LEAP 4 SME

ENERGY AUDIT POLICIES TO DRIVE ENERGY EFFICIENCY

A methodology to characterize energy consumption in SMEs at national level in European countries

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17th SDEWES Conference – Paphos (CY), 8 November 2022

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Italian National Agency for New Technologies, Energy and Sustainable Economic Development

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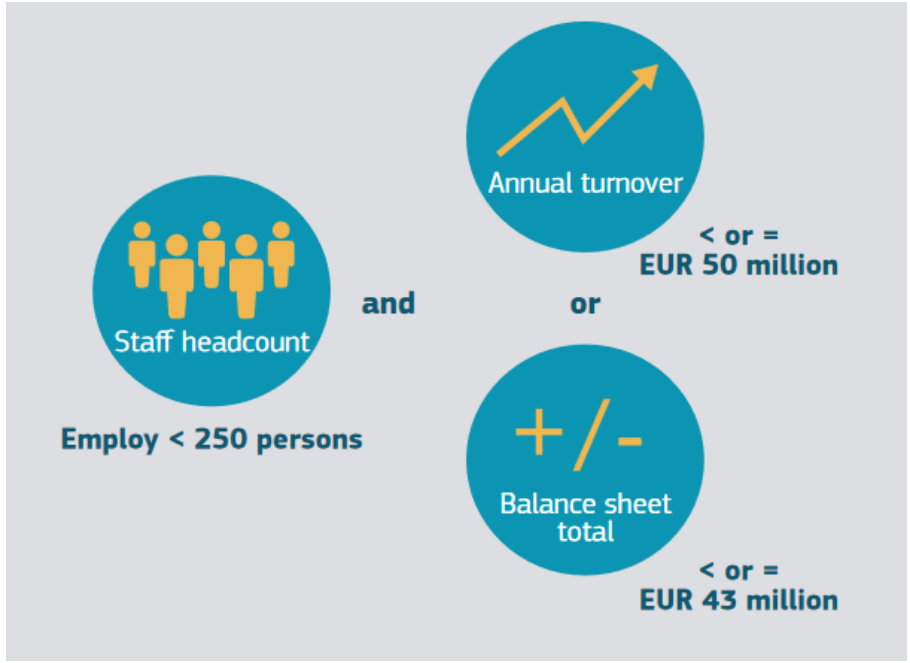
1. Definition of SMEs

- Small and medium-sized enterprises (SMEs) are defined in the EU recommendation 2003/361
- An enterprise is considered to be any entity engaged in an economic activity, irrespective of its legal form. This includes, in particular, self-employed persons and family businesses engaged in craft or other activities, and partnerships or associations regularly engaged in an economic activity.



Enterprise category	Headcount: annual work unit (AWU)	Annual turnover	or	Annual balance sheet total
Medium-sized	< 250	≤EUR 50 million	or	≤ EUR 43 million
Small	< 50	≤EUR 10 million	or	≤ EUR 10 million
Micro	< 10	≤EUR 2 million	or	≤ EUR 2 million

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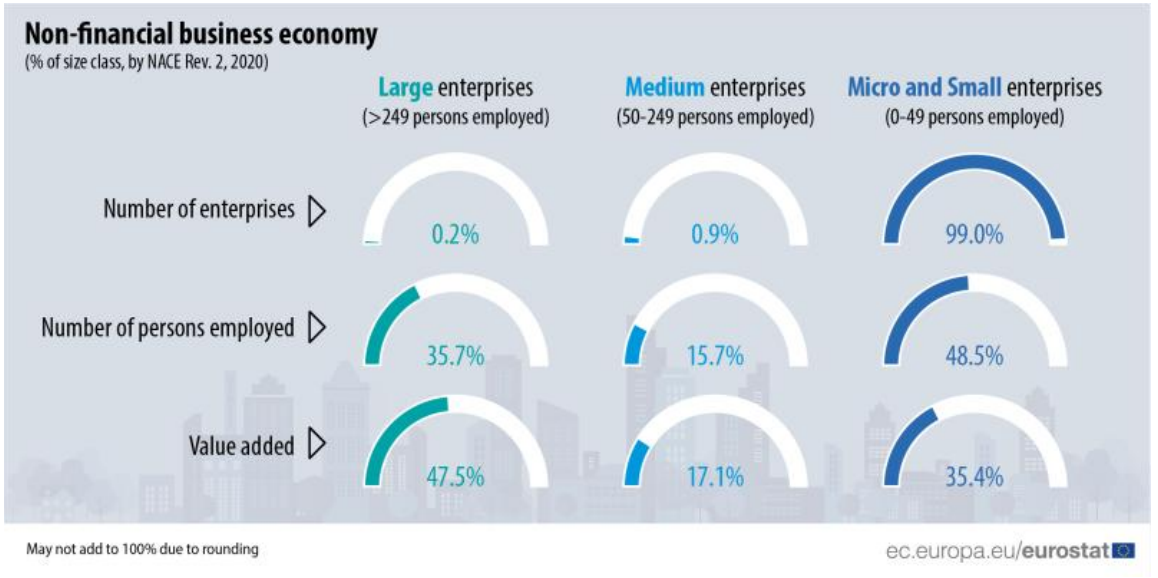
1. Definition of SMEs

