The European Commission's science and knowledge service

Joint Research Centre

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The JRC-IDEES database

Brussels, 12 Oct 2017

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JRC-IDEES

Integrated
Database of the
European
Energy
System

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INTRODUCTION

JRC-IDEES is a **open source** complete database of the energy system and all associated factors

- EUROSTAT compliant
- Time horizon: 2000-latest statistical year on an annual basis (currently: 2015)
- Geographical coverage: EU Member States

FIRST-OF-ITS-KIND

THE JRC-IDEES DATABASE

The database provides a **detailed decomposition** of energy use by sector in a consistent manner, combining

- historical data series (statistics) and
- (generic) structural parameters derived from studies, projects and surveys

The bulk of the figures in the database are **own estimates**

alternative quantifications of structural parameters can provide equivalently valid decompositions of data

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JRC-IDEES CONSISTS OF:

Official Statistical data

Economy related

Demographics

Energy balances

Energy prices

Emissions

Physical industrial production

Transport mobility

Processed "data"

Equipment characterisation

- Technology deployment
- Stock related data

Structural & behavioural features

- Detailed energy use info
- Behavioural patterns
- Operating characteristics

Non energy using equipment related factors

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Main data sources used in JRC-IDEES

- EUROSTAT:
  - Energy balances
  - Power generation statistics
  - Transport statistics
  - Pocketbook publications
  - Macroeconomic data (nama_nace and structural business statistics)
  - Demographic data
  - Energy consumption in households by type of end use
  - Energy from renewable sources (SHARES tool)
- UN databases (UNFCC National GHG Inventory Submissions, FAOSTAT etc.)
- U.S. Geological Survey (USGS) (Minerals Information Commodity Statistics and Information)
- British Geological Survey (European Minerals Statistics)
- EURELECTRIC
- ENTSO-E
- EEA
- EPIC database (Installed power plants capacities)
- EurObserv'ER (Renewable energy forms)
- Official national surveys and statistics
- EC supported projects and studies, including:
  - 'Survey on Energy Consumption in Households' (SECH 2010)
  - EU Building Observatory, BPIE, TABULA, ENTRANZE, EPISCOPE on buildings characteristics
  - TRACCS study
  - Preparatory studies of the eco-design for energy using products
  - ODYSSEE-MURE database
  - JRC studies and reports
- IEA reports
- U.S. DOE studies and reports
- Industry associations statistics, studies and reports

WHAT CAN BE FOUND IN JRC-IDEES

Historical **statistical** data concerning:

Demographics	The economy	Activity levels	Energy use

complemented by

Sectoral detail	*at the level of end uses of energy*	CO2 emissions	*detailed ETS sectors representation*
Technology data	*sizes, efficiencies, costs*	Energy equipment stock	*Vintages, equipment characteristics etc.*
Operating characteristics	*hours of use, km-driven etc.*		

But also

Stock related data	Building cell characteristics	Power generation capacities	Structural characteristics
Industrial production capacities, number of vehicles, etc.	*Thermal losses proxy, sqm*	*Including number of representative units of a typical size*	*Linking the physical output to products specificities*

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The Questions

How do we use energy?

What are the constraints raised by the infrastructure?

What was the effect of policies implemented?

How does our behaviour evolve over time?

What is the role of technology progress?

Are energy consumption indicators comparable across countries?

What is the domain for further policy action?

etc.

