

The European Commission's science and knowledge service

Joint Research Centre



The JRC-IDEES INDUSTRY

Brussels, 12 Oct 2017

JRC-IDEES

Integrated
Database of the
European
Energy
System

OUTLINE

Industrial Sectors

Decomposition process

Approach

Data sources

Dealing with structural differences

Output

Overview

Illustrative examples

INDUSTRIAL SECTORS

Energy Intensive

Iron and steel

- Integrated steelworks
- Electric arc

Non-ferrous metals

- Alumina production
- Aluminium primary production
- Aluminium secondary production
- Other non-ferrous metals

Chemicals

- Basic chemicals
- Other chemicals
- Pharmaceutical products etc.

Non-metallic minerals

- Cement
- Ceramics & other NMM
- Glass production

Paper and pulp

- Pulp production
- Paper production
- Printing and media reproduction

Non-energy Intensive

Food, Beverages and Tobacco

Transport equipment

Machinery equipment

Textiles and Leather

Wood and wood products

Other industrial sectors

Including:

Mining and quarrying

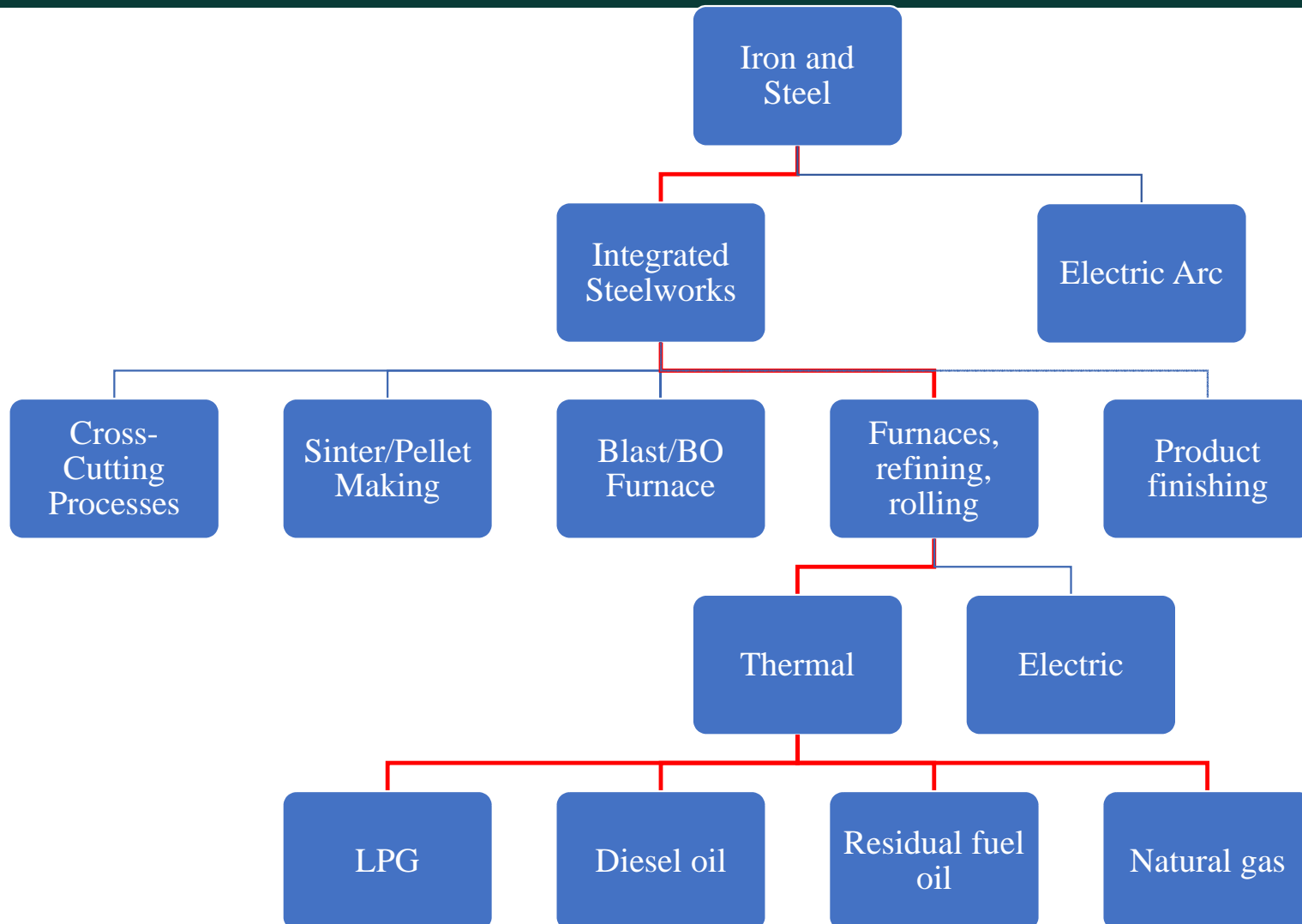
Construction

Non-specified industries

DECOMPOSITION – APPROACH

For each subsector energy requirements split between **different processes, energy end-uses, technology options** and **associated energy forms** consumed

Nested tree structure



DECOMPOSITION – APPROACH

For each subsector energy requirements split between **different processes, energy end-uses, technology options** and **associated energy forms** consumed

Full consistency between energy (EUROSTAT), production statistics (EUROSTAT, USGS, UN etc.) and sector specific technical studies

Decomposition tailor-made for every Member State to account for specific characteristics

Installed capacities identified, disentangled from their operation

DECOMPOSITION - PROCESSES

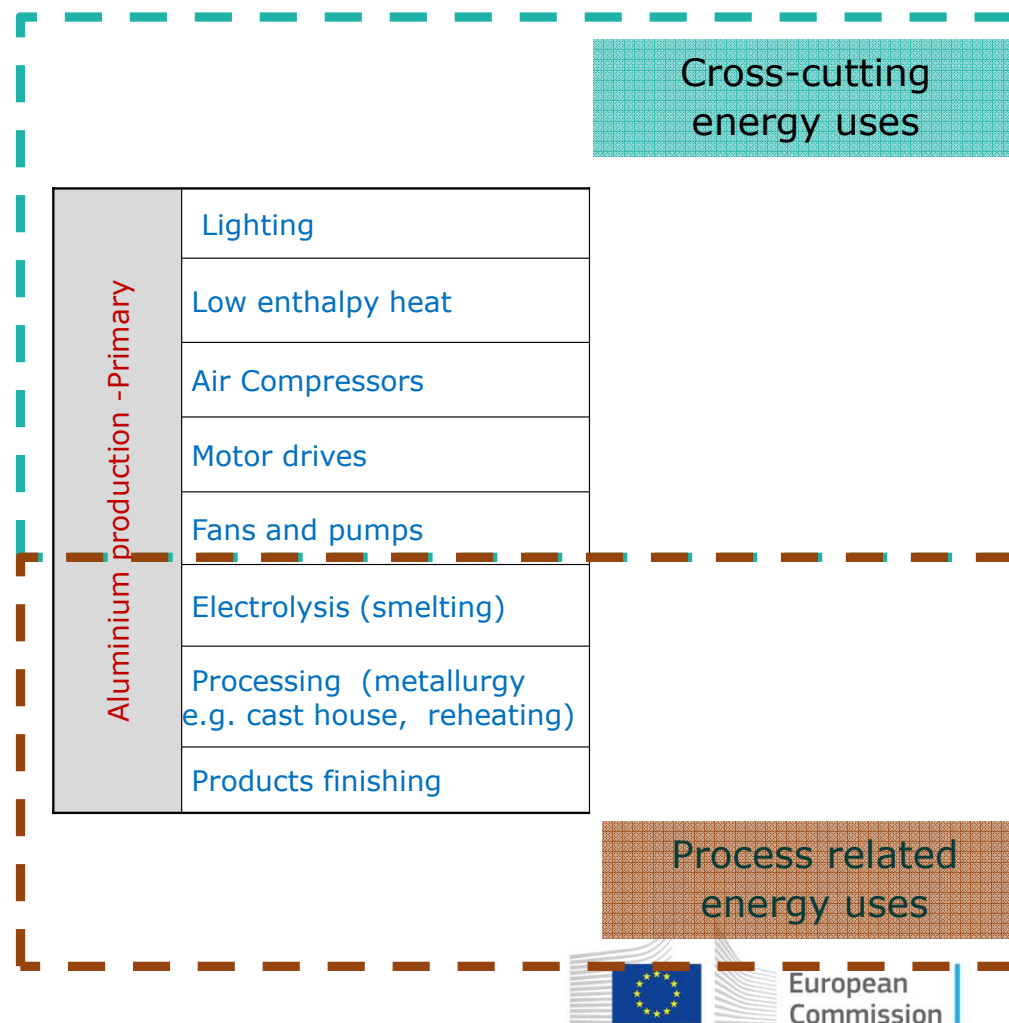
Distinction between three different types of energy uses:

Non-process related energy uses

- Use of cross-cutting technologies (including lighting, low enthalpy heat uses, air-compressors and motor drives)
- Common across all industrial sectors

Process related energy uses:
differentiated on the basis of the subsector specific characteristics

Process related non-energy uses:
Feedstock uses



DATA SOURCES

- EUROSTAT
- UN databases (UNFCC National GHG Inventory Submissions)
- U.S. Geological Survey (USGS) Minerals Information Commodity Statistics and Information; European Minerals Statistics of the British Geological Survey
- Industry associations statistics
- Specific studies and reports, including
 - BREFs
 - IEA sectoral studies
 - US DOE energy footprints
 - JRC studies
 - ...

