Benchmarking the European Reference Scenario 2016

An alternative bottom-up analysis of long-term energy consumption in Europe

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eceee Summer Study on energy efficiency

29 May – 3 June

Hyères, France

OUTLINE

INTRODUCTION
Motivation and Objective

Motivation:

- **Long-term scenarios** of future energy demand are a major prerequisite when **planning future energy systems** and policy intervention
- Prominent example: **EU Reference Scenario 2016**
- **High relevance** for political discussion on European level

Objective:

- Apply bottom-up model **FORECAST**
  - Using framework data published by the European Commission
  - **Compare** projections of energy demand for the EU27 until 2035 (at publicly available degree of detail)
  - Critically **reflect** upon the results
  - Better **understand** driving forces of energy demand

OUTLINE

METHODOLOGY
General model characteristics

FORECAST
FORecasting Energy Consumption Analysis and Simulation Tool

Model name	FORcasting Energy Consumption Analysis and Simulation Tool
Model focus	Demand-side
Model approach	Bottom-up
Type of model	Simulation
General aim	Determination of final energy demand and energy saving potentials on a highly disaggregated sectoral level
Sectoral disaggregation	Sector split into industry, tertiary and residential module; distinction within the modules regarding end-use applications and concrete energy saving measures
Spatial disaggregation	EU28 +NO +CH (+TR), aggregated on a national level DE disaggregated on NUTS 3 level (remaining EU countries wip)
Temporal horizon and time steps	2050, yearly time steps

METHODOLOGY
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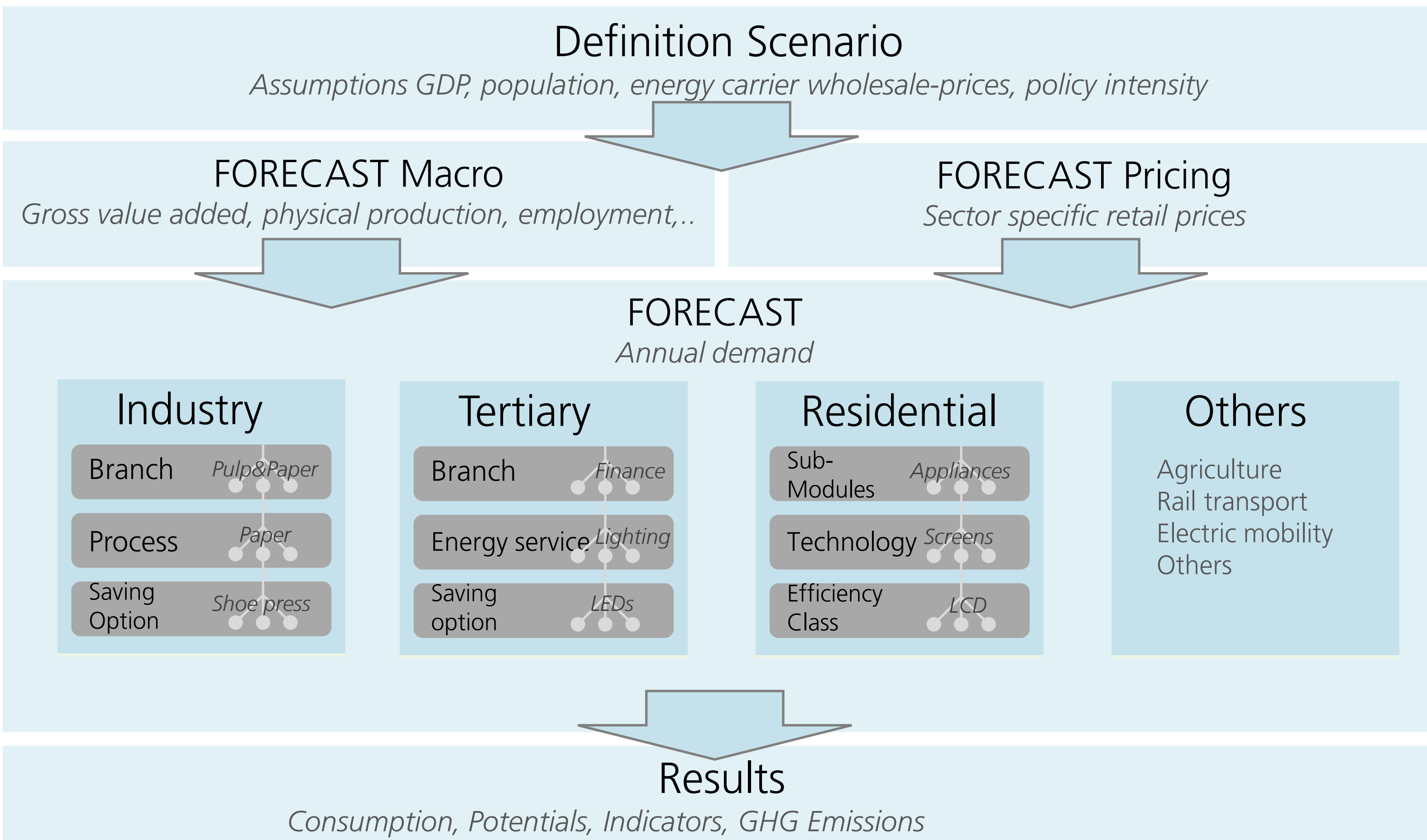