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The Challenges

Putting together fragmented, incomplete and inconsistent statistics

Performing a detailed decomposition of energy use

Keeping track of the evolution of the infrastructure

Identifying the role of non-energy related factors

Dealing with the lack of transparency

… while respecting the energy balances statistics and accounting for country specificities

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Level of Detail in the Demand side

Industry	11 sectors 21 subsectors	6 to 11 processes per subsector	~14 end-uses ~44 technology options per subsector
Residential	9 household types 9 appliances types	43 combined space and water heating types	135 technology options
Services	4 thermal uses 6 appliances types		47 technology options
Transport	4 (+2) modes	16 transport means	2 to 5 engine types 6 to 27 technology options per mean

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THE MATHEMATICAL APPROACH

The decomposition process may be interpreted as a **constraint satisfaction problem** (CSP) with the following constraints

- respect the energy balance by fuel *without any exception*
- respect activity data *without any exception*

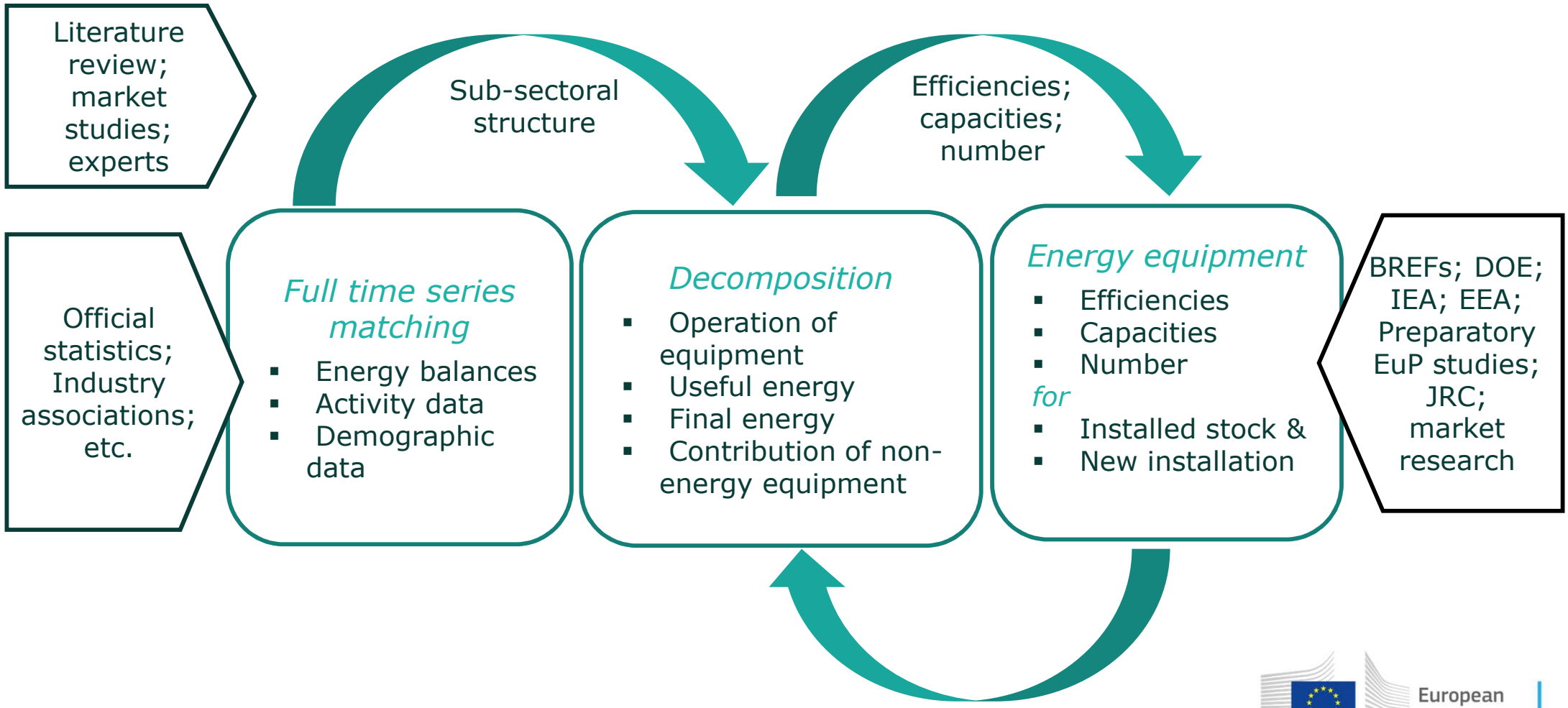
Without further information, this problem admits an infinite number of solutions; as such, *there is **no unique way** of performing such a disaggregation*.

