JRC-IDEES: the Integrated Database of the European Energy System

Overview and updates

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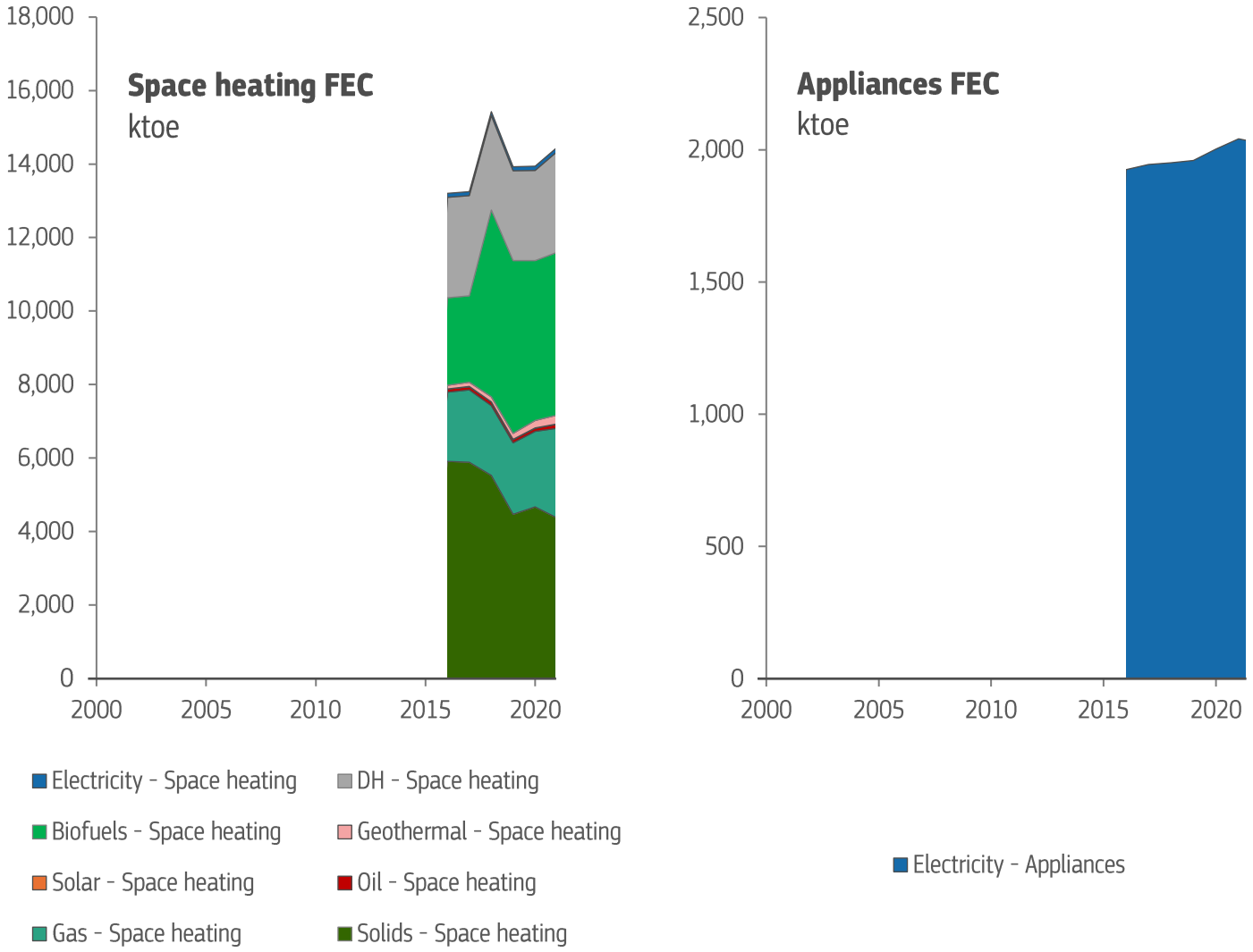
streamSAVE+ workshop on data for energy savings calculations

Background

- Energy modellers and policy analysts need extensive historical data to understand the evolution of the energy system
- But primary statistics may be fragmented or too aggregated to be directly usable for modelling or policy analysis
- Energy data users therefore spend much of their time processing statistics, making *ad hoc* assumptions to disaggregate available data, etc.

Typical data problem: Tracking residential energy use

Eurostat data:
Disaggregated energy consumption by end use, households [Poland]



- Eurostat provides disaggregated FEC by end use, but time coverage may be insufficient for e.g. benchmarks for energy efficiency policies
- Data might not always match energy balances or national data on energy equipment and appliances
- **How to create a consistent starting point for modeling or policy analysis?**

JRC-IDEES overview

- General approach: top-down primary statistics harmonized with bottom-up technical assumptions to create an *analytical* database
- Main input of historical data for JRC POTEnCIA energy system model
- Five energy sectors in each EU Member State:
  - Industry
  - Residential
  - Tertiary and agriculture
  - Transport
  - Power and heat generation

Primary statistical data

Macro-economic data
Demographics
Energy balances
Emissions
Industrial production
Transport mobility

Processed data

Characteristics of energy equipment
- Technology deployment
- Stock-related data

Use of energy equipment
- Detailed energy use data
- Operating characteristics

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- Five energy sectors in each EU Member State:
  - Industry
  - Residential
  - Tertiary and agriculture
  - Transport
  - Power and heat generation
- Each sector uses a specific structure to split energy balances into individual end uses while matching available statistics
- **Most of the contents of JRC-IDEES are processed data, rather than pure statistical data**

