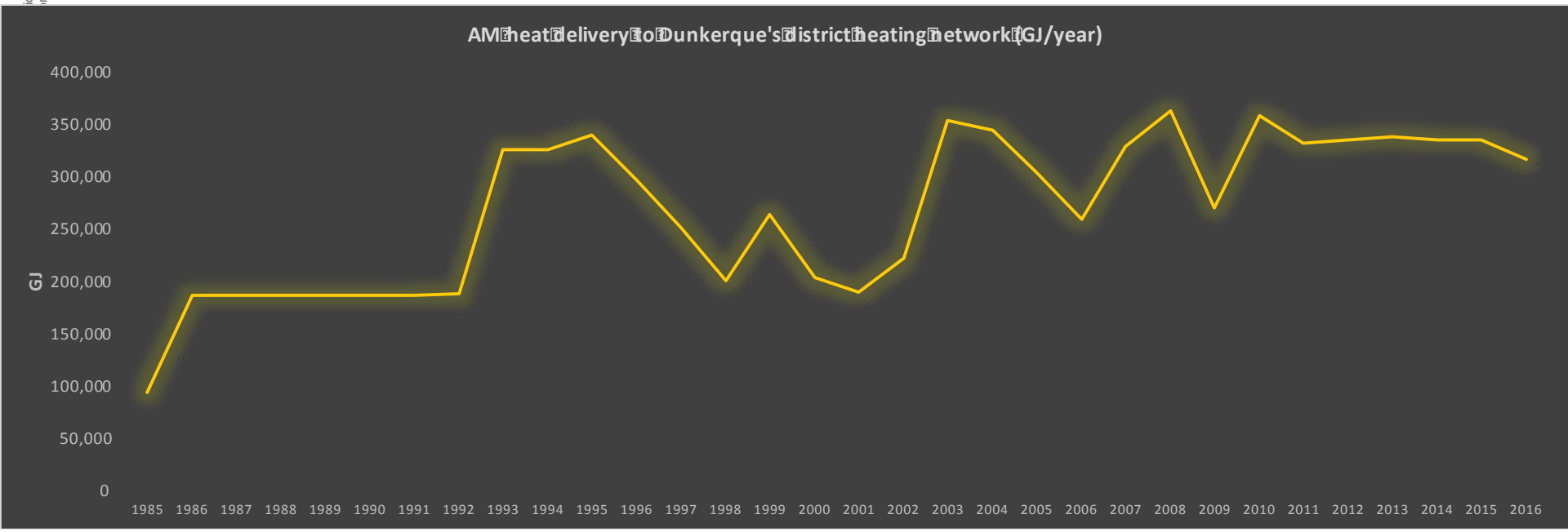
AM Dunkirk district heating connection



AM Dunkirk district heating connection

Environmental Assessment

- Assess the environmental savings associated to the AM - Dunkirk district heating network symbiosis
- First exploitation in 1985
- 270 TJ of heat delivered per year, in average