DECOMPOSITION - EXAMPLE

Energy consumption (ktoe) - Non Ferrous Metals	
<i>by fuel (EUROSTAT DATA)</i>	9.652,5
Solids	333,2
Liquids	301,0
Refinery gas	-
LPG	85,0
Diesel oil	60,7
Residual fuel oil	126,1
Other liquids	29,3
Naphtha	-
Gas	3.229,5
Natural gas	3.197,0
Derived gases	32,6
RES and wastes	12,1
Biomass and wastes	11,9
Solar	0,2
Steam distributed	146,0
Electricity	5.630,6
<i>by subsector (calibration output)</i>	9.652,5
Alumina production	1.923,7
Aluminium production	3.105,5
Aluminium - primary production	2.612,5
Aluminium - secondary production	493,1
Other non-ferrous metals	4.623,2

DECOMPOSITION EXAMPLE

Aluminium - primary production	2.612,5
Lighting	16,5
Air compressors	15,0
Motor drives	53,0
Fans and pumps	14,6
Low enthalpy heat	1,9

Cross cutting energy uses

Aluminium electrolysis (smelting)	2.004,8
Aluminium processing (metallurgy e.g. cast house, reheating)	297,0
Aluminium finishing	209,7

Process related energy uses

DECOMPOSITION EXAMPLE

Aluminium - primary production	2.612,5
Lighting	16,5
Air compressors	15,0
Motor drives	53,0
Fans and pumps	14,6
Low enthalpy heat	1,9
Solids	0,0
LPG	0,0
Diesel oil	0,3
Other liquids	0,0
Natural gas	0,6
Biomass	0,0
Solar	0,0
Electricity	1,0

Aluminium electrolysis (smelting)	2.004,8
Aluminium processing (metallurgy e.g. cast house, reheating)	297,0
Aluminium processing - Thermal	108,8
LPG	6,9
Diesel oil	0,6
Residual fuel oil	0,0
Natural gas	101,3
Aluminium processing - Electric	188,2
Aluminium finishing	209,7
Aluminium finishing - Thermal	87,0
LPG	2,3
Diesel oil	2,1
Natural gas	82,6
Aluminium finishing - Steam	101,6
Solids	29,1
Refinery gas	0,0
LPG	0,0
Diesel oil	1,3
Residual fuel oil	6,2
Other liquids	3,0
Natural gas	57,3
Derived gases	0,0
Biomass	0,7
Steam distributed	4,0
Aluminium finishing - Electric	21,0

DEALING WITH STRUCTURAL DIFFERENCES

Huge variation in value added and energy intensities across Member States

- ... cannot solely be explained through discrepancies in the energy equipment
- ... relate to differences in the structure of the industry, as concerns the production processes and the output produced

Challenge: Quantify the structural differences so as to render the industries comparable from an energy viewpoint

Comparable product

Comparable qualities

INDUSTRIAL OUTPUT – COMPARABLE QUANTITIES

Physical tonnes of output:

- Sectors with a clearly defined product

Iron and steel	t steel
Alumina	t alumina
Aluminium	t aluminium
Cement	t cement
Pulp	t pulp
Paper	t paper

'Equivalent tonnes' of output:

- Relates the production to a clearly defined product
- By means of value added and energy intensity
- Accounting for additional information (if available)

Other non-ferrous metals	t lead eq.
Chemicals	t ethylene eq.
Ceramics & other NMM	t bricks eq.
Glass production	t container glass eq.
Printing and media reproduction	t paper eq.

'Physical output index':

- For non-energy intensive sector
- Proxy – at EU level matches VA

WHAT FOR?

Quantification of *energy service requirements per unit of output*

- Comparable across countries and over time

Explicit identification of *energy installations*

- Installed capacities of energy using equipment
- Decommissioning and new investments
- Explicit techno-economic characteristics, dynamically evolving

Installed capacity (kt production)

Alumina production (kt)	9.781,1
Aluminium production (kt)	7.197,3
Aluminium - primary production	3.217,0
Aluminum - secondary production	3.980,4
Other non-ferrous metals (kt lead eq.)	18.149,5

Capacity investment (kt production)

Alumina production (kt)	485,2
Aluminium production (kt)	290,5
Aluminium - primary production	111,1
Aluminum - secondary production	179,4
Other non-ferrous metals (kt lead eq.)	923,5

Decommissioned capacity (kt production)

Alumina production (kt)	68,9
Aluminium production (kt)	42,7
Aluminium - primary production	21,1
Aluminum - secondary production	21,6
Other non-ferrous metals (kt lead eq.)	642,5

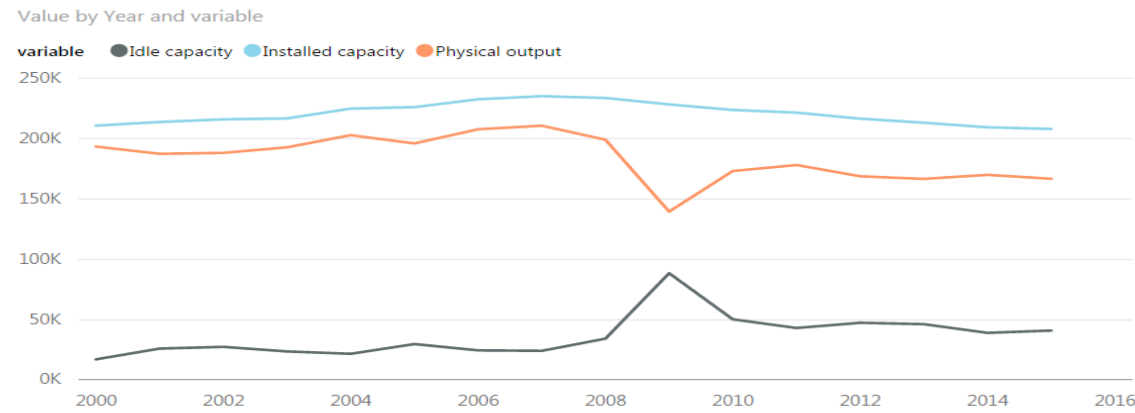
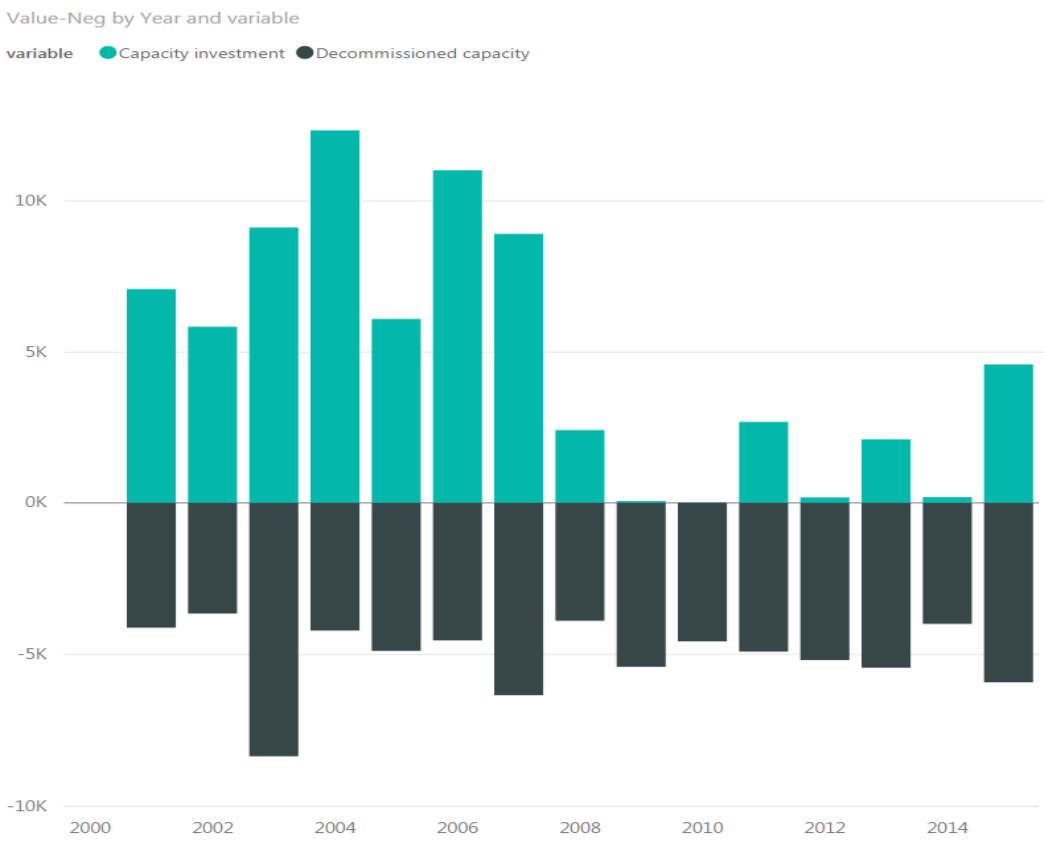
Idle capacity (kt production)

Alumina production (kt)	2.170,6
Aluminium production (kt)	2.148,1
Aluminium - primary production	1.131,9
Aluminum - secondary production	1.016,2
Other non-ferrous metals (kt lead eq.)	3.128,3

ENERGY INSTALLATIONS – AN EXAMPLE

sector: Iron and steel
subsector: All

Value by subsector: Integrated steelworks, Electric arc



Value by Year and variable

INDUSTRIAL OUTPUT – PRODUCT QUALITIES

Identification of **useful energy demand per output**
through installed equipment

In theory this should be equal across countries

Variations in useful energy demand relate to

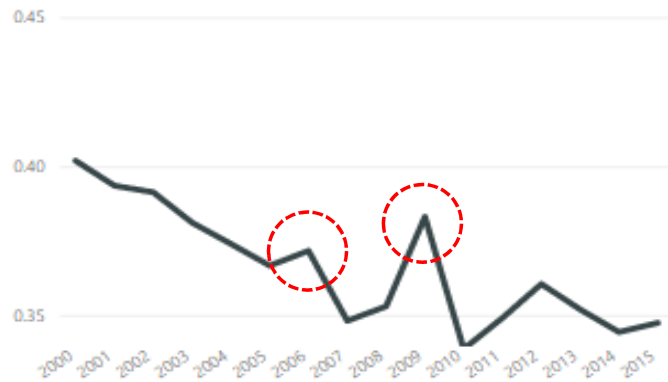
- product properties ('quality') and mix
- Efficiency of operation of equipment

Define '**common reference output**'

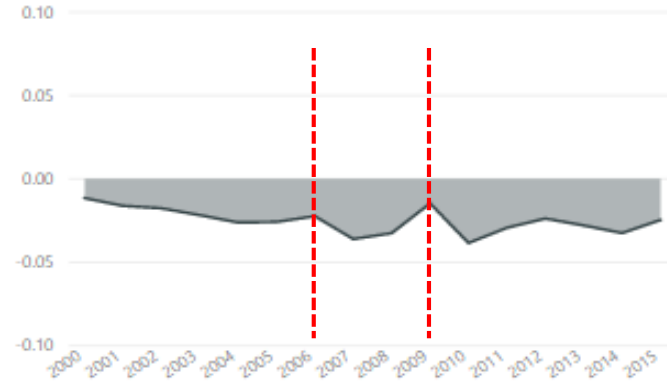
- clearly defined useful energy intensity
- to eliminate the impact of different product qualities
- to quantify inefficiencies in operation

INDUSTRIAL OUTPUT – PRODUCT QUALITIES

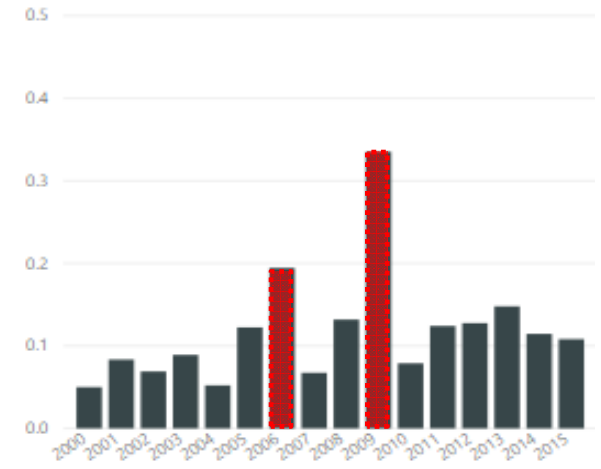
Final energy per t of steel - country example



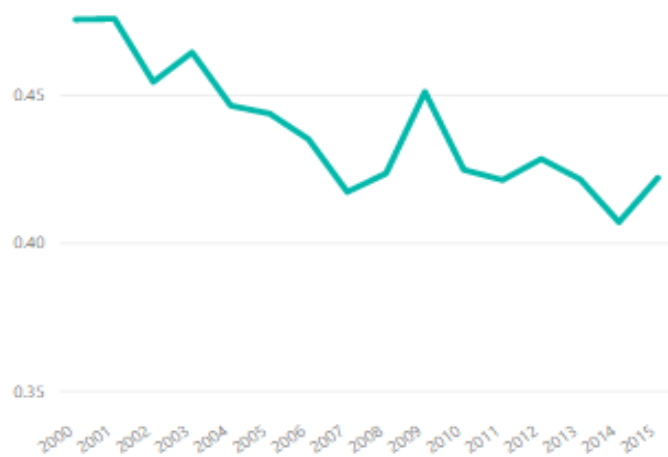
Useful energy per tonne of steel - difference to EU-2015 - ...