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JRC-IDEES decomposition

- Overall scope: all data reported for each EU Member State, 2000-2023 yearly time series

Industry

Residential

Tertiary and agriculture

Transport

Power & heat generation

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Industry	11 industry sectors 21 industry subsectors
Residential	9 household types 8 appliance types
Tertiary and agriculture	4 thermal uses 6 appliance types
Transport	5 transport modes
Power & heat generation	Nuclear, thermal, and renewable generation

JRC-IDEES decomposition

- Overall scope: all data reported for each EU Member State, 2000-2023 yearly time series

Industry	11 industry sectors 21 industry subsectors	6-11 processes per subsector
Residential	9 household types 8 appliance types	39 combined space/water heating types
Tertiary and agriculture	4 thermal uses 6 appliance types	
Transport	5 transport modes	20 transport means
Power & heat generation	Nuclear, thermal, and renewable generation	10 fuel types 7 renewable types

JRC-IDEES decomposition

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Industry	11 industry sectors 21 industry subsectors	6-11 processes per subsector	1-10 technology/fuel options per process
Residential	9 household types 8 appliance types	39 combined space/water heating types	135 technology/fuel options
Tertiary and agriculture	4 thermal uses 6 appliance types		47 technology/fuel options
Transport	5 transport modes	20 transport means	35 technology/fuel options
Power & heat generation	Nuclear, thermal, and renewable generation	10 fuel types 7 renewable types	1-4 technologies per type 1-4 plant sizes per type

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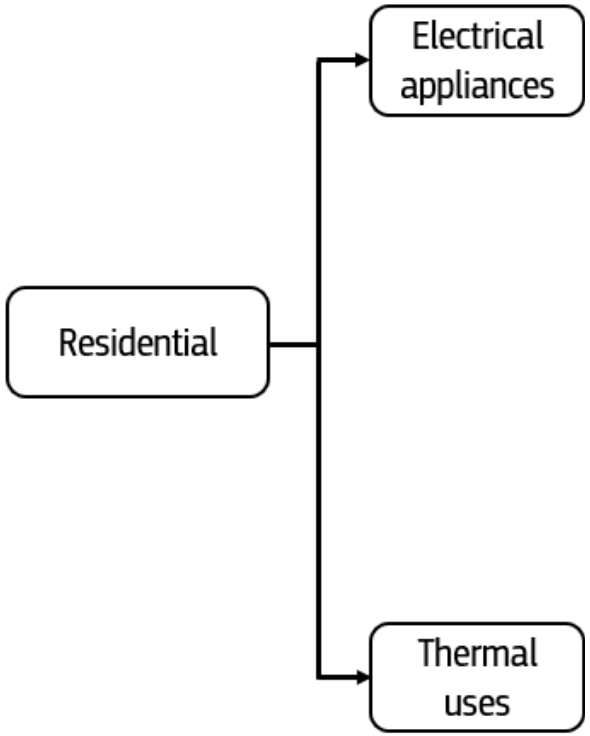
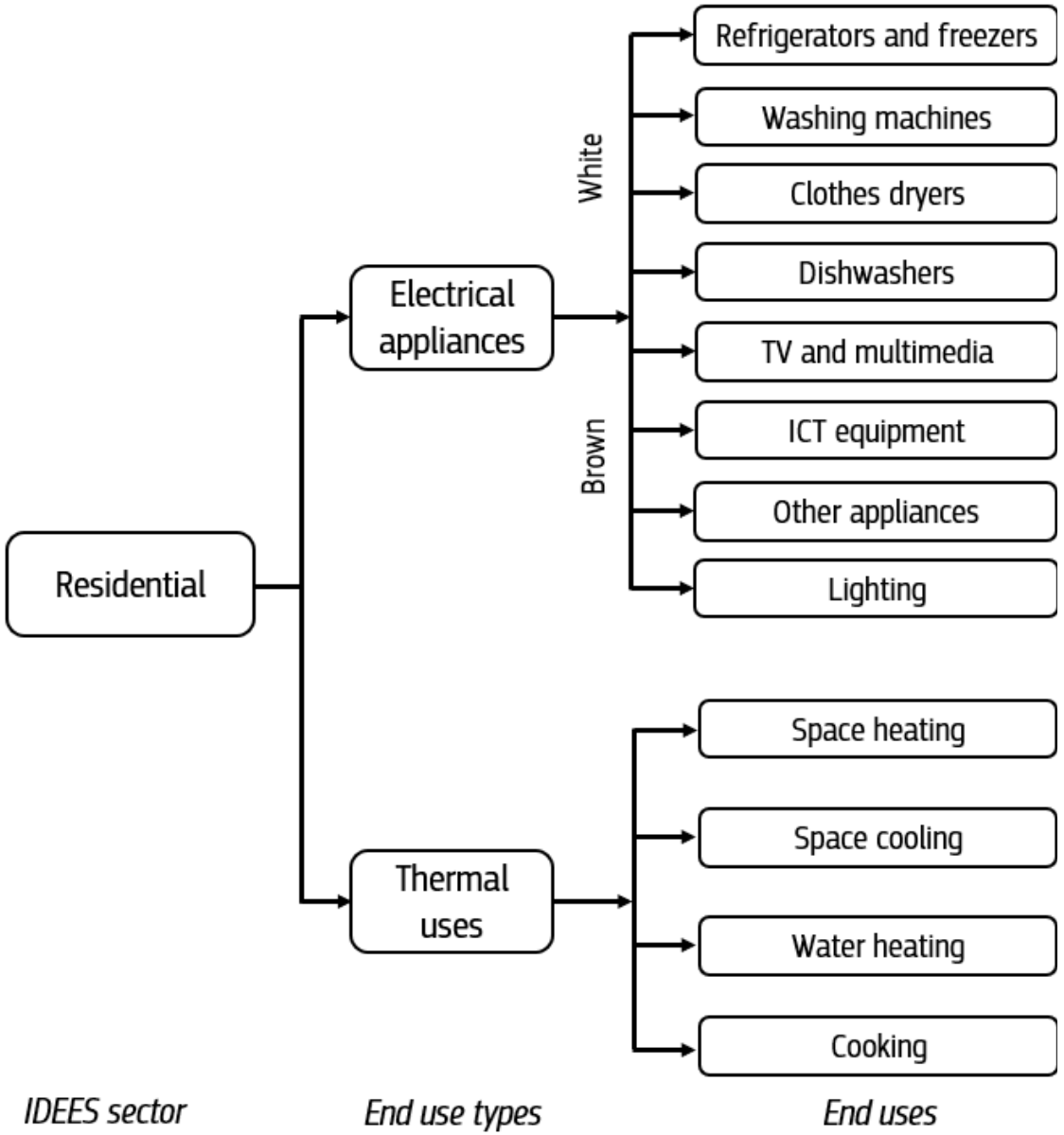
JRC-IDEES decomposition: residential