- The 99.8% of European Enterprises are SMEs (Max 0,5% of Large Enterprises DE/LU)
- 100 million of employees in SMEs
- 50 % of Europe's Gross Domestic Product (52% of Gross Value Added)

https://ec.europa.eu/commission/presscorner/detail/en/fs_20_426



https://ec.europa.eu/eurostat/cache/infographs/sbs_2022/

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1. Energy consumption of SMEs

- IEA estimates that SMEs accounts for about 13% of total global energy demand [3]
- Their environmental impact is estimated to be about 60% to 70% in EU in 2010 [4]
- The estimation of potential of energy efficiency in SMEs can be between 10% [5] and 30% [3] with cost-effective measures, of which 37% could be achieved with zero capital investment [6]
- SME consumption at national level has been estimated in a limited number of papers published in the literature.
  - ITALY [14], industrial SMEs in Italy could achieve 60% of domestic consumption accounting for 16 Mtoe [15]
  - SWEDEN, 30% of industrial energy consumption is due to non-energy-intensive SMEs [16]
  - UK SMEs could account for more than half of total industrial and tertiary energy consumption [17]

Lack of information of methodologies applied to evaluate the energy consumption of SMEs. Quantitative analyses of SMEs overall energy efficiency potential are still scarce

LEAP4SME

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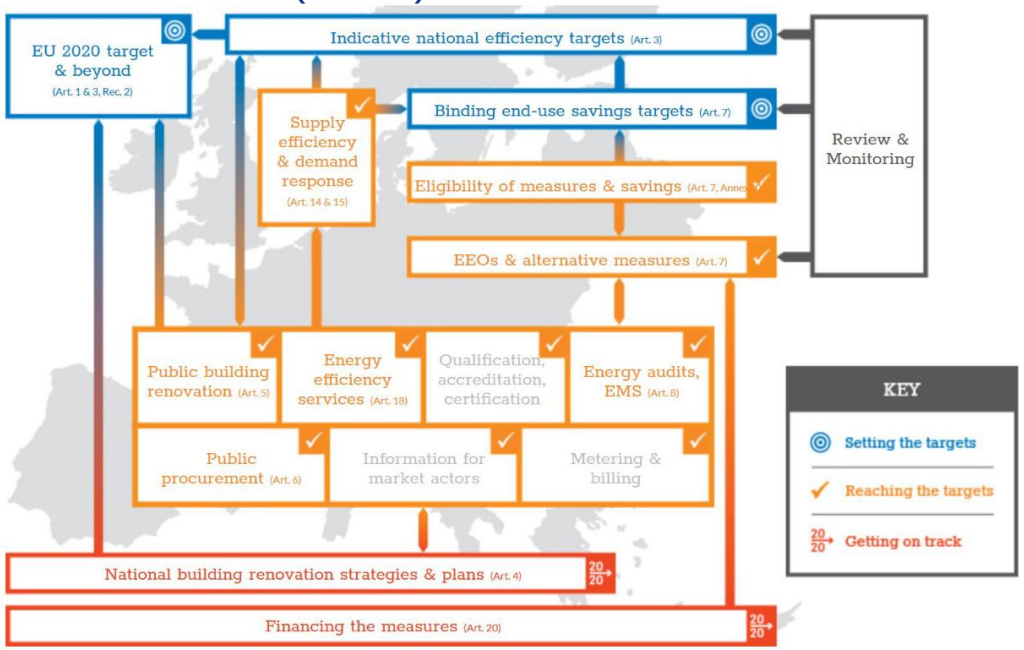
2. Methodology - energy consumption of SMEs