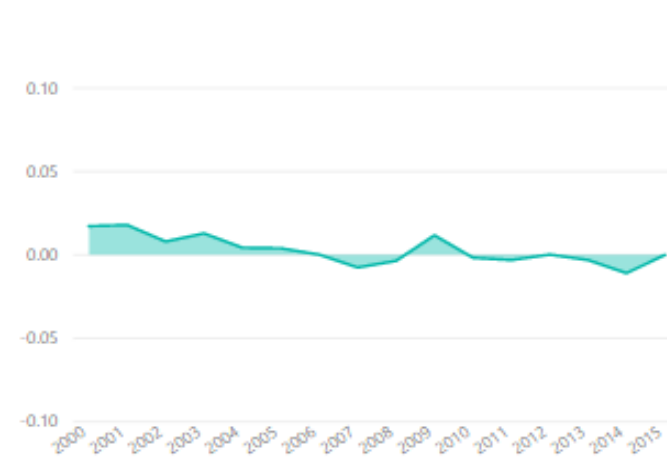
Ratio of idle capacity over total



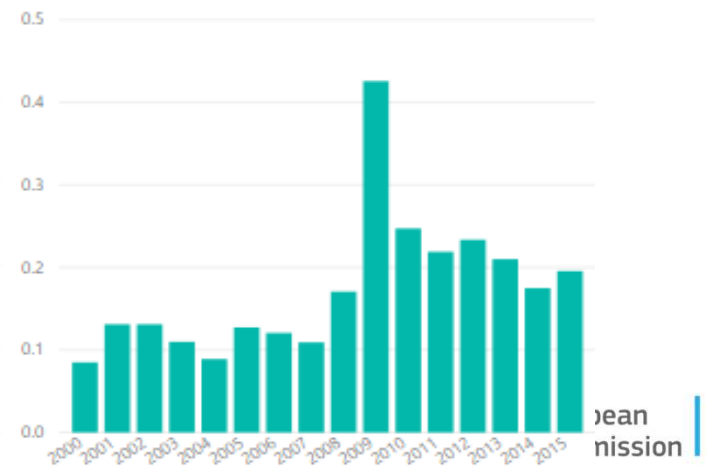
Final energy per t of steel - EU28



Useful energy per tonne of steel - difference to 2015 - EU28



Ratio of idle capacity over total



year
mission

WHAT CAN BE FOUND IN JRC-IDEES

- Activity data
- Macro-economic data
- Physical output or representative production indicator
- Final energy consumption
 - Eurostat structure
 - Split into subsectors, processes, fuels
- Useful energy
 - Same subsector, process, fuel structure
- CO₂ emissions
 - Energy use related
 - Process emissions
- Capacities
 - Installed capacity
 - Capacity in use, idle capacity
 - Capacity investments
 - Characteristics
- Indicators
 - Intensities
 - Efficiencies

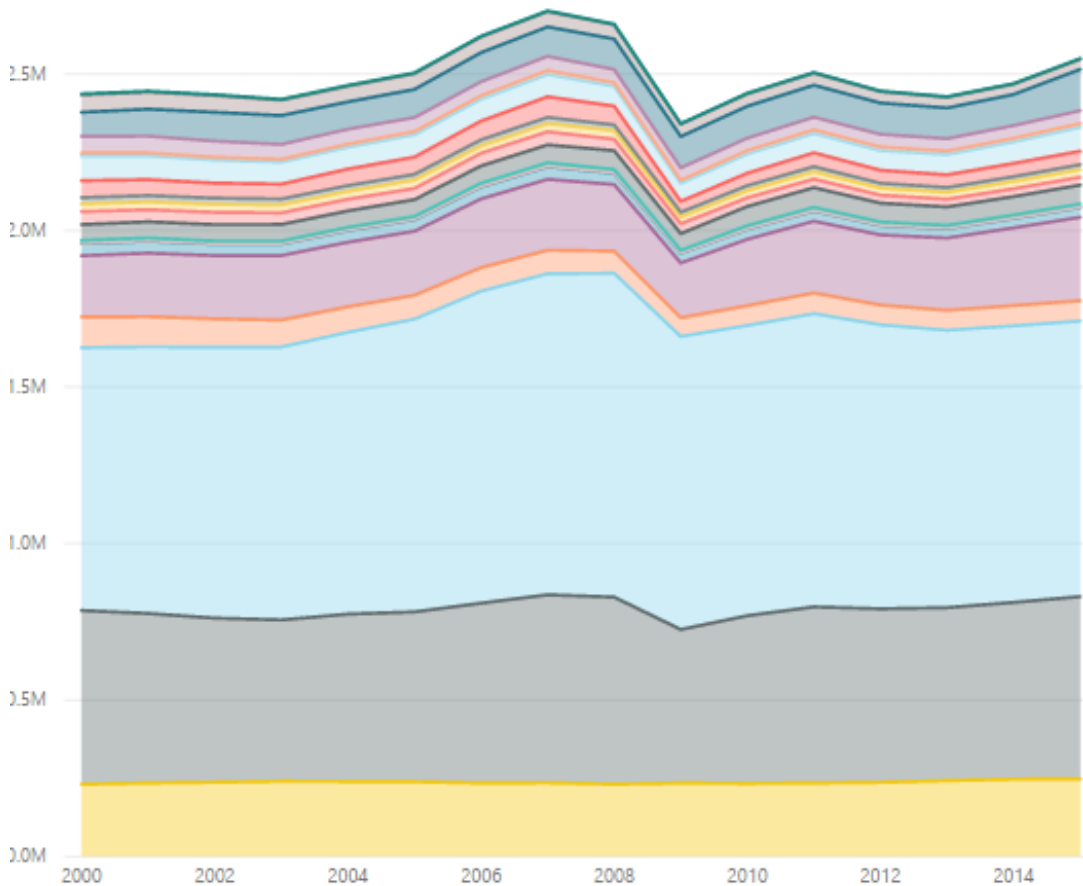
INDUSTRIAL SECTORS DECOMPOSITION FILE

Sheet	Description	Sheet	
Ind_Summary	Industrial sectors summary	PPA	WWP
○ Ind_Summary_fec	○ split of final energy consumption	○ PPA_fec	○ WWP_fec
○ Ind_Summary_uec	○ split of useful energy demand	○ PPA_uec	○ WWP_uec
ISI Iron and Steel	Iron and Steel	○ PPA_emi	○ WWP_emi
○ ISI_fec	○ Detailed split of final energy consumption	FBT	OIS
○ ISI_uec	○ Detailed split of useful energy consumption	○ FBT_fec	○ OIS_fec
○ ISI_emi	○ Detailed split of CO ₂ emissions	○ FBT_uec	○ OIS_uec
NFM	Non Ferrous Metals	○ FBT_emi	○ OIS_emi
○ NFM_fec	○ Detailed split of final energy consumption	TRE	
○ NFM_uec	○ Detailed split of useful energy consumption	○ TRE_fec	
○ NFM_emi	○ Detailed split of CO ₂ emissions	○ TRE_uec	
CHI	Chemicals Industry	○ TRE_emi	
○ CHI_fec	○ Detailed split of final energy consumption	MAE	
○ CHI_uec	○ Detailed split of useful energy consumption	○ MAE_fec	
○ CHI_emi	○ Detailed split of CO ₂ emissions	○ MAE_uec	
NMM	Non-metallic mineral products	○ MAE_emi	
○ NMM_fec	○ Detailed split of final energy consumption	TEL	
○ NMM_uec	○ Detailed split of useful energy consumption	○ TEL_fec	
○ NMM_emi	○ Detailed split of CO ₂ emissions	○ TEL_uec	
		○ TEL_emi	

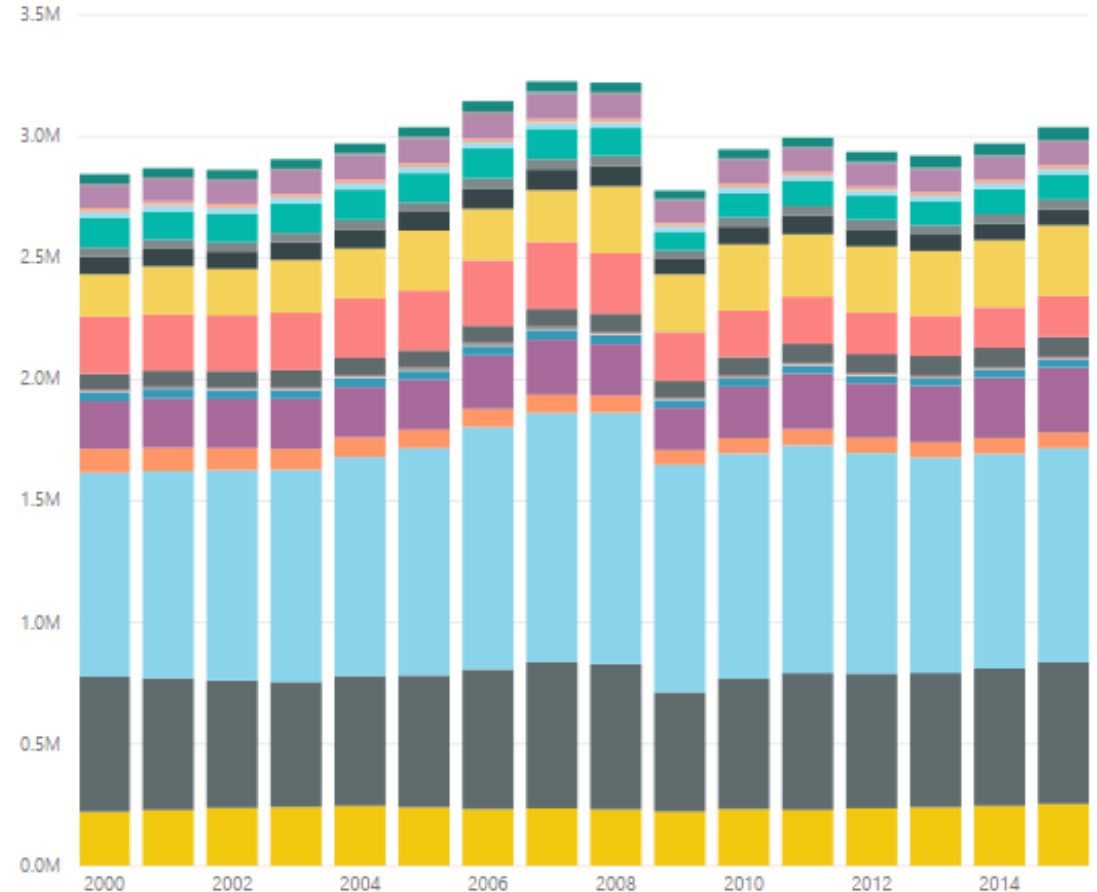
PROVIDING AN OVERVIEW

- Food, beve... ● Machinery ... ● Other Indu... ● Textiles an... ● Transport E... ● Wood and ... ● Alumina pr... ● Aluminium ... ● Basic chemi... ● Cement ● Ceramics &... ● Glass prod... ● Iron and st... ● Other chem... ● Other non-...
- Paper production ● Pharmaceutical products etc. ● Printing and media reproduction ● Pulp production