Reducing the number of solutions through

- acknowledging the limits imposed by the stock of the installed energy equipment
- respecting the evolving characteristics of the new equipment
- taking into account, when available, official country-specific information

Note: the decomposition process often requires ex-post adjustments for specific years, countries and/or technologies.

DATA DECOMPOSITION APPROACH



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THE ROLE OF INSTALLATIONS AND THEIR USE

Role of technical improvements vis-à-vis consumers' behaviour in driving energy demand

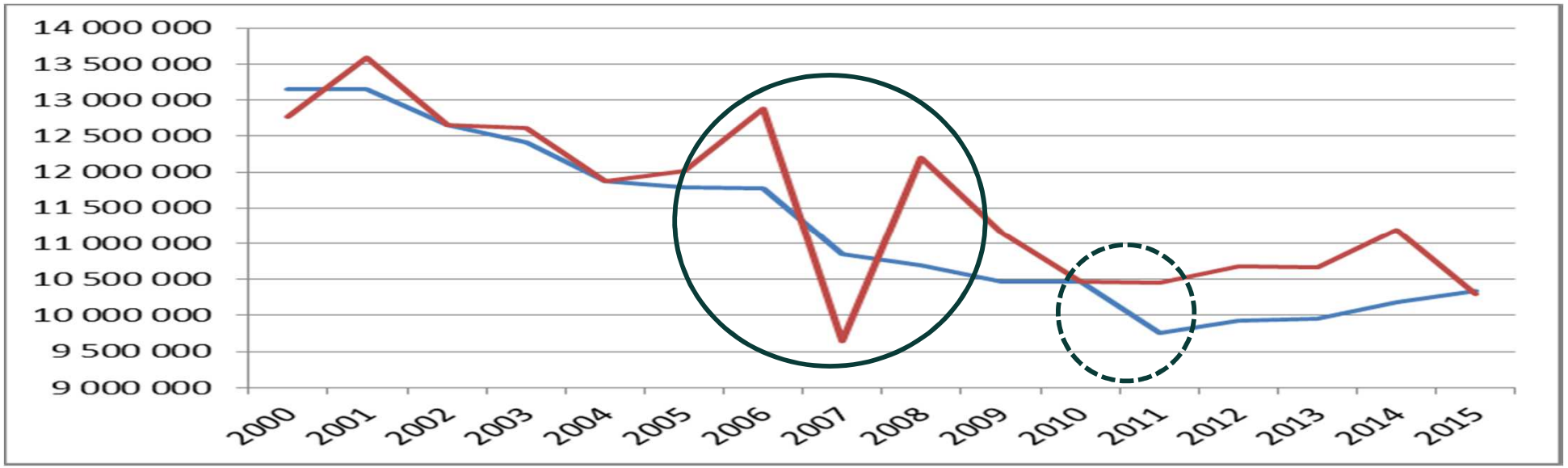
- Vintage-specific characteristics of stock and new installations
- Operation of the equipment

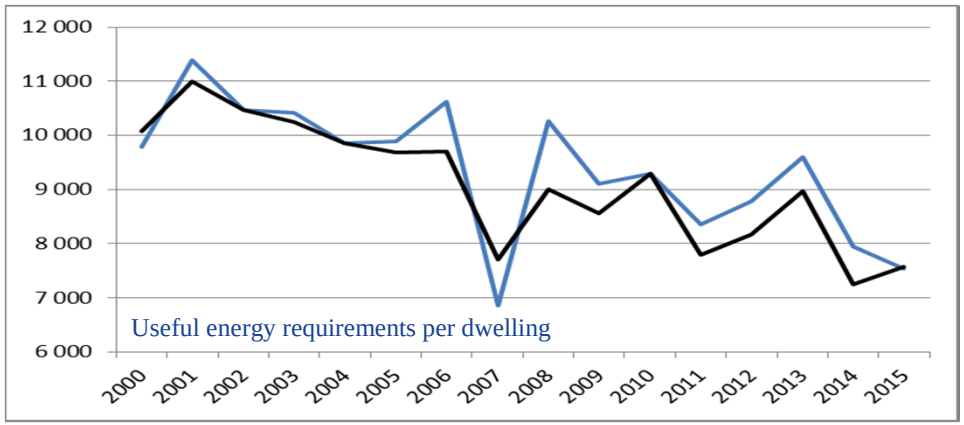
Better capture existing constraints:

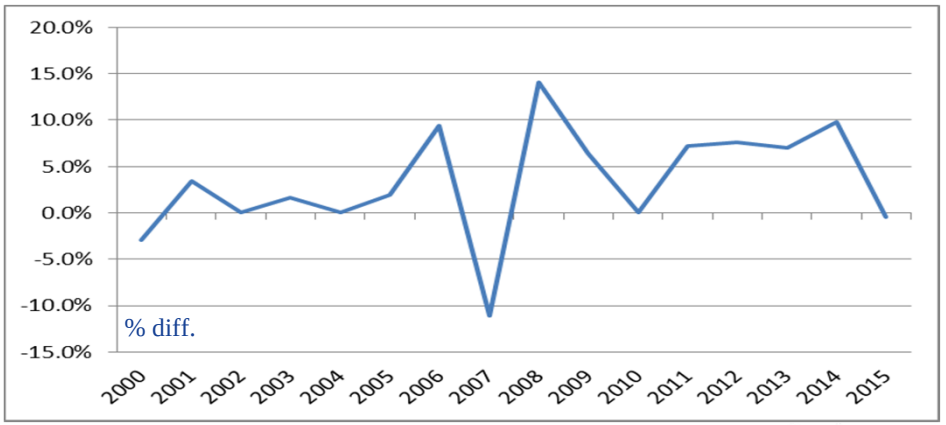
- Installations prevail over operation
- Replacement of equipment explicitly quantified (the same applies for idle equipment)
- By definition new equipment is assumed to have better technical characteristics compared to the stock (on a country basis)

Identifying useful energy needs at the level of a representative consumption unit

Number of oil fired dwellings in a country assuming equal useful energy requirements per dwelling vs respecting the existence of vintages