METHODOLOGY
Main inputs/outputs

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Input/output data			
Main input data	**Tertiary**	**Residential**	**Industry**
	Main drivers		
	➢ No. of employees by sub-sector ➢ Floor area per employee by sub-sector [m^2]	➢ No. of households ➢ Building surface by type of building [m2]	➢ Physical production by process [t/a] ➢ Value added by sub-sector [Meuro/a]
	Energy carrier prices		
	Technology data		
	➢ Technology driver ➢ Installed power ➢ Full load hours ➢ Saving potentials ➢ Lifetime ➢ Diffussion ➢ Insulation levels ➢ Heating system efficiency & shares	➢ Market stock ➢ Lifetime ➢ Operation power/hours ➢ Standby power/hours ➢ Insulation levels ➢ Heating system efficiency ➢ Market stock ➢ Performance factor	➢ Specific energy consumption ➢ Saving potentials ➢ Lifetime ➢ Diffusion ➢ Insulation levels ➢ Heating system efficiency & shares
Main output data	➢ Fuel and electricity demand (by process/technology/appliance, energy carrier, etc.) ➢ Energy savings (CO_2 abatement, energy saving costs, CO_2 abatement costs)		

METHODOLOGY
FORECAST Industry

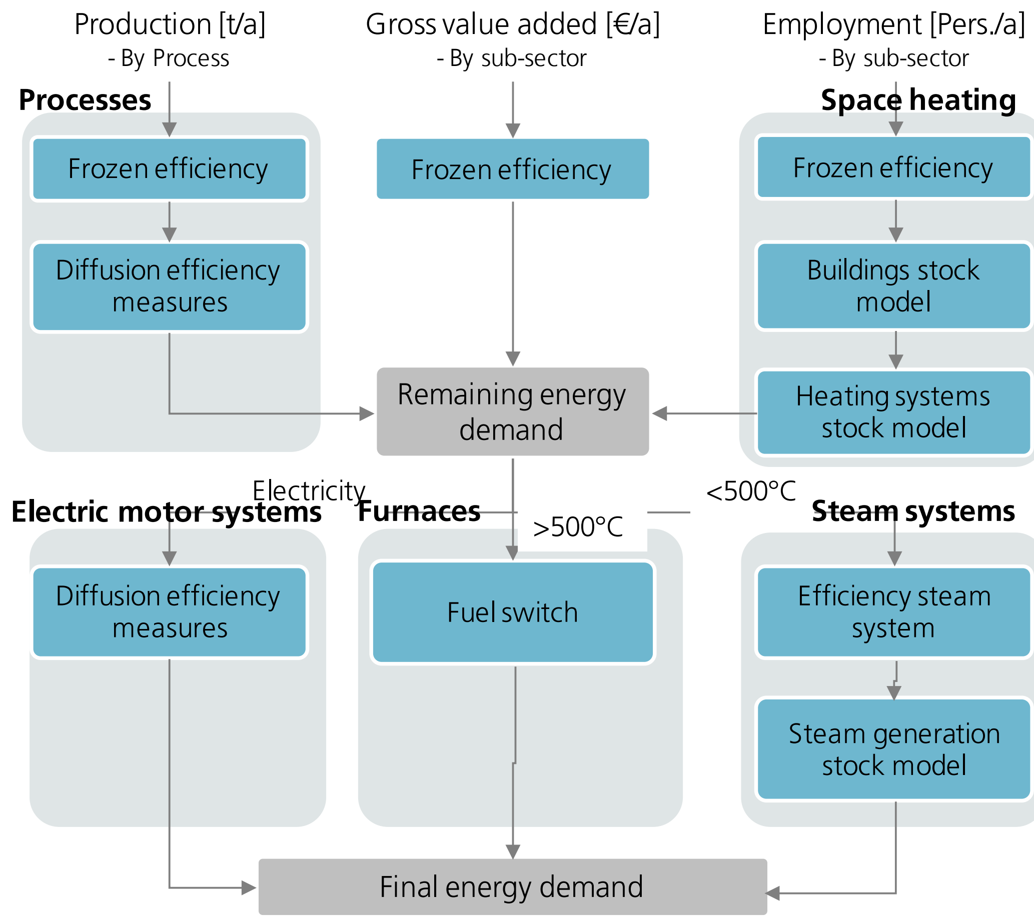
FORecasting Energy Consumption Analysis and Simulation Tool