IDEES sector *End use types*

JRC-IDEES decomposition: residential



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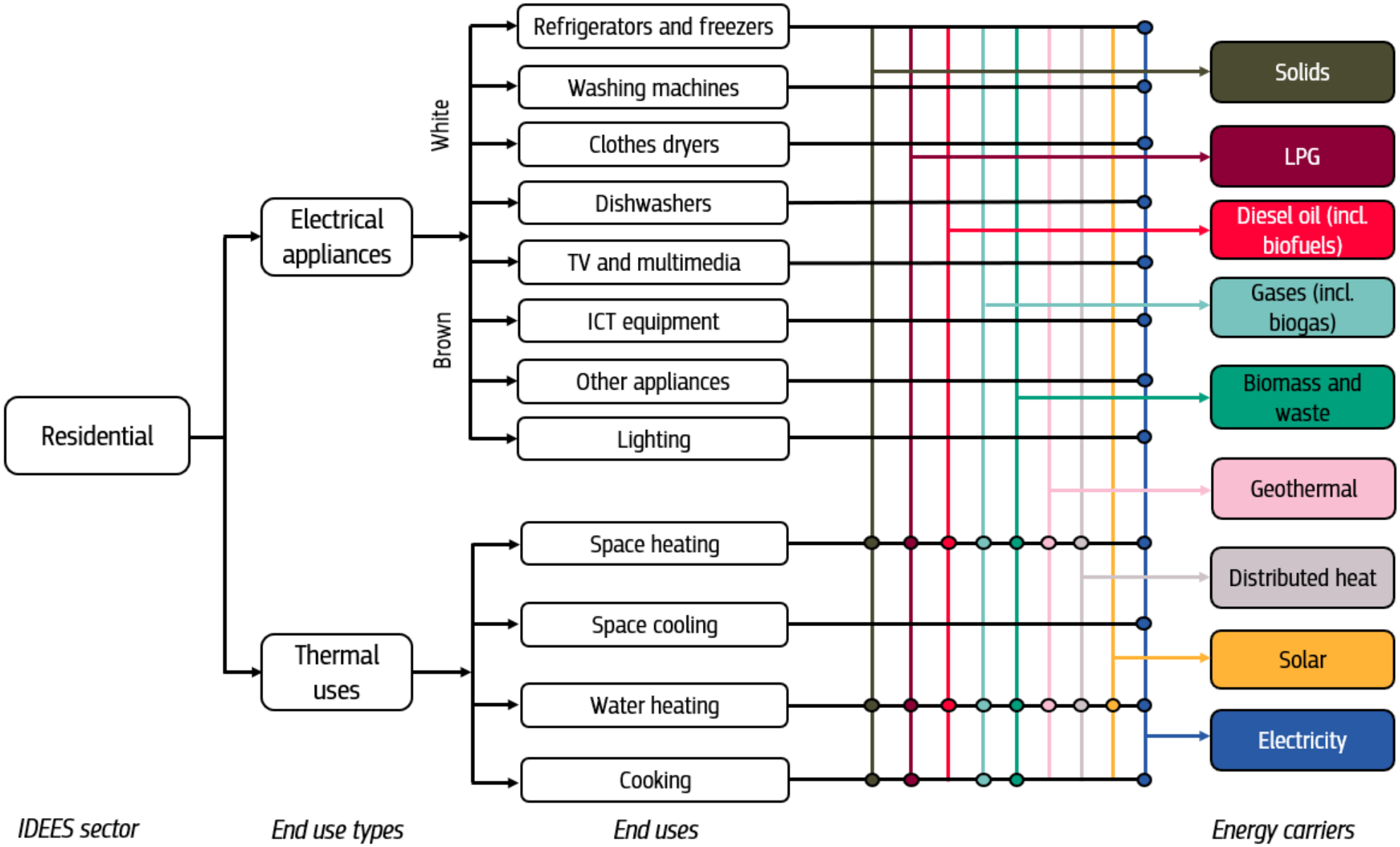
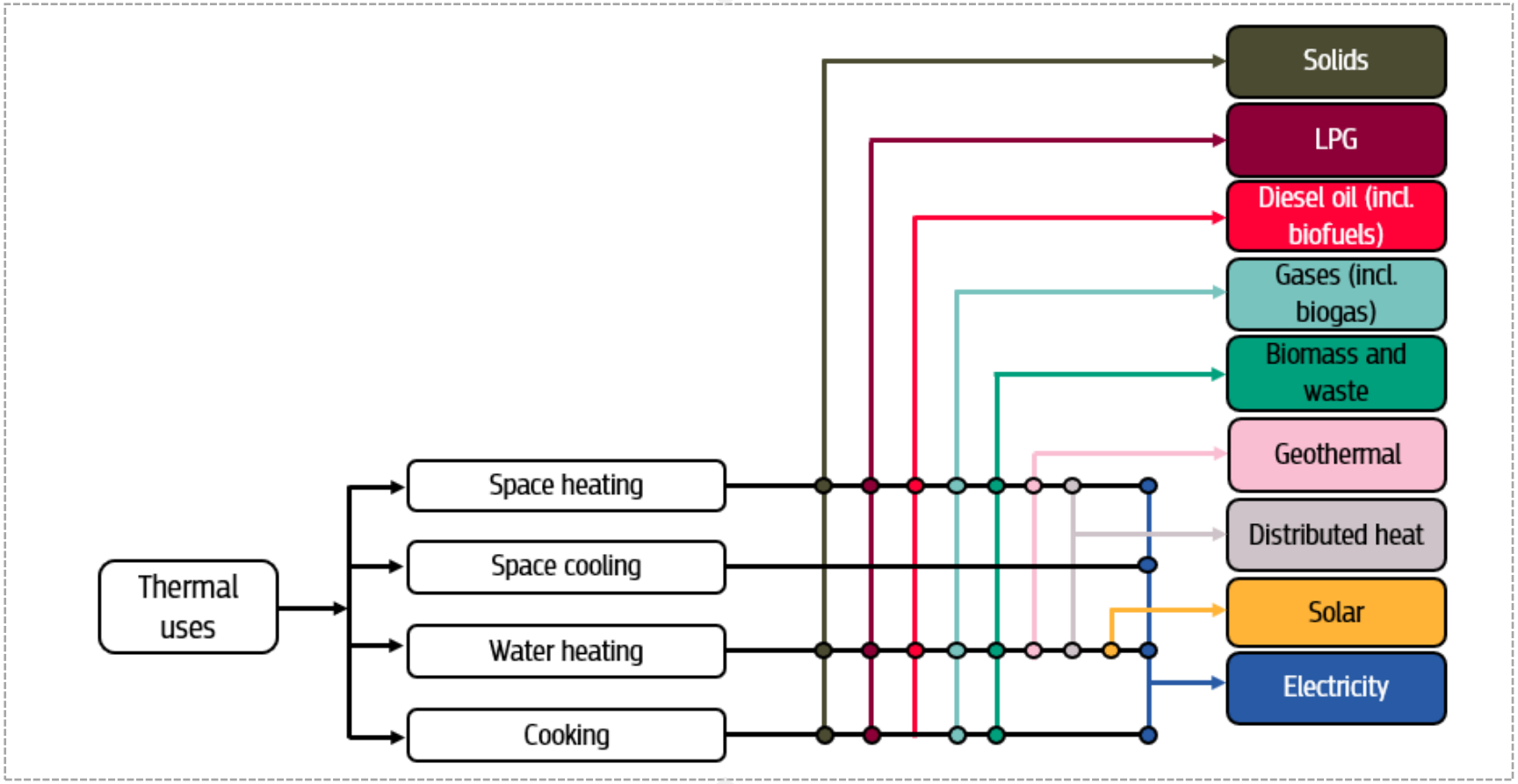


