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Modelling industrial decarbonisation

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The industrial landscape

- **Industry is extremely diverse**
  - NACE C (manufacturing) has >330 subsector codes
  - Industrial profile varies from on to another
  - Some industrial processes are completely bespoke
  - Industrial environment at Member States are also diverse

- **Need for very high heat and process emissions**

- **Economic factors including low profit margins, capital intensity, long asset life, and trade exposure.**

Energy Efficiency Opportunity Assessment Model (EEEO)

- Uses a **baseline energy consumption for each sub-sector** (iron and steel, petrochemicals, passenger transport or freight transport etc)

- An extensive **Energy Saving Opportunity (ESO) database developed by ICF,** which currently contains the following number of individual measures:
  - Industrial – 210 measures
  - Tertiary – 84 measures
  - Residential – 77 measures
  - Transport – 22 measures

- **Robust bottom-up methodology** to calculate technical potential and economic potential of each member state

Inputs – ESO definition

- Energy saving potential (for each fuel type)
- Availability (immediate or end-of-life)
- Lifetime of technology
- Year first available
- Capital cost
- Operating cost (fixed and variable)

Model Framework

- Energy intensive indsutries
  - *Iron and Steel*
  - *Non-ferrous metals*
  - *Chemicals, etc.*
- Residential
- Tertiary
- Transport

Source: ICF databases

3. Energy saving opportunities (ESO) by sector

- Proportion of the end use that is relevant for a given ESO
- Market penetration potential of ESO

4. Technical applicability of ESO

Each measure tested for cost-effectiveness using a Cost of Conserved Energy (CCE) approach

5. Technical energy saving potential

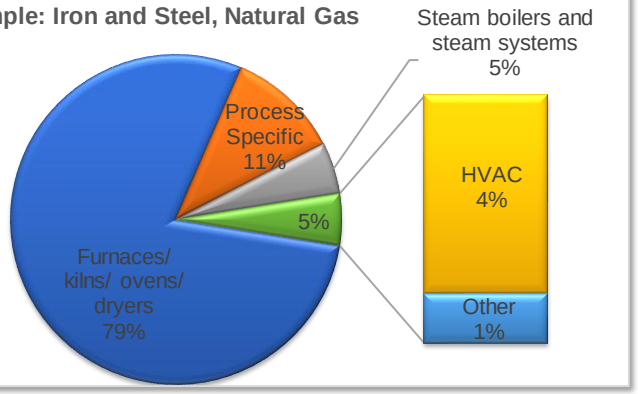
6. Economic energy saving potential

1. BAU final energy demand Member States (2015-2050)

- Energy intensive industries
- Residential
- Tertiary
- Transport
  - *Public road transport*
  - *Private cars and motorcycles*
  - *Heavy goods/ light commercial*
  - *Rail*

2. Sector/subsector fuel mix and end use profile by fuel

Example: Iron and Steel, Natural Gas



Output – Technical and Economic saving Potential

- **Technical savings potential**
  - Consumer preference of technology – Prevents double counting of savings against baseline
  - Current market uptake – Assessment of ESO penetration in current year (for sector, country, etc.)
  - Future market uptake – Retrofit of baseline technology at end of life in 2030/2050
  - Measure/technical applicability - Refers to the proportion of facilities with relevant equipment

- **Economic saving potential**
  - Calculated using cost of conserved energy methodology (CCE) i.e., €/KWh saving
  - CCE is then compared against the relevant retail tariff for that year to judge whether a ESO is economically viable

Technical and Economic energy saving potential for EU in 2030

Sector Group	BAU projection [MTOE /yr]	Economic Potential [MTOE]	Technical Potential [MTOE]	Heat savings [%]
Refineries	42.5	1.9 (4.5%)	10.6 (25%)	73%
Iron and Steel	67.5	3.1 (4.6%)	16.3 (24%)	55%
Non-Ferrous Metal	8.6	0.5 (5.8%)	1.9 (22%)	42%
Non-Metallic Mineral	36.9	1.3 (3.6%)	7.2 (19%)	60%
Pulp and Paper	37.3	1.4 (3.8%)	7.2 (19%)	49%
Chemical and Pharmaceutical	66.4	3.2 (4.9%)	16.5 (25%)	45%
Food and Beverage	26.3	1.7 (6.5%)	6.8 (26%)	35%
Machinery	19.8	1.3 (6.5%)	5.3 (27%)	17 – 21%

Top economic energy saving potential - EU

- Exhaust gas heat recovery
- Advanced heating and process control
- Integrated control systems
- Higher efficiency burners
- Flue gas monitoring
- Energy Management Systems
- Sub-metering
- CHP
- Steam trap survey and repair
- Combustion optimization

What's the problem

- **Internal perspective needs to be considered**

- **Internal barriers (economic, organisational behaviour, competencies)**
  - Capital availability
  - Hidden cost
  - Risk
  - Low status of energy efficiency
  - Inertia and bounded rationalities
  - Imperfect evaluation criteria
  - Competencies and awareness

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