- **<u>The aim of this work is to present a methodology for the energy consumption characterization of European SMEs at national level</u>**
- The estimation of energy consumption of European SMEs is based on two main data sources:
  - National data from large enterprises Art.8 EED (managed by Energy Ministries or Agencies)
  - Official energy statistics published by Eurostat: National Energy Balances (NEB) & Physical Energy Flow Accounts (PEFA)



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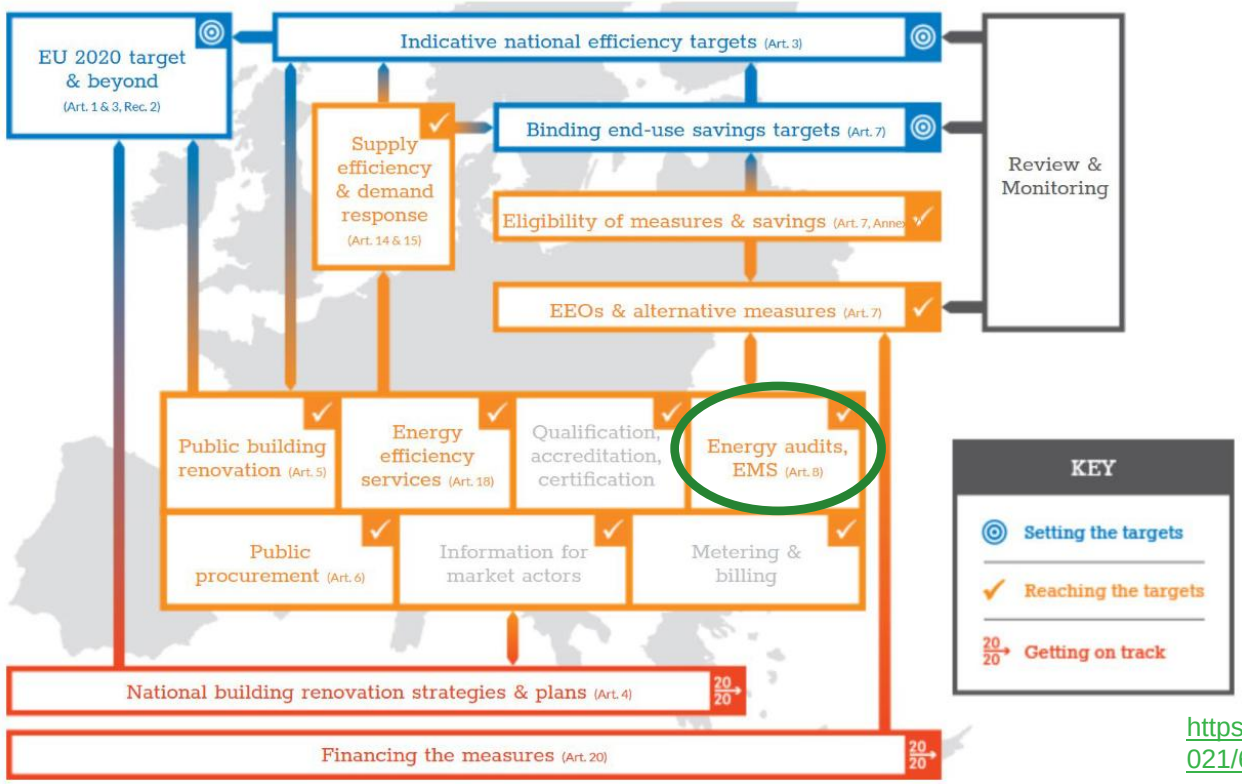
2. Methodology - energy consumption of SMEs

- Energy Efficiency Directive is the regulatory framework to help the EU reach its energy efficiency targets and it is composed of a balanced collection of binding measures and recommendations
- EED Art. 8 → Large enterprises obligation to carry out energy audits every 4 years



https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/662615/EPRS_BRI(2021)662615_EN.pdf