JRC-IDEES calibration: residential thermal uses

Primary (top-down) statistics:
Eurostat energy balances, demographic statistics, EU Building Stock Observatory, etc.



Calibration iterated to **split households by equipment type** while matching:

- Eurostat energy balances and (where possible) disaggregated energy use data
- Plausible evolution in stock of installed energy equipment
- Plausible operating characteristics and efficiencies

Technical (bottom-up) datasets:
Eurostat data on disaggregated energy use in households, Ecodesign Impact Accounting Annual Report, national statistics on residential energy equipment, etc.

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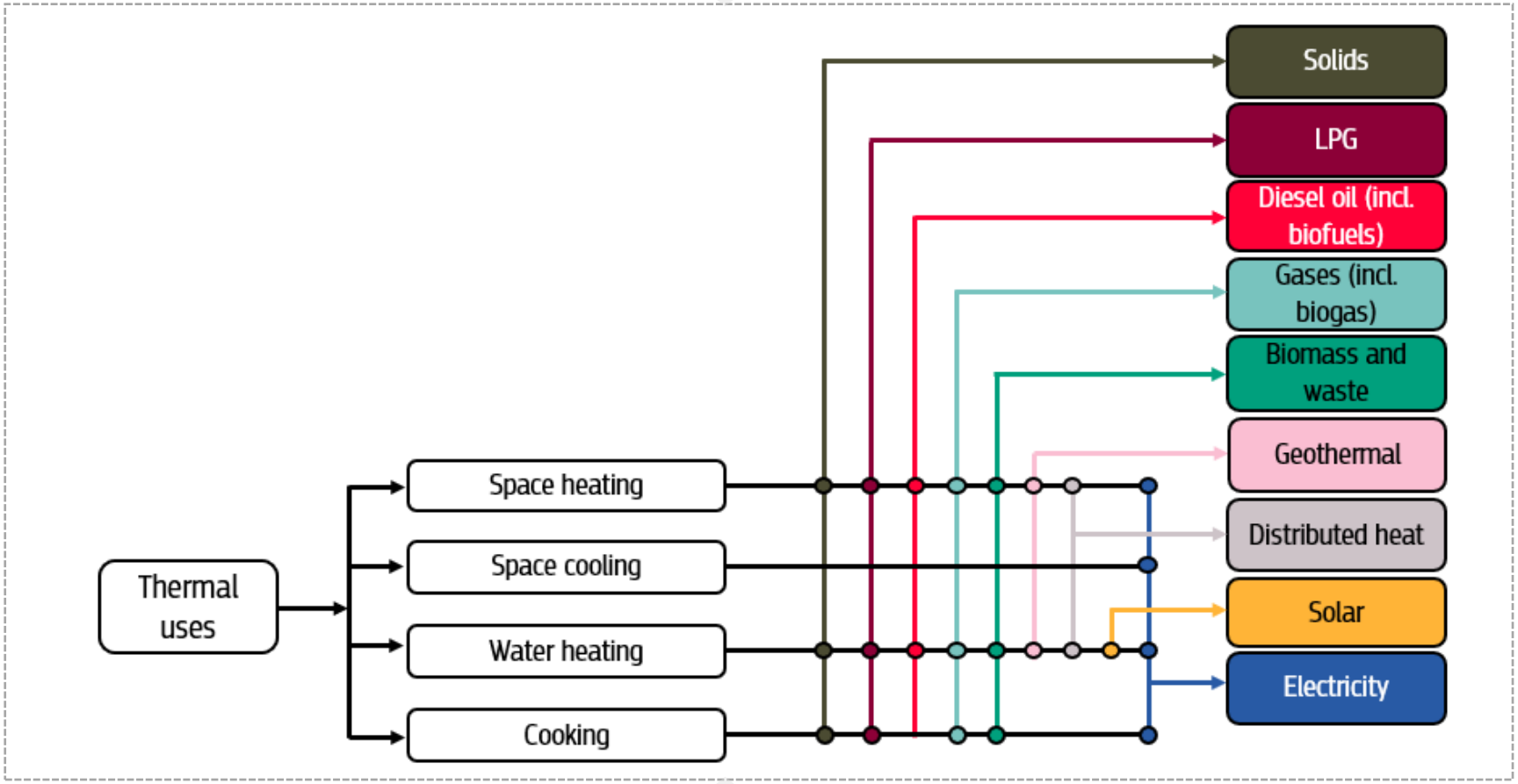