Source: Quantis

Main assumptions for Carbon footprint

- Approximately 400 tons of steel installed in 1985

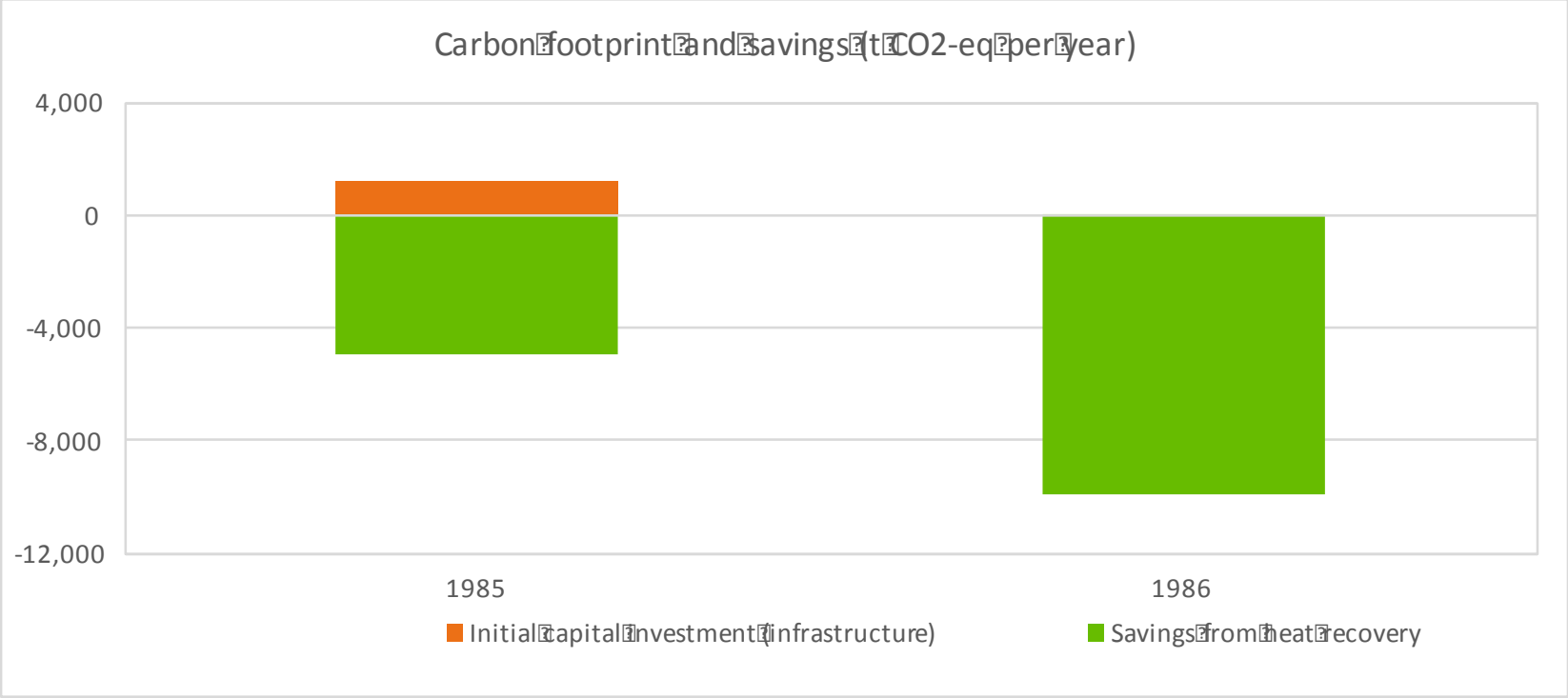
Source: Quantis & ArcelorMittal

- Substituting average heat mix for residential and services in Nord-Pas-de-Calais region:
  - 54% natural gas
  - 29% light fuel oil
  - 10% wood
  - 7% electricity