Value by Year and subsector



Value by Year and subsector



PROVIDING AN OVERVIEW

sector

Iron and steel

subsector

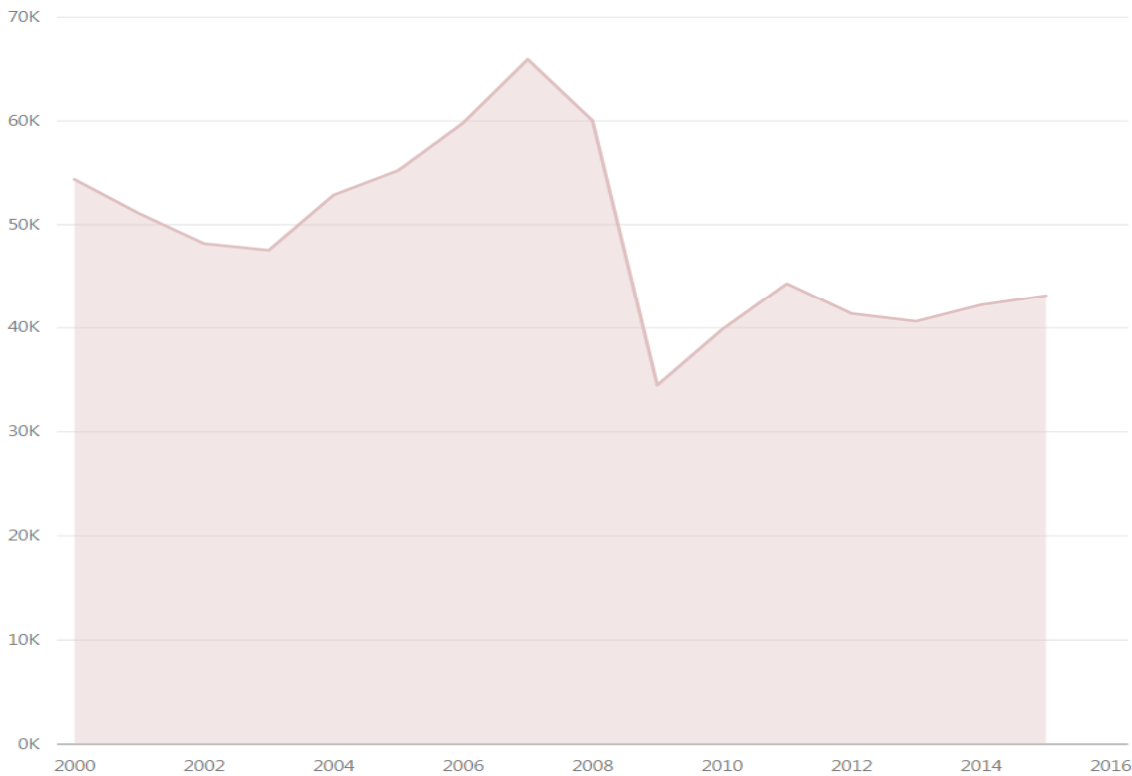
All

Value by sector

Iron and steel

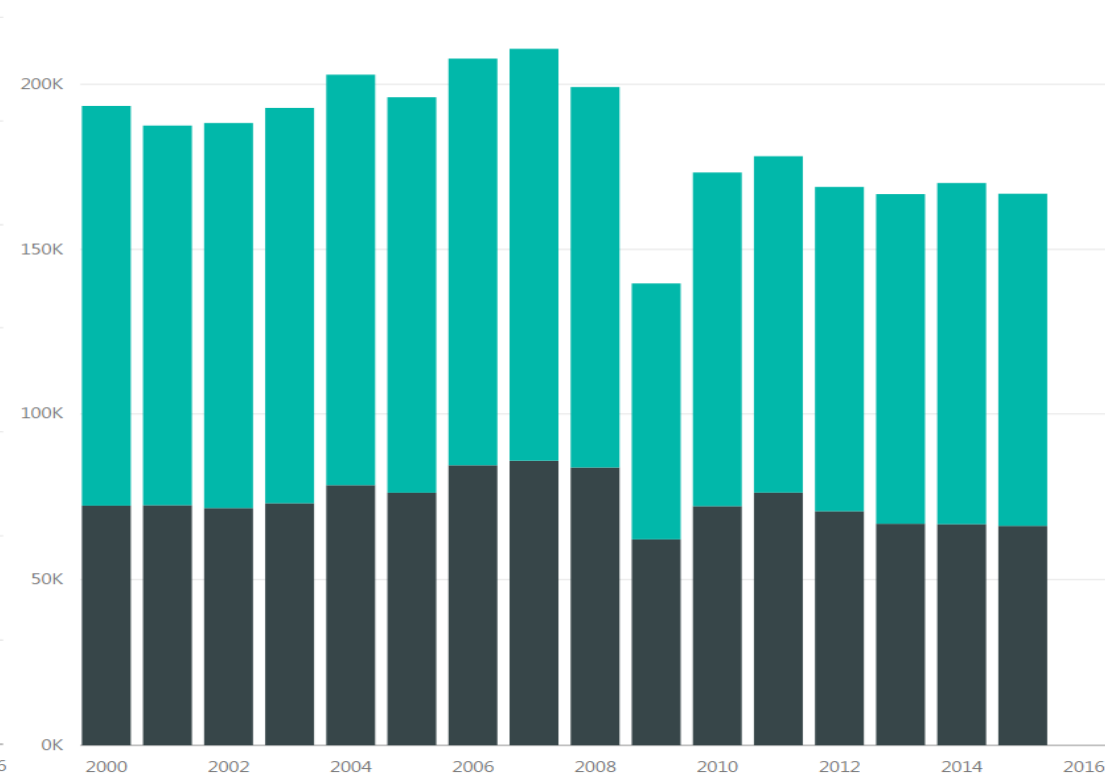
Value by Year and subsector

subsector ● Iron and steel



Value by Year and subsector

subsector ● Electric arc ● Integrated steelworks



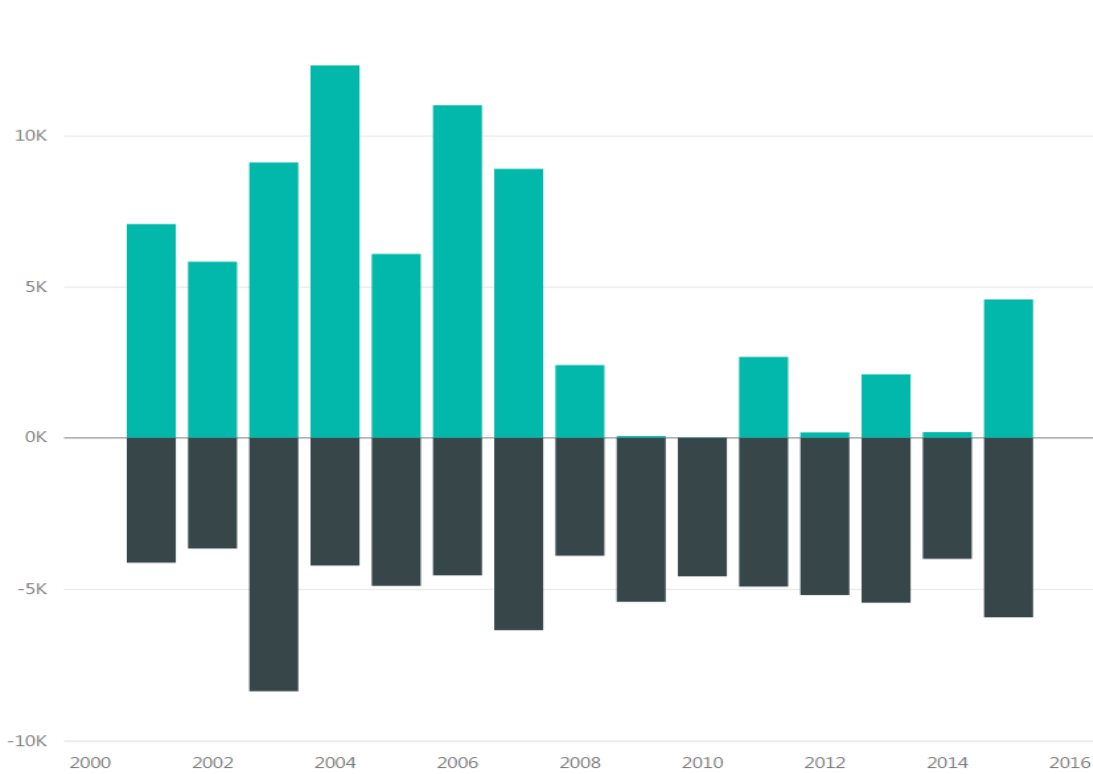
PROVIDING AN OVERVIEW

sector:
 subsector:

Value by subsector: Integrated steelworks Electric arc

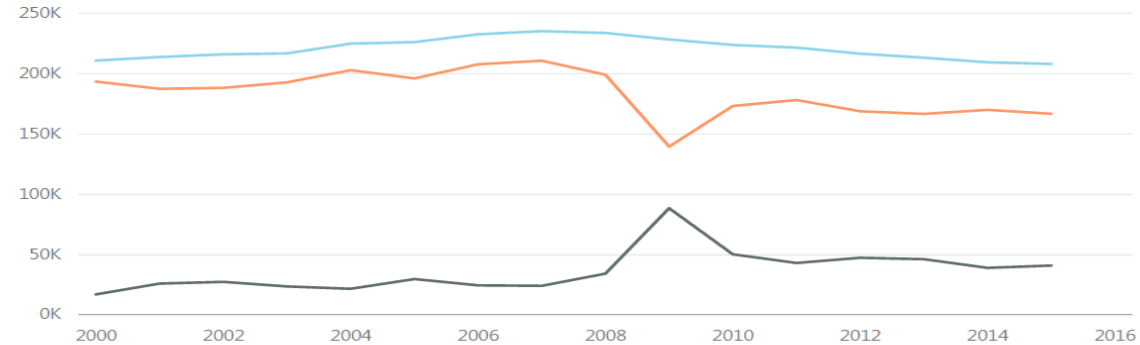
Value-Neg by Year and variable

variable: ● Capacity investment ● Decommissioned capacity



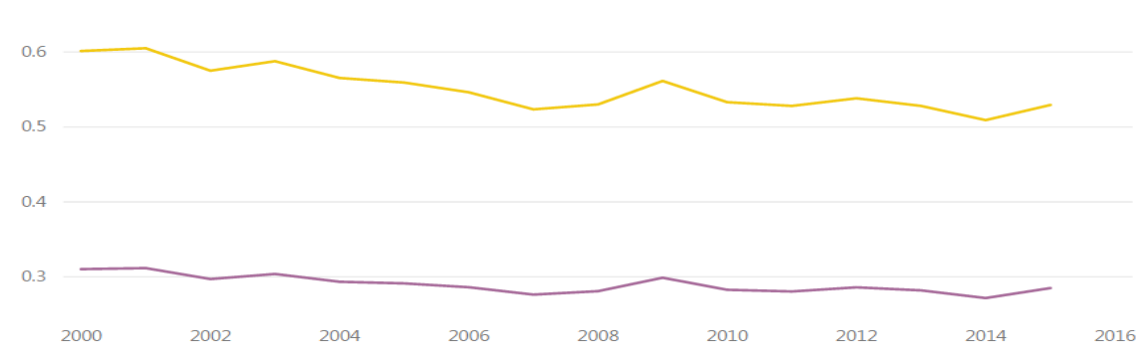
Value by Year and variable

variable: ● Idle capacity ● Installed capacity ● Physical output



Value by Year and variable

variable: ● Energy intensity ● Useful energy demand intensity



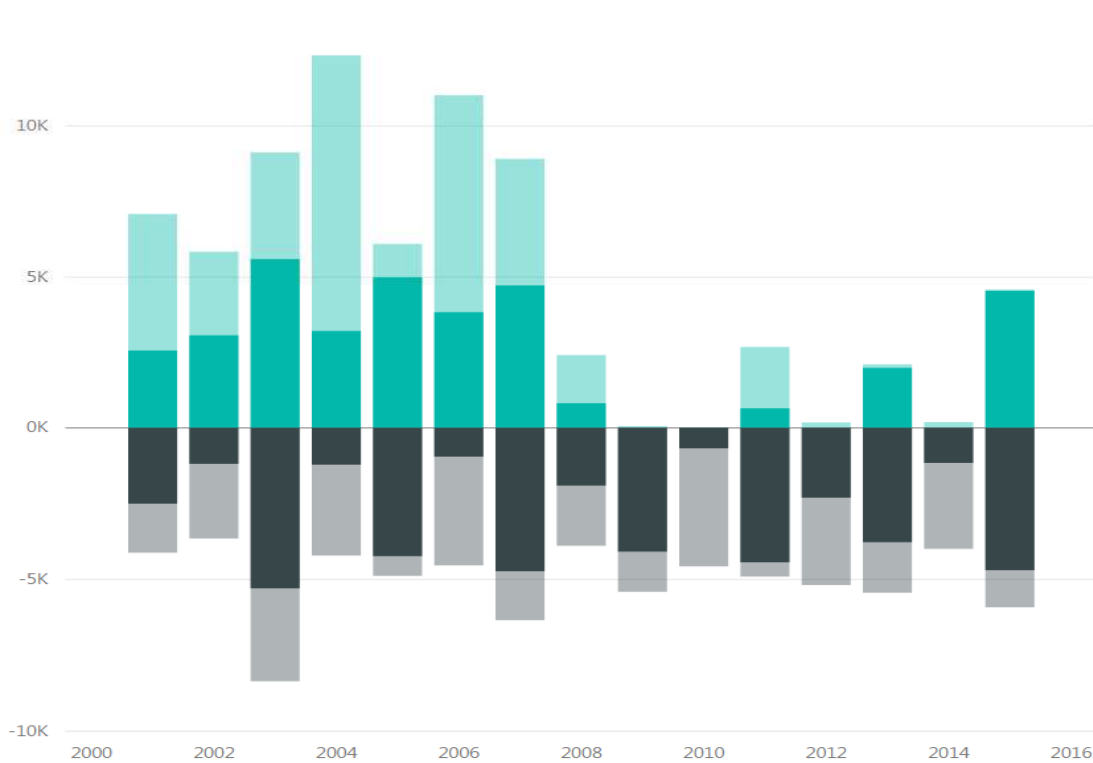
PROVIDING AN OVERVIEW

sector: Iron and steel
subsector: All

Value by subsector
Integrated steelworks
Electric arc

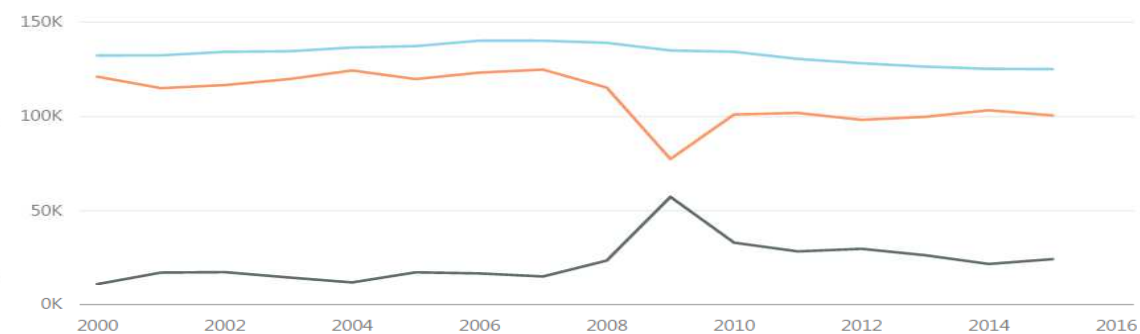
Value-Neg by Year and variable

variable: Capacity investment, Decommissioned capacity



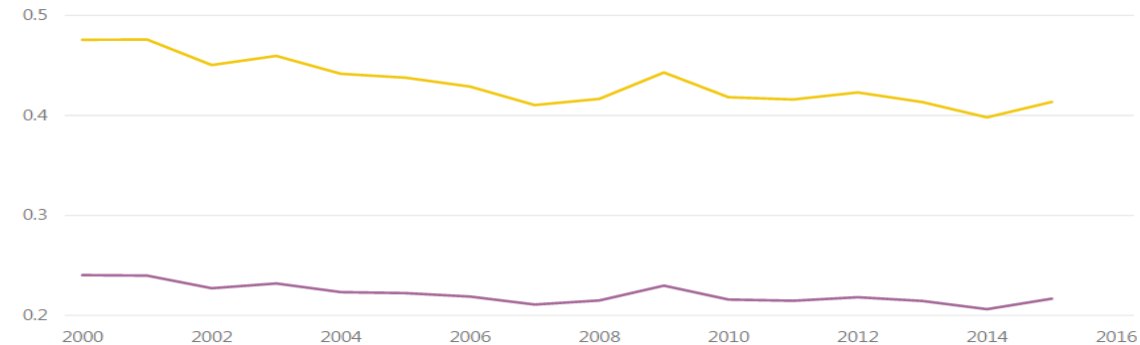
Value by Year and variable

variable: Idle capacity, Installed capacity, Physical output



Value by Year and variable