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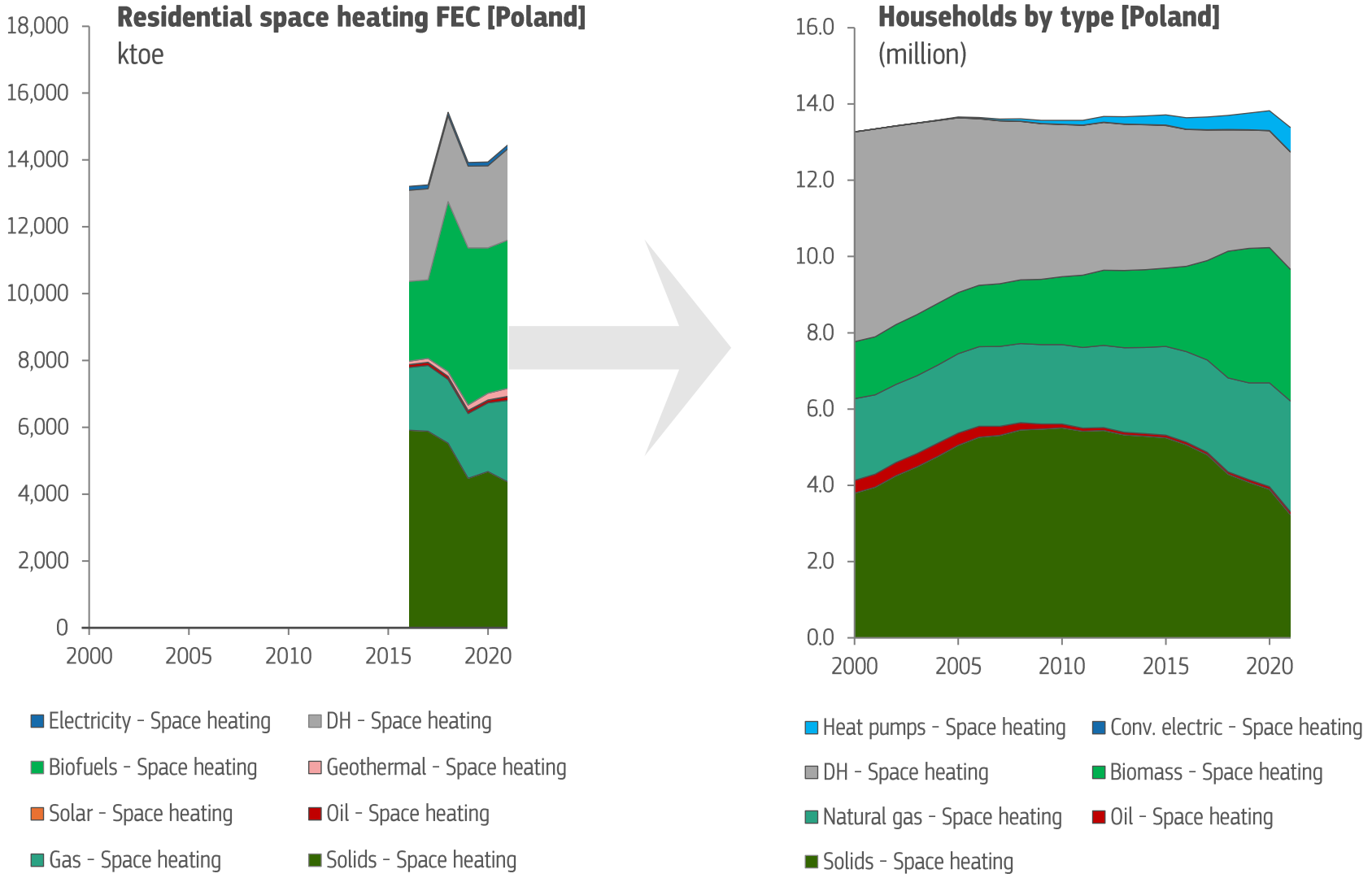
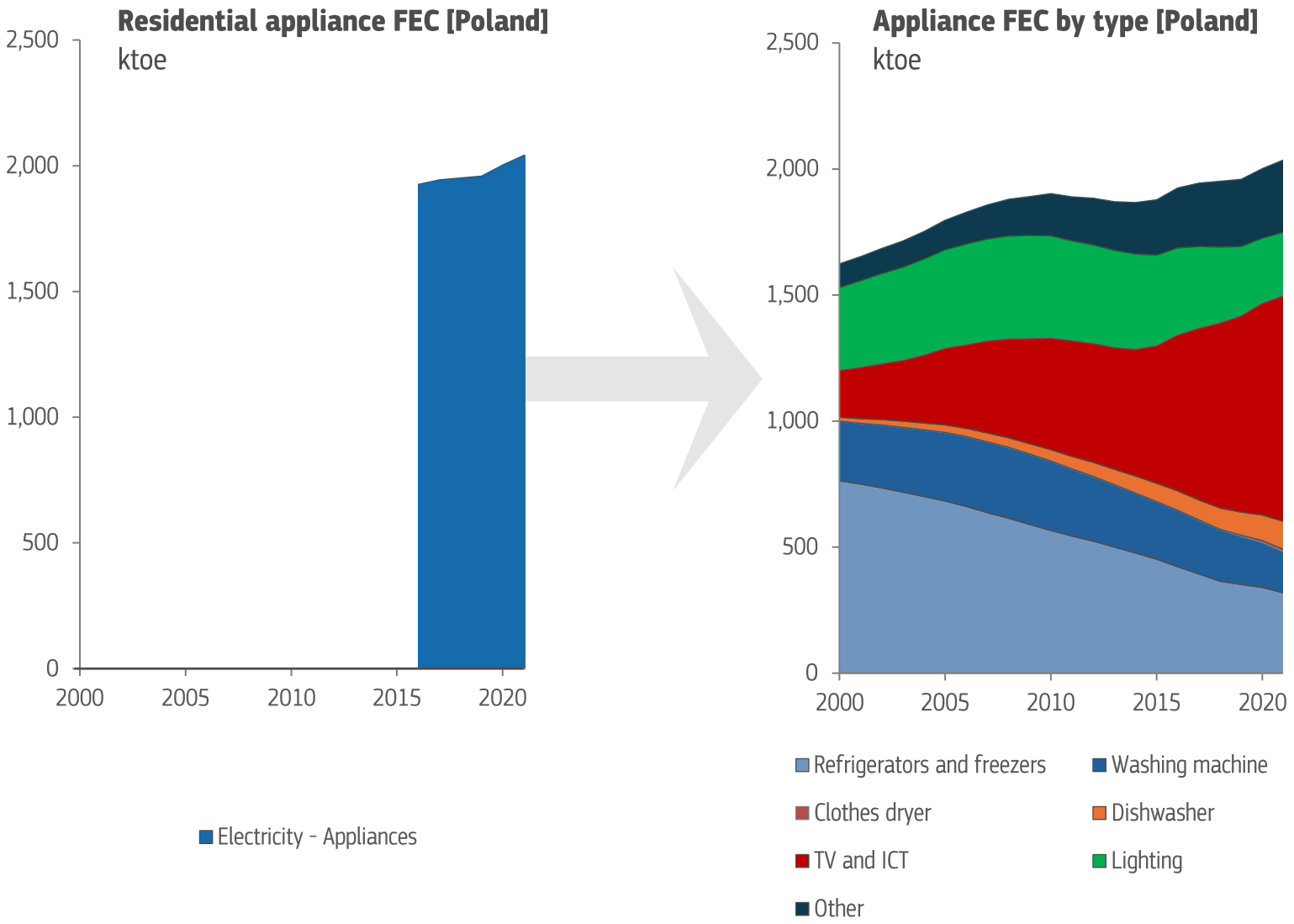
Typical calibration result: households by equipment type



Typical calibration result: FEC by appliance type



Main residential indicators reported in JRC-IDEES

Level of reporting	*Reported indicator*
Sector	Population
	Heating degree-days
	Number of existing, new and renovated households
	Total useful surface area for existing, new and renovated households
	Household size (inhabitants per household)
	Total FEC by energy carrier
	Total energy-related CO_2 emissions by energy carrier