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UNDERSTANDING DIFFERENCES

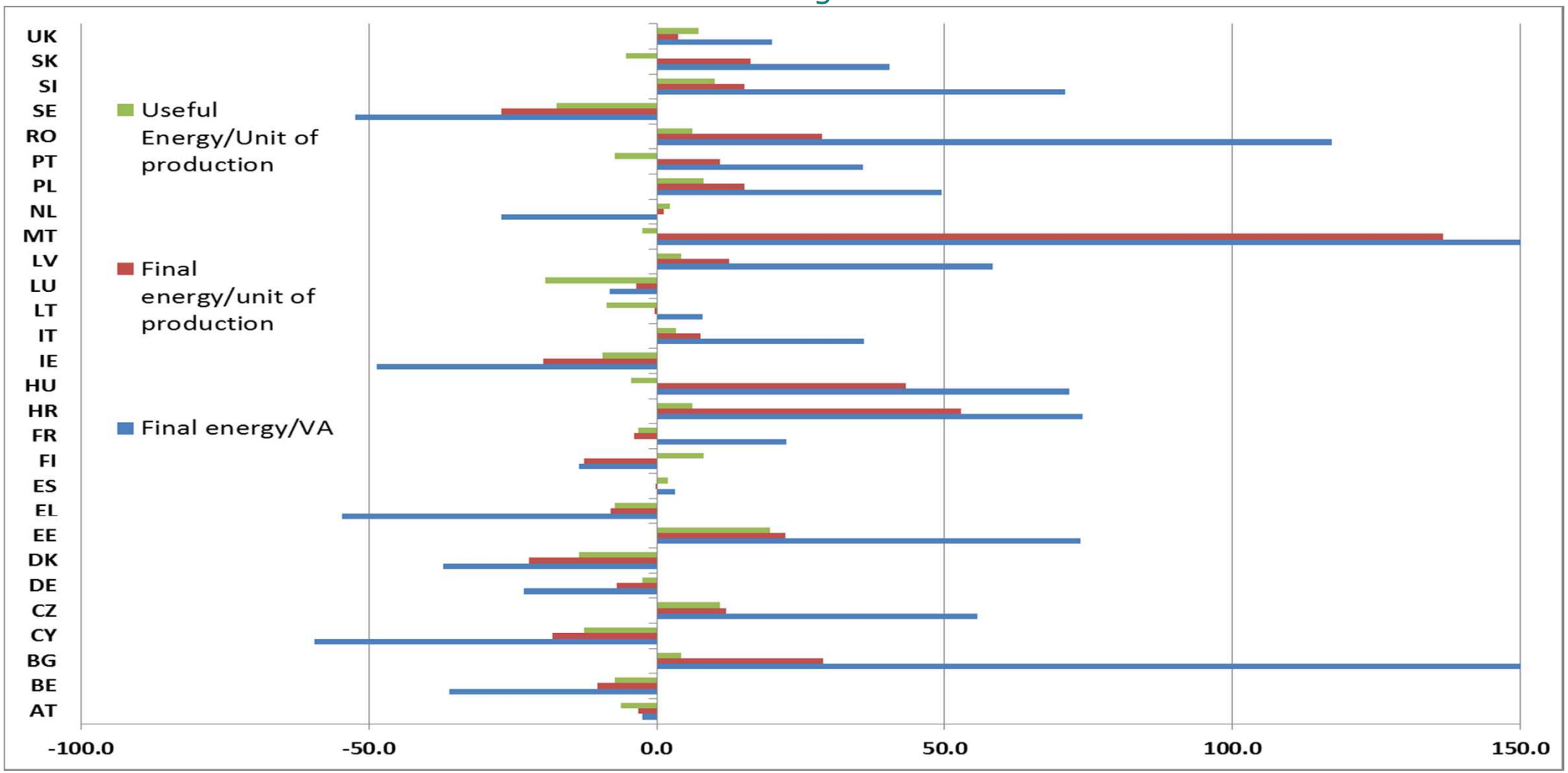
A better understanding of the observed variations in energy intensities across countries

- Establishing a common reference point by quantifying structural properties

The concept of the **representative consumption unit**:

- representative tonne of output
- representative household
- representative appliance
- representative vehicle

The case of manufacturing industries in 2015



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Key Features

By construction, the database **matches** Eurostat statistical data

Consistent approach throughout all sectors

Takes into account Member States and sector specific characteristics

- the data decomposition within each sector is tailor-made for each country

Explicitly quantifies the contribution of non-energy equipment related factors in meeting energy service

- better identification of the characteristics of energy equipment

Incorporates a very high level of sectoral detail and disaggregation by end-use

- making it usable as input for many different models
- allowing a consistent matching of policies' scopes (e.g. ETS)

Decomposes energy consumption down to the level of one representative consumption unit (e.g. household, appliance, car)

- explicitly distinguishes between technical and behavioural characteristics
- creates a basis for defining the scope for policy action

JRC-IDEES OFFERS THE POSSIBILITY TO

Identify the drivers for past energy system evolution

- *macro-economic/demographic/climatic*
- *technology dynamics*
- *structural changes and behavioural patterns*
- *the impact of past policies*
- *implicit monitoring of policies*

Quantify the scope for future policy actions

- *which are the key energy consuming end uses?*
- *what is the margin for the (technical) improvement of the energy equipment stock?*
- *what is the role of non-energy equipment?*