Modeling approach

- Bottom-up simulation
- High technology detail
- Policy instruments:
  - EU ETS
  - Taxes/prices
  - Standards
  - Etc.

Level of detail

- 11 to 14 sub-sectors
- 64 processes
  + ~ 200 efficiency measures
- 2 building types
- > 20 technologies for heat generation incl. CHP
- 7 motor systems
  + >100 efficiency measures



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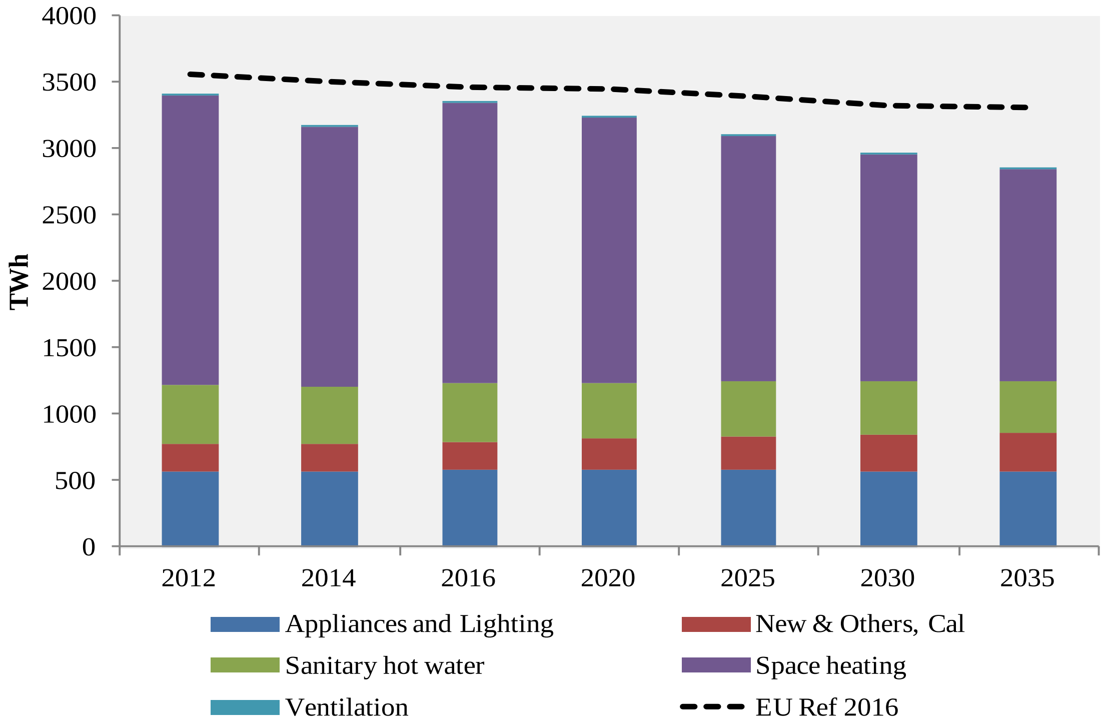
FRAMEWORK ASSUMPTIONS