- All indicators: 2000-2023 annual time series for each Member State
- See JRC-IDEES documentation for background and references
- Three categories of indicators:
  - **Primary statistics** (top-down constraint)
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  - **Own estimates** (bottom-up/technical assumptions or modelling)

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Thermal uses	Number of existing, new and renovated households by installed heating equipment
	FEC by thermal use and by energy carrier
	Thermal energy service by thermal use and by energy carrier
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Electrical appliances	Number of existing, new and replaced appliances
	Penetration factor (appliances per household)
	Power per appliance and per new appliance (in average operating mode)
	Installed electrical capacity
	Operating hours
	Total FEC; FEC by electrical appliance

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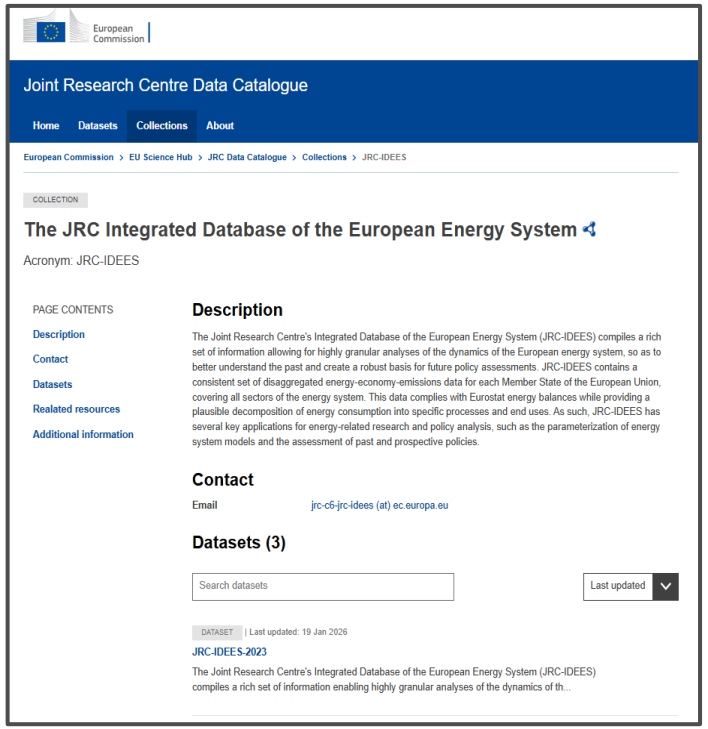
JRC-IDEES-2023

- **JRC-IDEES-2023 v1.0** (January 2026): coverage extended to 2000-2023 with new data sources and improved calibration
- Dataset and documentation in open access from JRC Data Catalogue: https://data.jrc.ec.europa.eu/collection/id-0110



Conclusion

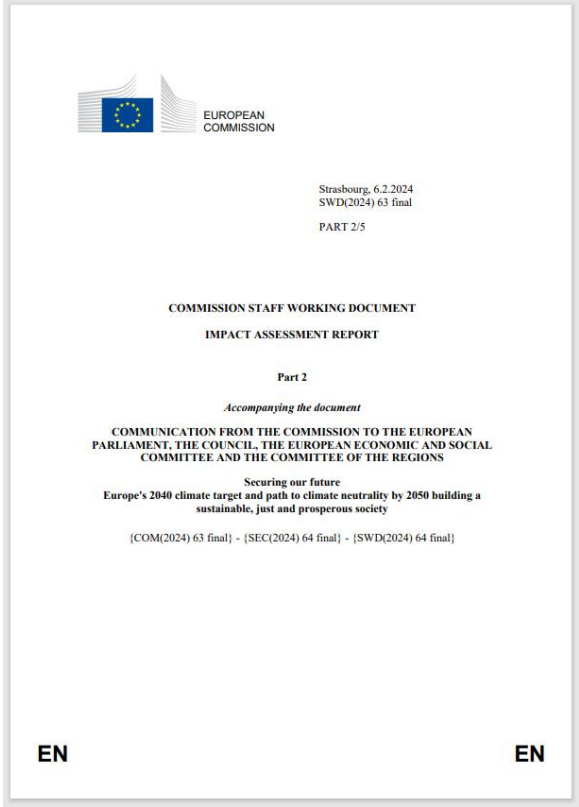
- JRC-IDEES can help
  - Identify past drivers of energy system change
  - Quantify the scope for future policy actions at a granular level
  - Set a common reference for energy policy modelling and assessment
- But keep in mind JRC-IDEES is mostly **processed data**, rather than a pure statistical database
- Work already started on next updates and geographic enlargement to Energy Community countries

Thank you

- JRC-C6-IDEES@ec.europa.eu
- https://joint-research-centre.ec.europa.eu/scientific-tools-databases/potencia-policy-oriented-tool-energy-and-climate-change-impact-assessment_en

JRC POTEnCIA
energy system model

- POTEnCIA: developed since 2011 by the JRC to build in-house capacity to run detailed scenarios for climate and energy policy analysis
- Initial review phase in close collaboration with Commission, MS and academia experts
- Operational since 2019 with the publication of the Central Scenario
- Model extensions since Central scenario: Focussed on representing energy transition/deep decarbonisation
- Application in 2040 Climate Target's Impact Assessment, in the context of a multi-model analysis


EUROPEAN COMMISSION

Strasbourg, 6.2.2024
SWD(2024) 63 final

PART 2/5

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Part 2

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Securing our future
Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society