Set a **common reference** for future energy policy assessment within the Energy Union

- *Saving resources by avoiding redundant work on decomposing historical energy data*
- *Improving the data quality through experts and scientific feedback*
- *Ensuring transparency*
- *Rendering modelling results comparable*

fully flexible and expandable

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JRC-IDEES ACCESSIBILITY

Accessible to the general public through an online platform

- Documentation on JRC-IDEES
- Full JRC-IDEES data-box
  - Detailed excel files for the whole energy system

    sector specific ones but also energy and CO2 emissions balances (enhanced)
  - Visualisations of the available data
  - Database structure (under investigation)

in line with the JRC open data principles

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AN INTUITIVE VISUALISATION INTERFACE

An add-on to interact with…

Available tailor made visuals

Explore a sector, a fuel, compare countries… at a glance with predefined dashboards

Allowing flexible exploration

User-defined tables and graphs

… built for an in-depth understanding of trends

User-defined aggregation/decomposition level

Generate insights through the analysis of

- *sectorial dynamics*
- *links and correlations*

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Snapshots…

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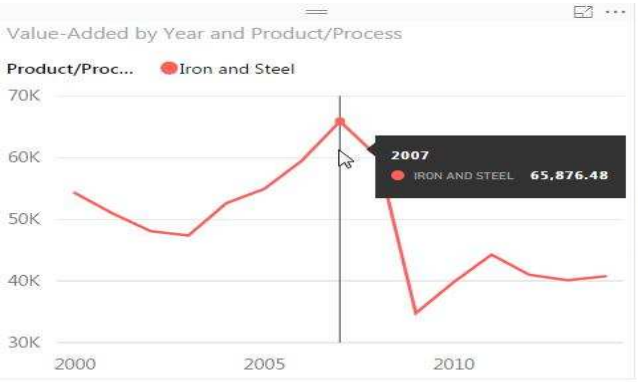
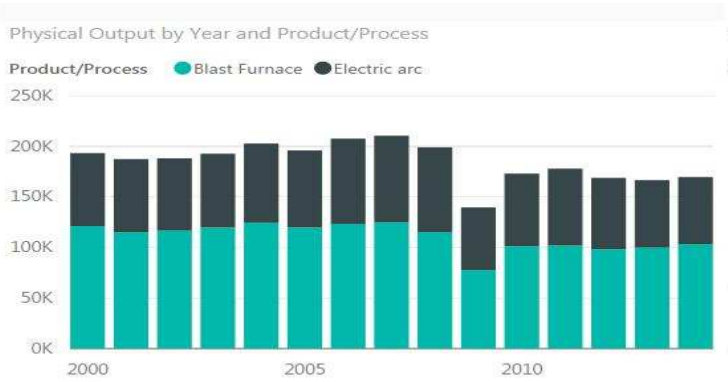
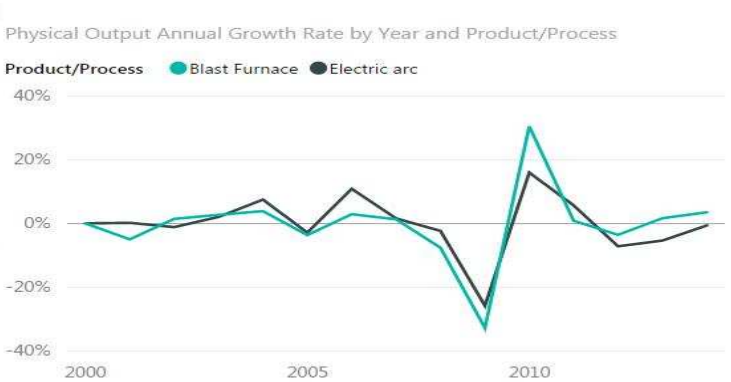
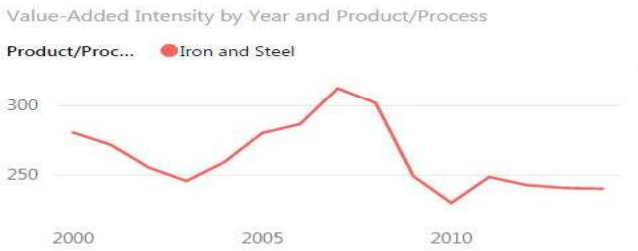
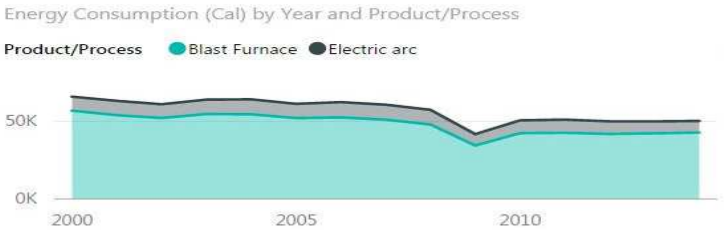
PROVIDING A SECTOR OVERVIEW