- Applying FORECAST using framework data published by the European Commission for the **European Reference Scenario 2016**
- EU Ref Scenario 2016 includes policies and measures adopted by 2014*
(EU level & member states) **-> Current Policy Scenario**
- **Main drivers** taken from EU Ref Scenario 2016:
  - GDP
  - Population
  - Household size (number of households)
  - GVA industry (by sub-sector)
  - GVA tertiary
- Translated into **physical drivers of energy demand**
(e.g. sqm per employees, industrial production, building surface by type of building)

*) including amendments to 3 Directives agreed in the beginning of 2015

Source: EU Ref 2016 (Capros et al. 2016)

RESULTS
*EU27 Final energy demand - Residential**



- **More ambitious decreasing trend** between 2012 and 2035 (-0.8% p.a.; from 3405 to 2852 TWh) than in the EU Ref Scenario 2016 (-0.3% p.a.)
- Decrease in heating, hot water generation caused by **improved thermal efficiency** (driven by EPBD) and **replacement** of inefficient heating systems

*) Results of the European Reference Scenario 2016 were available in 5 years steps.
Values in between these 5 year steps have been interpolated.

Source: own calculation and EU Ref 2016 (Capros et al. 2016)

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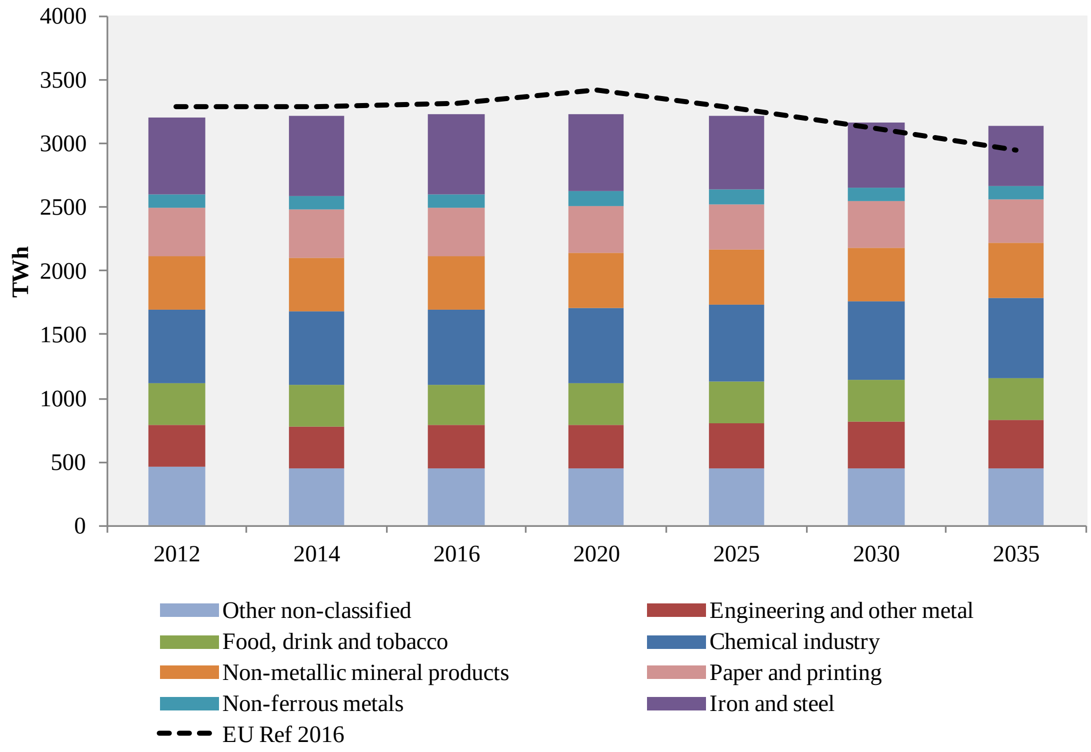
RESULTS
*EU27 Final energy demand – Industry**