{COM(2024) 63 final} - {SEC(2024) 64 final} - {SWD(2024) 64 final}

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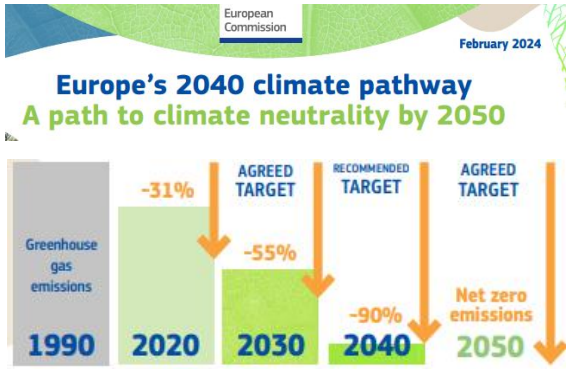
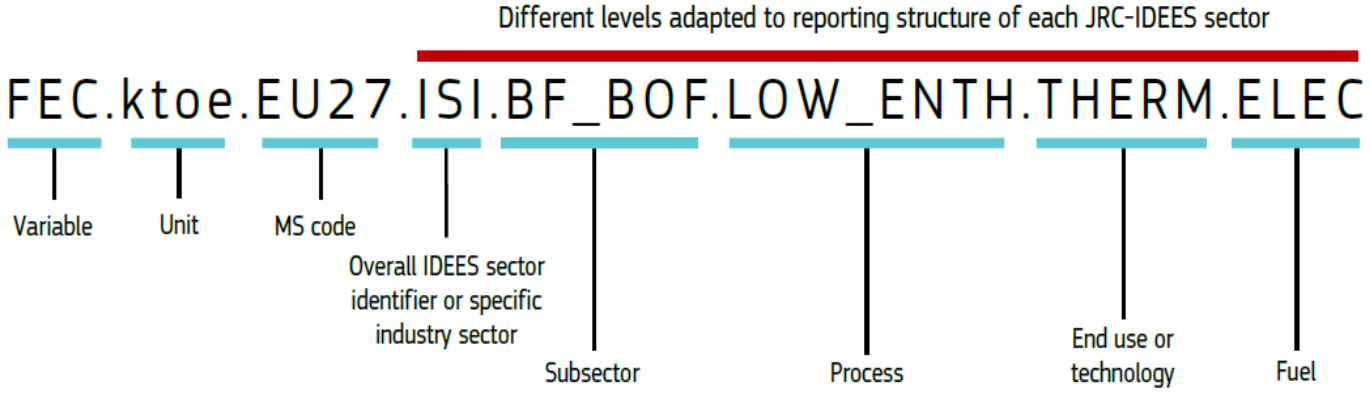


JRC-IDEES-2023

Sector	*Summary of changes*
Industry	The calibration of (sub-)sector-level activity using Eurostat Structural Business Statistics (24) now incorporates dataset *sbs_ovw_act* (Enterprises by detailed NACE Rev. 2 activity and special aggregates, 2021-2023). During calibration, this dataset was assessed to be generally consistent with the earlier *sbs_na_ind_r2* dataset (2005-2020) for the purposes of JRC-IDEES, but the combination of the two datasets could create breaks in reported time series for value added.
Residential	The calibration of residential thermal uses now incorporates Eurostat dataset *nrg_inf_hptc* (Heat pumps - technical characteristics by technologies) (25) and the updated Ecodesign Impact Accounting 2024 reports (26). The latter reference is also used in the calibration of appliances.
Tertiary and agriculture	Consistently with the residential sector, the calibration of thermal uses in services now uses Eurostat dataset *nrg_inf_hptc* (Heat pumps - technical characteristics by technologies) (25) and the updated Ecodesign Impact Accounting 2024 reports (26). The calibration of appliances has been further adapted to represent the increasing importance of data centres (section 3.3.1.3).
Transport	The methodology used to calibrate aviation and maritime transport has been detailed in a separate report (27). This calibration methodology has been slightly adapted for JRC-IDEES-2023 to better reflect the contribution of ships below 5,000 gross tonnage to intra-EU emissions. For the overall transport sector, Ref. (28) now further discusses sources and calibration.
Power & heat generation	The calibration of generation capacities was additionally verified using the National Energy and Climate Plans of the EU Member States (29) and the ENTSO-E Transparency Platform (30). A simplified dispatch optimization model was used to ensure that calibrated capacities, efficiencies, and generation are technically feasible and consistent with plausible dispatch decisions at the level of individual power plant types reported in JRC-IDEES.

JRC-IDEES-2023

- For easier processing of the data files in Python, R, etc.,
  rows in col. DA of the Excel data files now each have a unique identifier



						2000	...	2021
MS code	Industry sector	Subsector	Process	End use	Fuel			
EU27	ISI	TOTAL	TOTAL	TOTAL	TOTAL	34962.264098	...	24254.125065
					NONCOKE_SOLIDS	1438.147902	...	1395.715232
					COKE	3902.243336	...	1213.662511
					RFG	0.000000	...	0.320292
					LPG	397.085297	...	218.310727
...	...	...	...	...	...	...	...	...
SK	OIS	OIS	PROC_COOL_STEAM	STEAM	BIOMASS_WASTE	1.313050	...	0.179430
					STEAM_DISTR	0.033227	...	0.000000
			PROC_COOL_ELEC	ELEC	ELEC	1.187538	...	3.541869
			MOTOR	MECH	DIESEL_LIQBIO	13.795061	...	9.153116
			GENERIC	MECH	ELEC	38.542176	...	75.900344