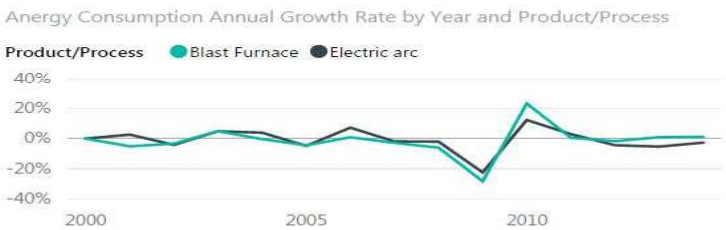






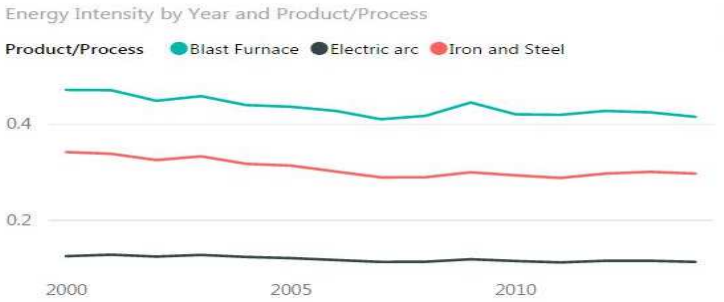


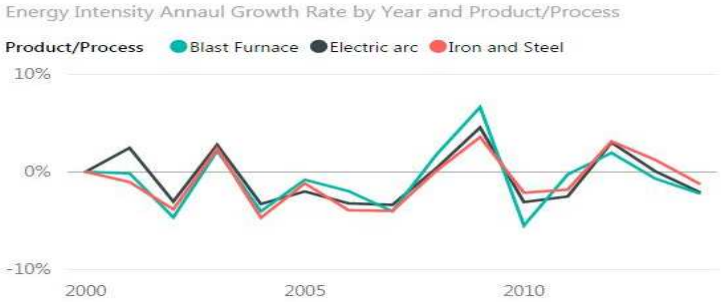




Compound annual growth rates over 2000-2014 period

Variable	Blast Furnace
CO2 emissions (kt CO2)	
CO2 intensity (kt CO2 / ktoe)	
Energy consumption (calibration output)	-0.019 %
Energy consumption (EUROSTAT energy balances - ktoe)	
Energy intensity (toe/t of output)	-0.019 %
Physical output	-0.016 %
Value added (Millions of Euro at 2010 prices)	
Value added intensity (VA/t of output)	