variable: Energy intensity, Useful energy demand intensity



PROVIDING AN OVERVIEW

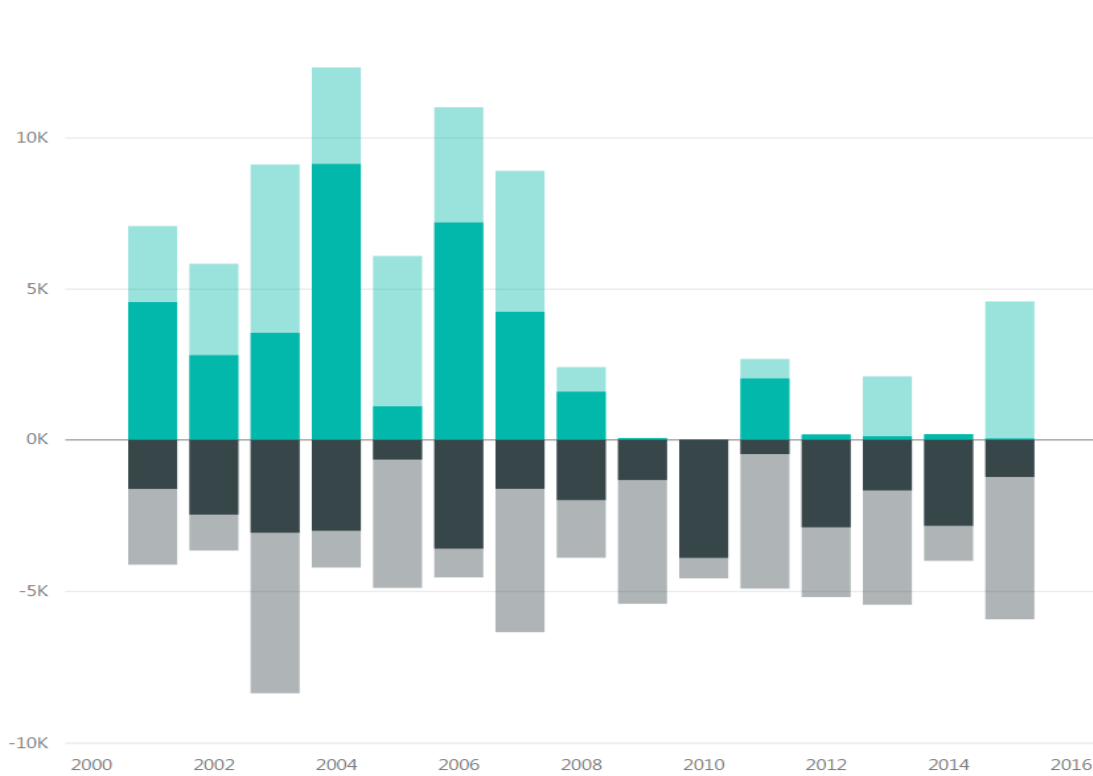
sector
Iron and steel

subsector
All

Value by subsector
Integrated steelworks Electric arc

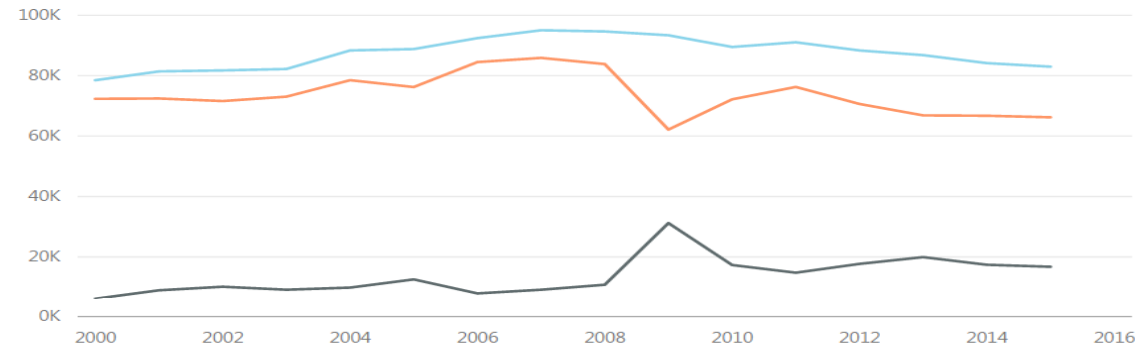
Value-Neg by Year and variable

variable ● Capacity investment ● Decommissioned capacity



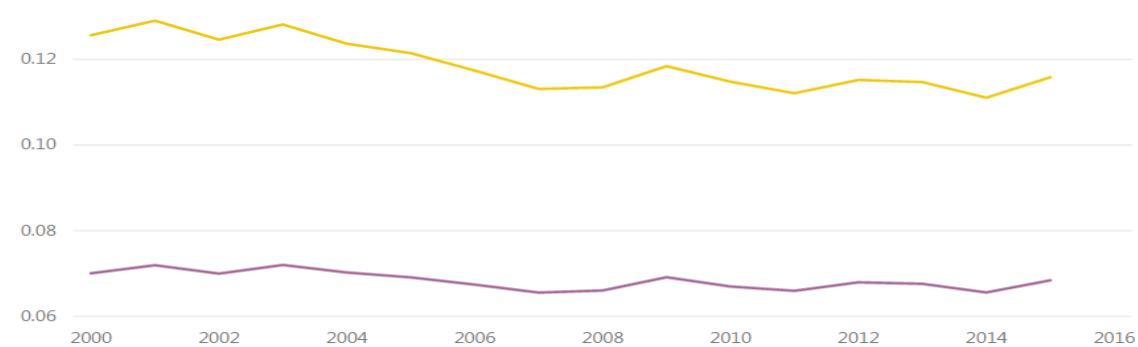
Value by Year and variable

variable ● Idle capacity ● Installed capacity ● Physical output



Value by Year and variable

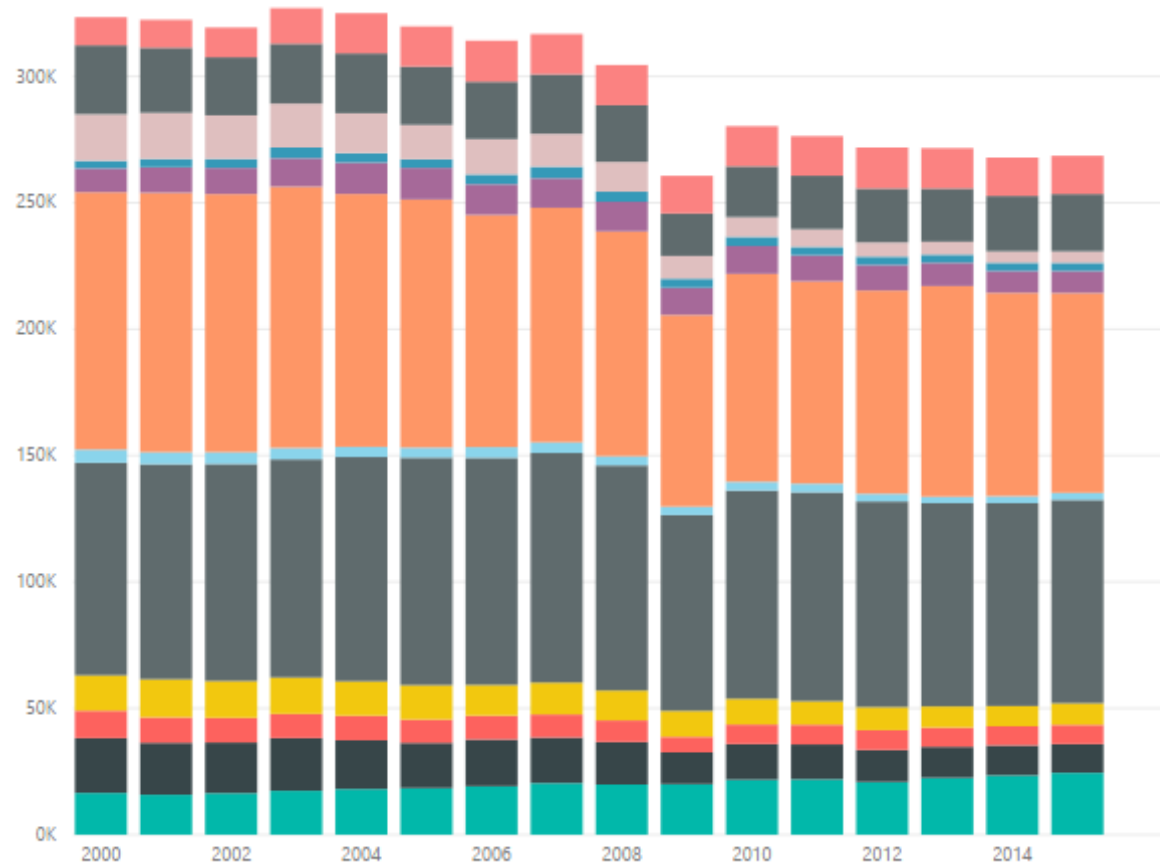
variable ● Energy intensity ● Useful energy demand intensity



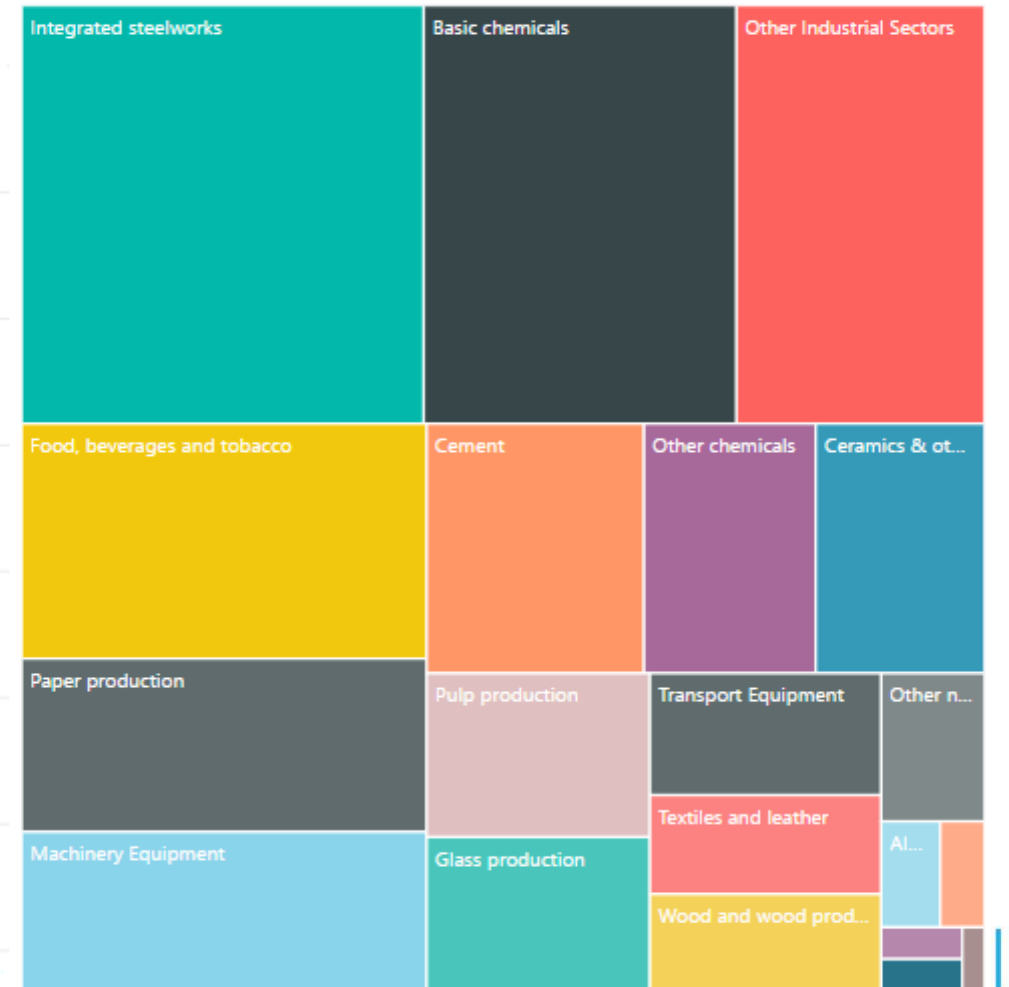
PROVIDING AN OVERVIEW

Value by Year and Fuel

Fuel ● Biomass ● Coke ● Derived gases ● Diesel oil ● Electricity ● LPG ● Natural gas ● Other liquids ● Refinery gas
● Residual fuel oil ● Solar ● Solids ● Steam distributed