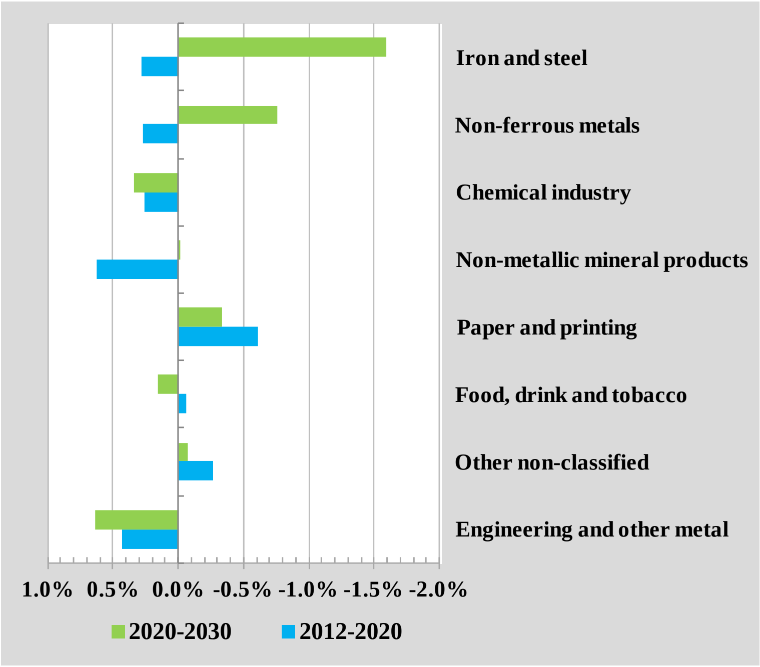


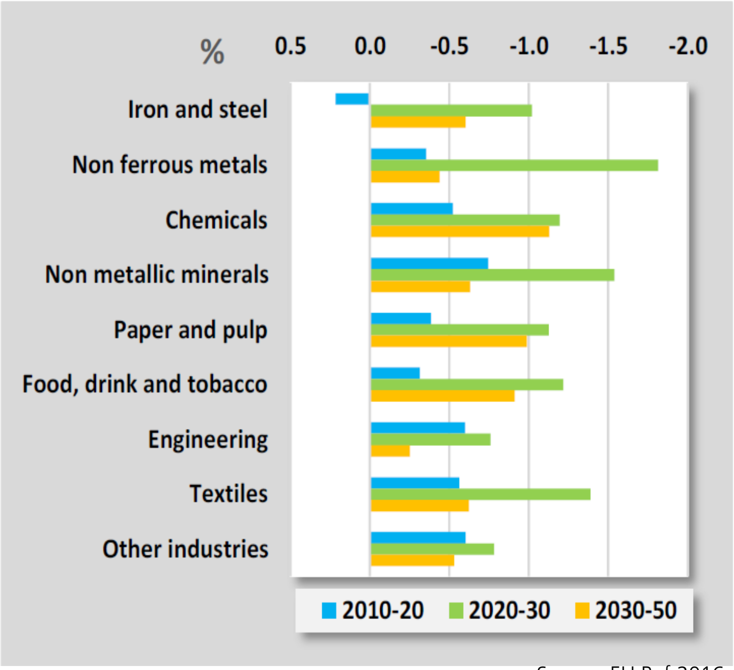
- Slightly **decreasing trend** between 2012 and 2035 (-0.1% p.a.; from 3205 to 3134 TWh)
- Overall assumptions on **energy intensity reductions** in industry are **more ambitious** in the **EU Ref 2016** - particularly between the years 2020 and 2030

*) Results of the European Reference Scenario 2016 were available in 5 years steps.
Values in between these 5 year steps have been interpolated.

Source: own calculation and EU Ref 2016 (Capros et al. 2016)

RESULTS
Average annual change of industrial FED





Source: EU Ref 2016
(Capros et al. 2016)

- Less ambitious increase of energy efficiency based on **current available technologies** in the primary industry sector
- Innovative **breakthrough technologies not expected** to enter the European market in large scale **before 2030**

OUTLINE

I. Introduction

II. Methodology

III. Framework assumptions & results

IV. Conclusions

CONCLUSIONS

I. Every model is an **abstraction of reality:** dependent on data availability, subject to uncertainties and assumptions

II. Scenario and model **comparisons** are an important method **to improve** the **robustness** of energy models

III. Suggestions for **future research**:

- Scenario design and model runs **aiming for comparison** (e.g. model experiment via targeted sensitivity analysis)
- **Increased transparency** of assumptions and input data to improve comparison (e.g. main drivers like industrial production)
- More **standardisation** of energy demand modelling to improve overall comparability of models (e.g. data sources and simulation routines)