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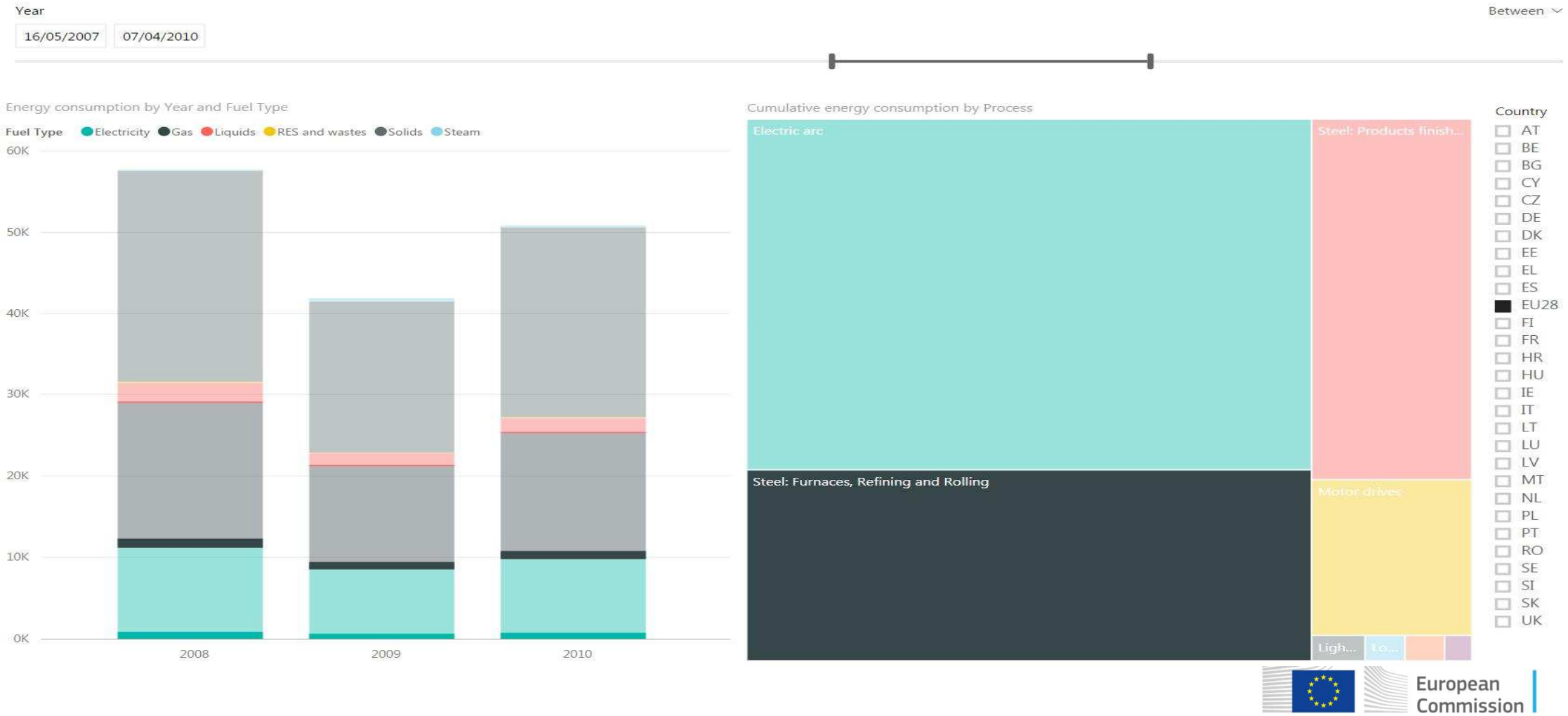
...OR FOCUSING ON SECTOR DETAILS



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...OR MAKING COMPARISONS

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Next steps and Maintenance

Iterative consultation process allowing continuous improvements

- JRC-IDEES 2015 (version 0.9)
  - Access to it will be made available to Member States experts tomorrow
  - Initiating a validation process
  - Involving stakeholders and the academia
- JRC-IDEES 2015 foreseen to be made available to the general public not later than March 2018 …

… initiating the process for the development of the JRC-IDEES 2016

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Thank you for your attention

JRC Science Hub –POTEnCIA:
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