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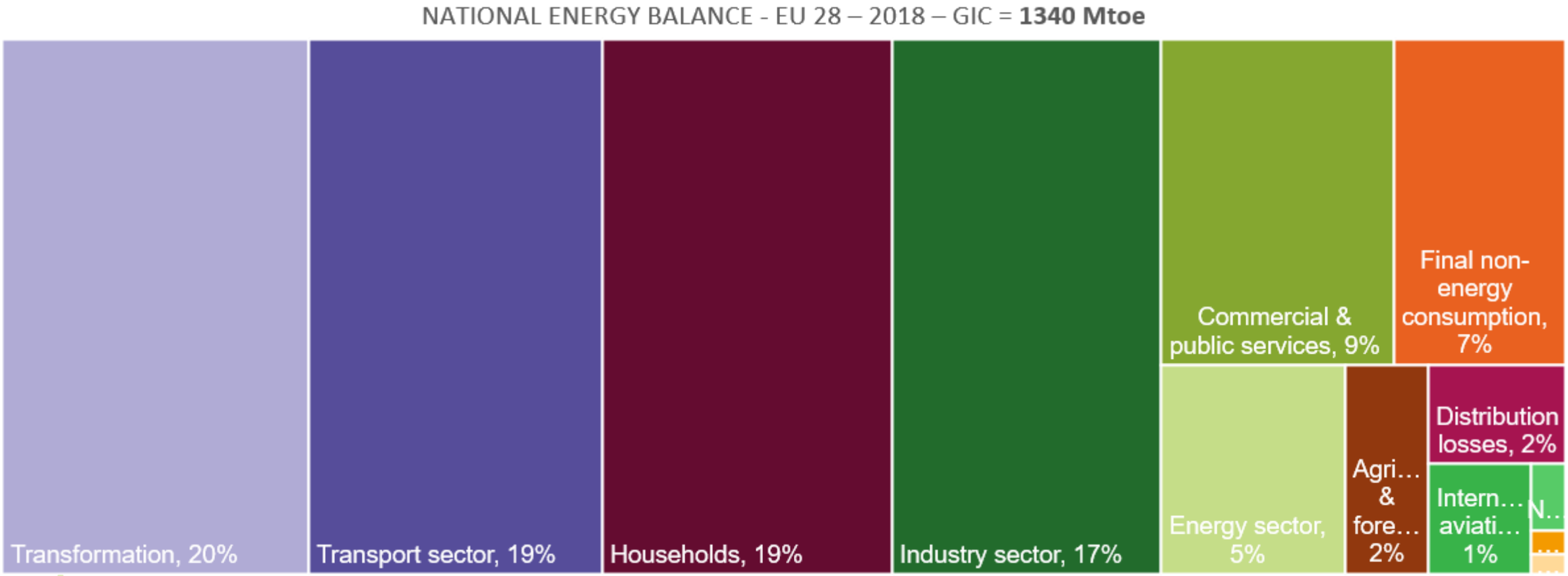
2. Methodology - energy consumption of SMEs

- Official energy statistics published by Eurostat:
  - **National Energy Balances (NEB)** & Physical Energy Flow Accounts (PEFA)

NEB is based on “fuel-sales-on-the-territory” principle and the consumption aggregated by transformation and final uses



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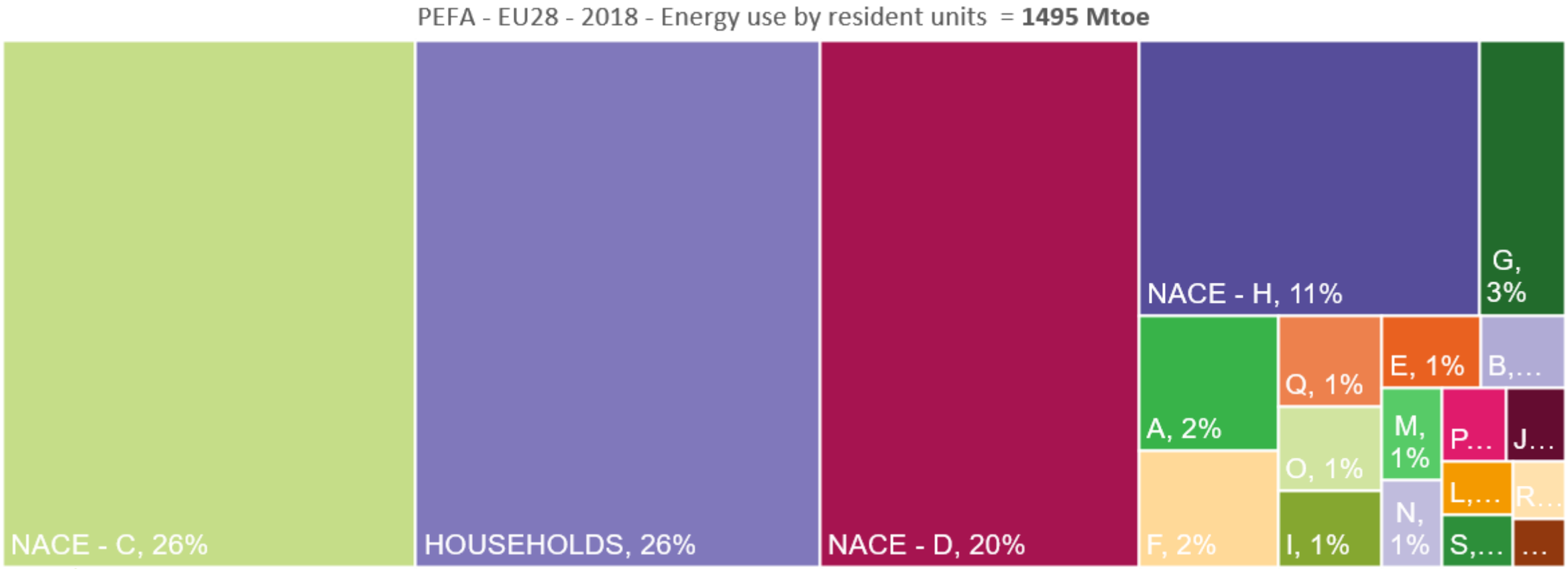
2. Methodology - energy consumption of SMEs