Source: http://www.stats.environnement.developpement-durable.gouv.fr/Eider/

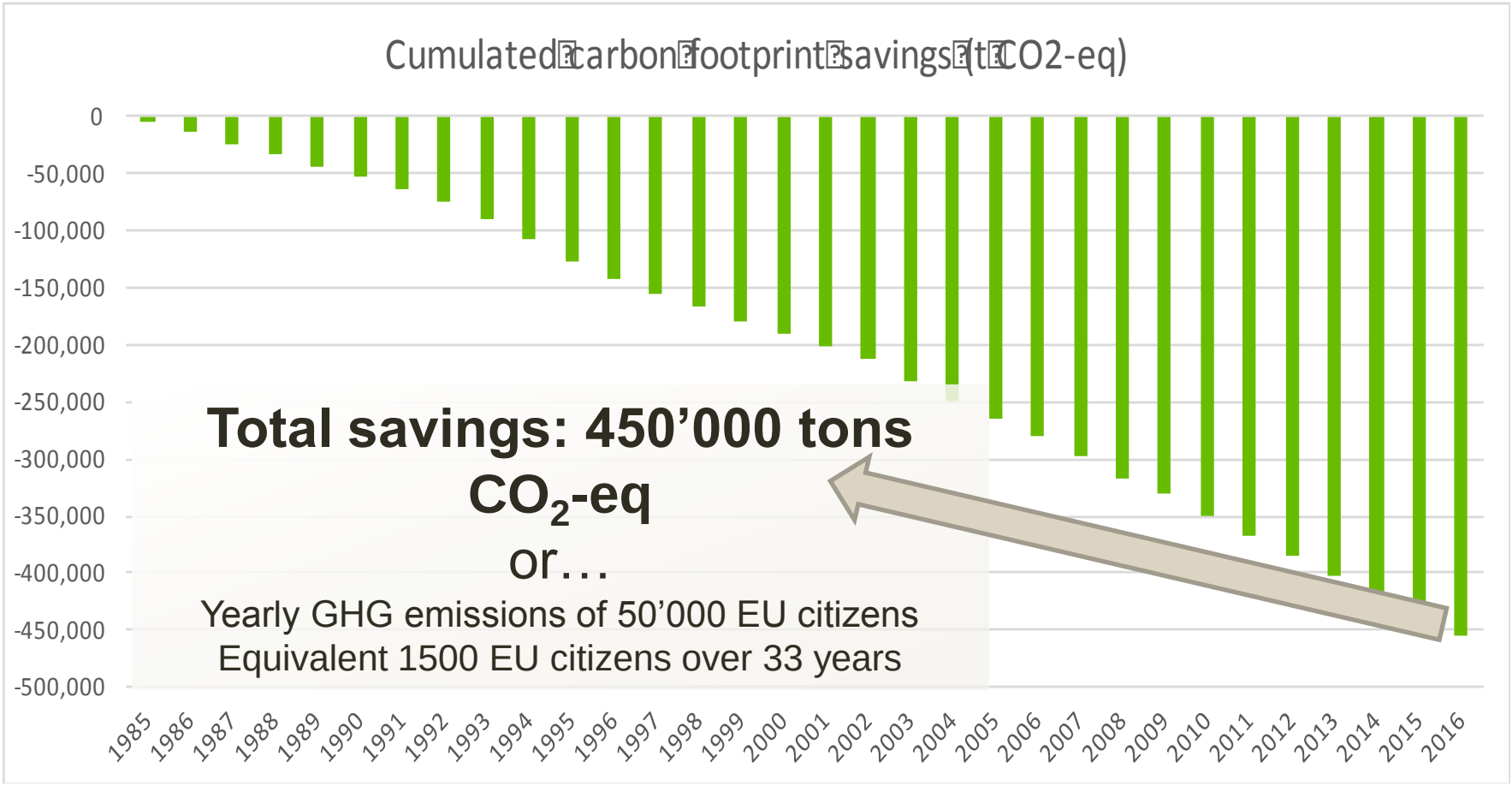
Carbon footprint

- What happened in years 1 and 2 ?
- Environmental ROI is less than 1 year



Source: Quantis

Carbon footprint from 1985 to 2016



Source: Quantis

Dunkirk District heating – Benefits

Typology	Benefits
Social	• 8 non-relocationable jobs • Energy security for an industrialised region in crisis • Brand image • New technical competencies
Economic	• Low cost heat source • New revenues • New local economic activities
Environmental	• Carbon footprint reduction • Dust emission reduction • Energy performance • Development of energy recovery

Source: Strane Innovation

Dunkirk District heating : successful business, interactive and economically sustainable in time

Success factors	
Available heat sources at high thermal density	Economic interest for industrial Stakeholders
Political will (public subventions)	Motivated involved stakeholders
Intense regional dialogue (through local associations)	Communication on success
No blocking points with environmental regulations	Tax advantages
Trust (long term)	Share financial risk

Source: Strane Innovation

Technological drivers for industrial symbiosis in Steel industry

- Technological enablers for Industrial Symbiosis:
  - Efficient hot water & steam networks
  - Heat exchangers and pipe-lines
  - On-line measurements and energy balance tools (systemic models)
  - Compact and energy storage systems
  - Predictive dynamic models to choose the best business plan on the long term with daily, weekly, monthly, yearly variations

- Technological drivers in the near future:
  - Heat recovery from hot solids ($coke_{1000°C}$, $slags_{1000°C}$, $slabs_{1000°C}$, $coils_{500°C}$)
  - Recovery of gas flares (with intermittent availability)
  - Chemical transformation of industrial gases (mixture of H_2, CH_4, CO, CO_2, N_2)

Thank you for your attention

EPOS

SYMBIOSIS IN INDUSTRY

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 679386
This work was supported by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 15.0217