Increase reliability and acceptance of model and scenario results to improve basis for political decision making

Quelle: Herbst et al. 2016

Many thanks for your attention!

http://www.forecast-model.eu

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Quelle: Herbst et al. 2016

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Methodology: example tertiary

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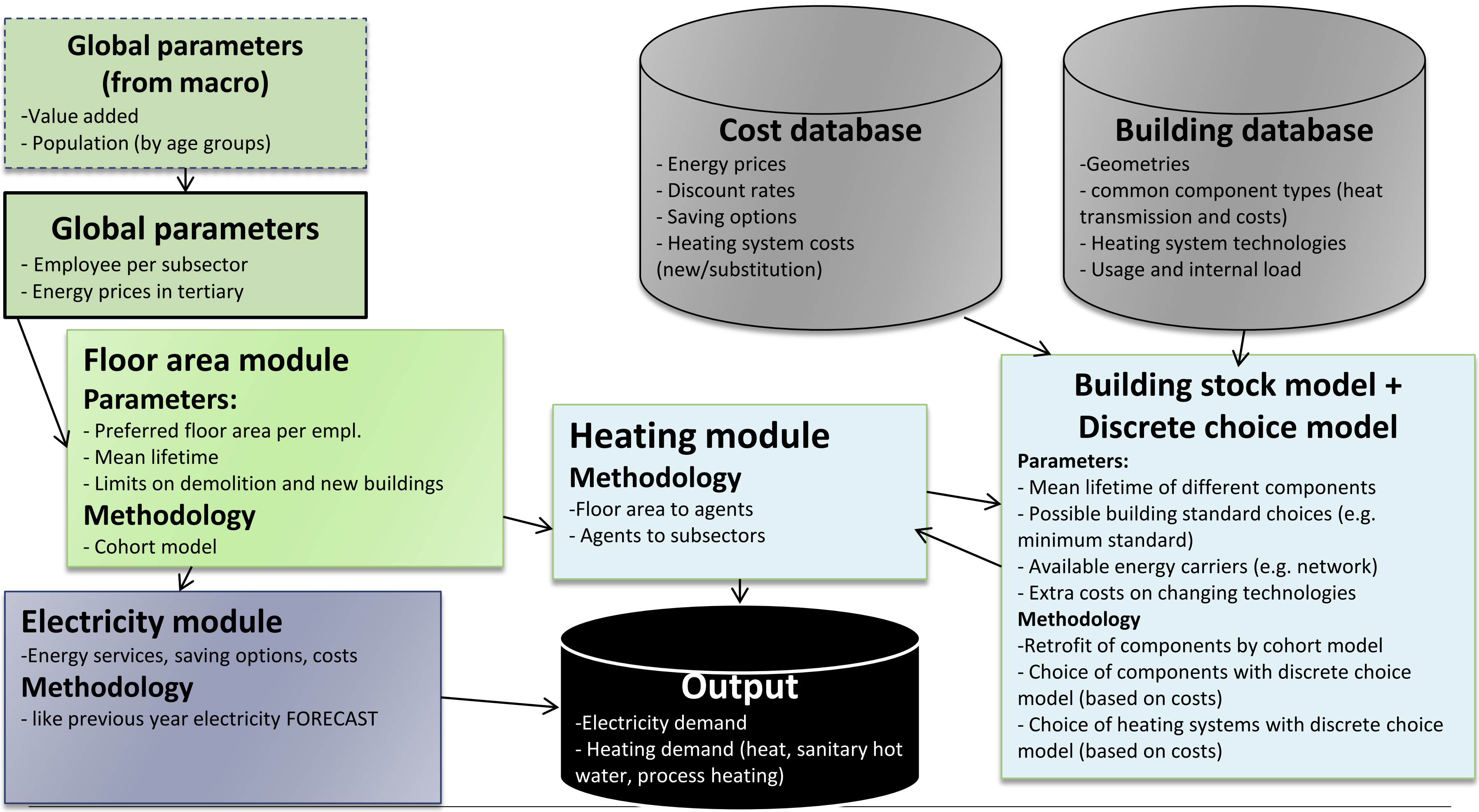

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Methodology: example tertiary

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