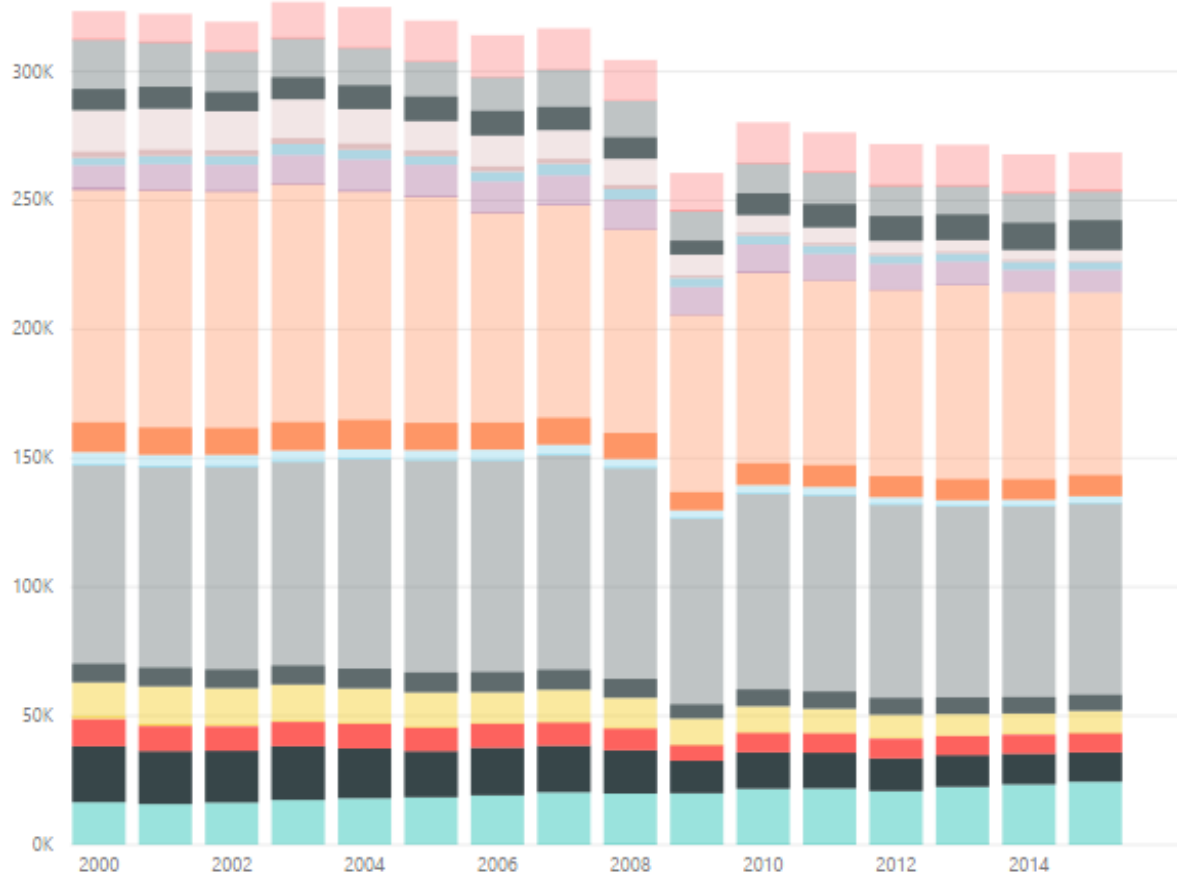
Value by Subsector



PROVIDING AN OVERVIEW

Value by Year and Fuel

Fuel ● Biomass ● Coke ● Derived gases ● Diesel oil ● Electricity ● LPG ● Natural gas ● Other liquids ● Refinery gas
● Residual fuel oil ● Solar ● Solids ● Steam distributed



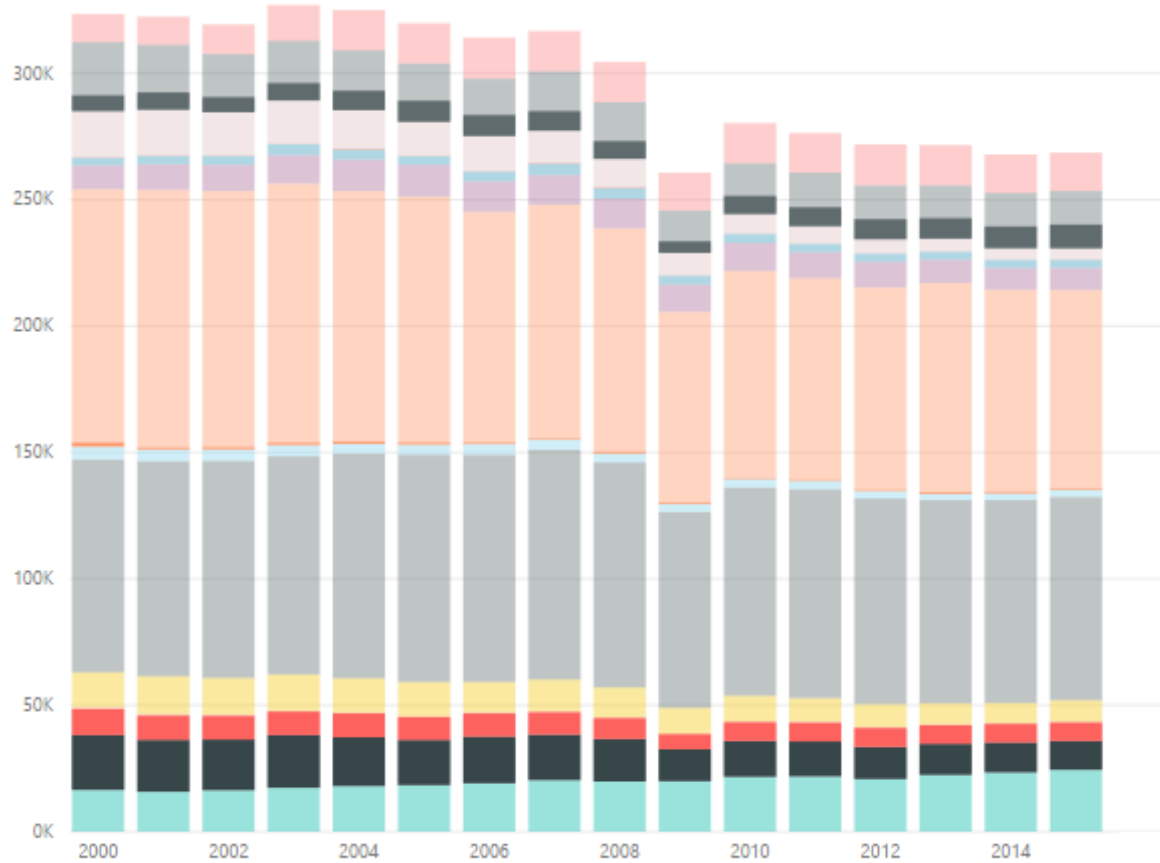
Value by Subsector and Process



PROVIDING AN OVERVIEW

Value by Year and Fuel

Fuel ● Biomass ● Coke ● Derived gases ● Diesel oil ● Electricity ● LPG ● Natural gas ● Other liquids ● Refinery gas
● Residual fuel oil ● Solar ● Solids ● Steam distributed



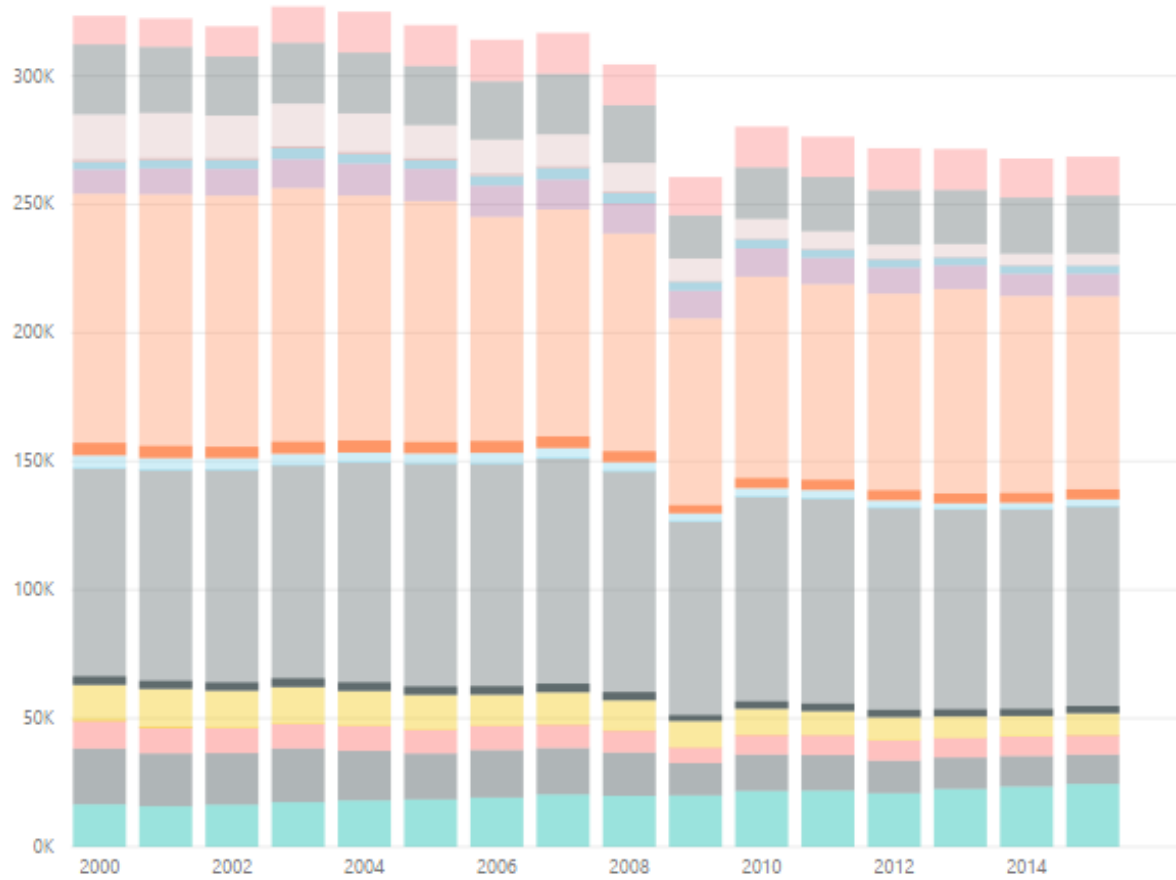
Value by Subsector and Process



PROVIDING AN OVERVIEW

Value by Year and Fuel

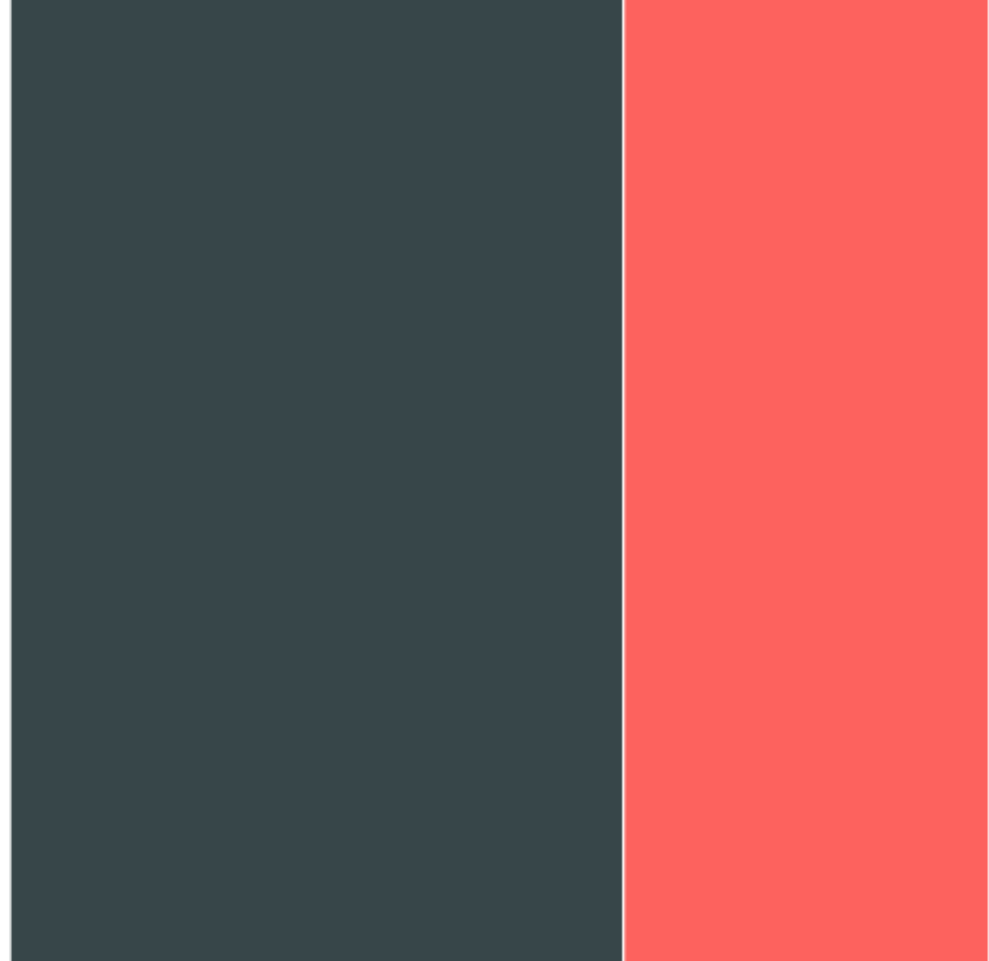
Fuel ● Biomass ● Coke ● Derived gases ● Diesel oil ● Electricity ● LPG ● Natural gas ● Other liquids ● Refinery gas ● Residual fuel oil ● Solar ● Solids ● Steam distributed



Value by Subsector, Process and End-use

Steel: Furnaces, Refining and Rolling - Thermal

Steel: Furnaces, Refining and Rolling ...



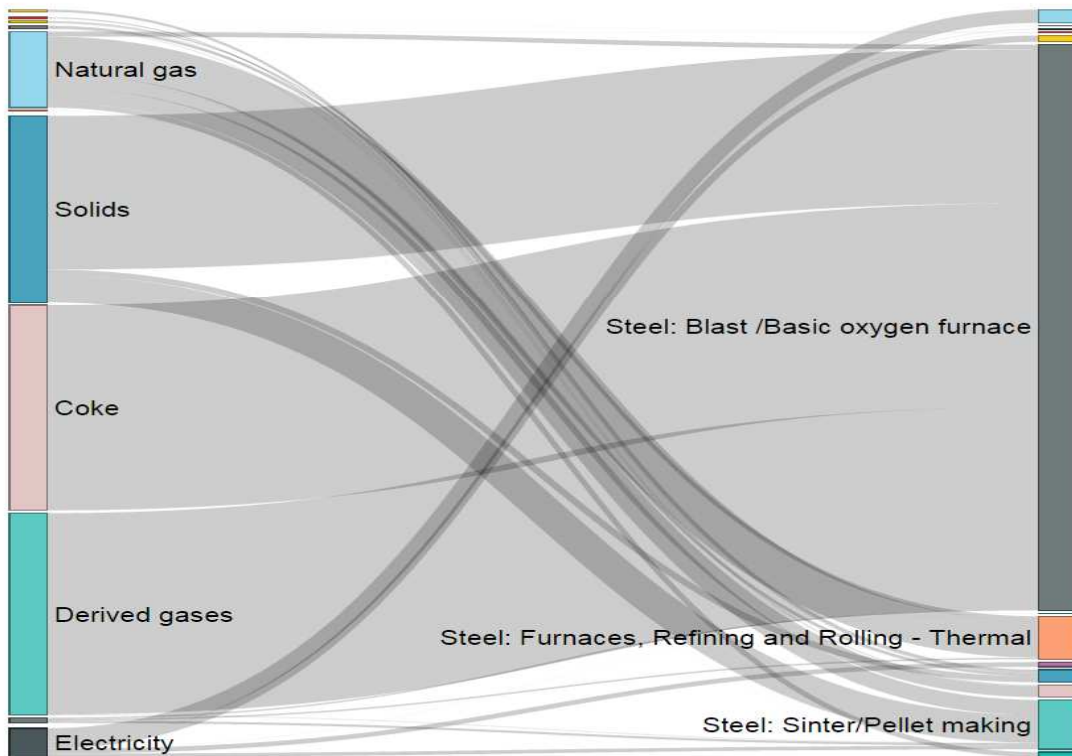
PROVIDING AN OVERVIEW

Year
2015 2015

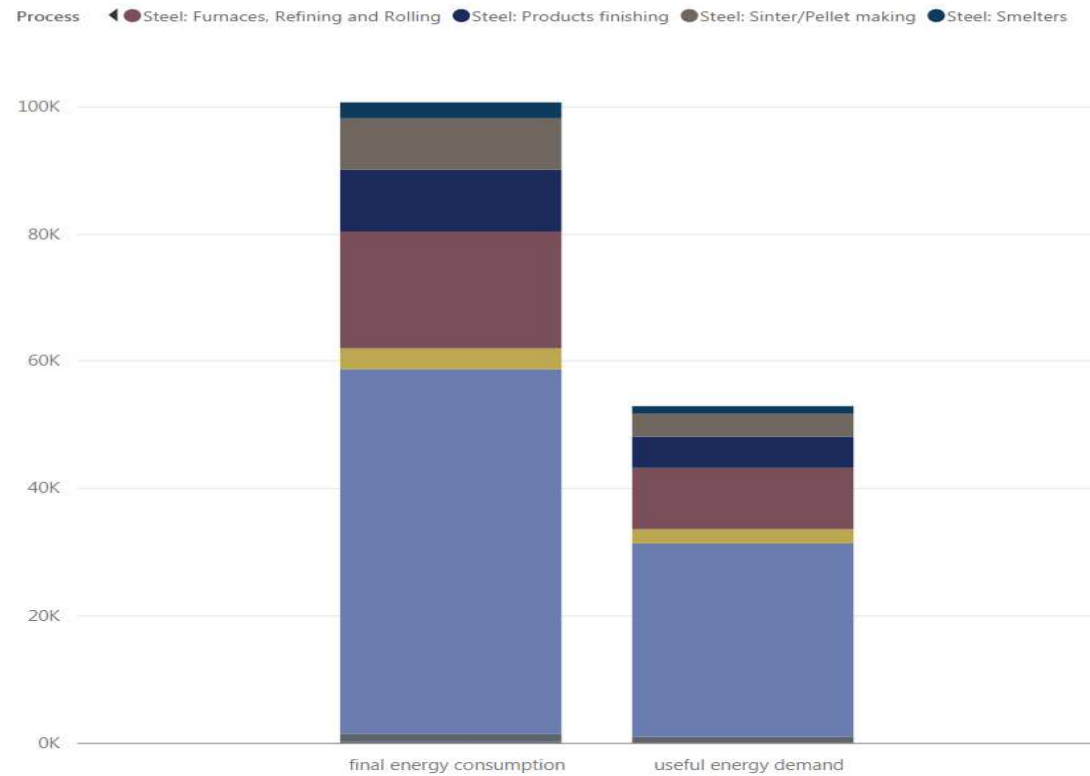
Subsector
Integrated steelworks



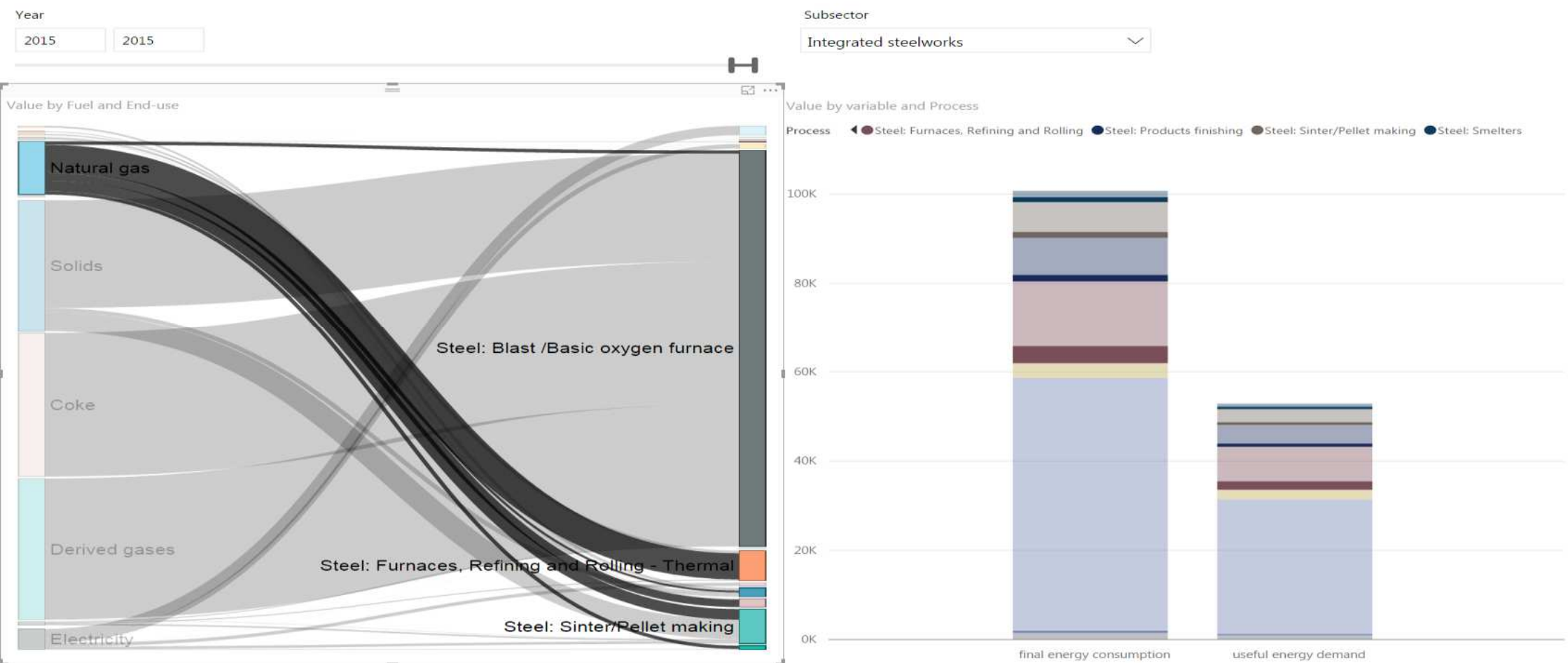
Value by Fuel and End-use



Value by variable and Process



PROVIDING AN OVERVIEW





Thank you for your attention



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JRC-C6-JRC-IDEES@ec.europa.eu