- Official energy statistics published by Eurostat:
  - National Energy Balances (NEB) & **Physical Energy Flow Accounts (PEFA)**

PEFA is based on “residence” principle and the primary energy consumption aggregated by economic activity (NACE)



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2. Methodology - energy consumption of SMEs

- The Gross Inland consumption is estimated as the sum of:
  - + Household (NEB+PEFA)
  - + Large enterprises (Art. 8 EED)
  - + Public companies (PEFA)
  - + Others (NEB)
  - + **SMEs --- Calculated by difference**

- Four scenarios analyzed to estimate a consumption range of SMEs:
  - **"Base" and "Refined" methods (definition of obligated enterprise)**
  - **With or without "Bridge correction" (reconciliation Eurostat databases)**

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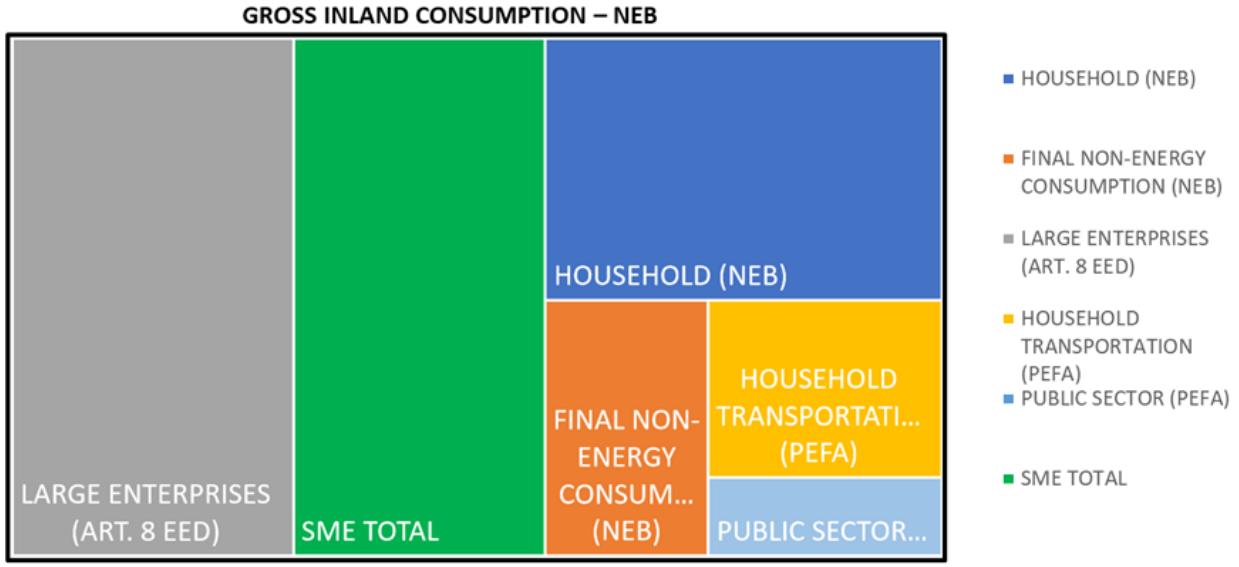
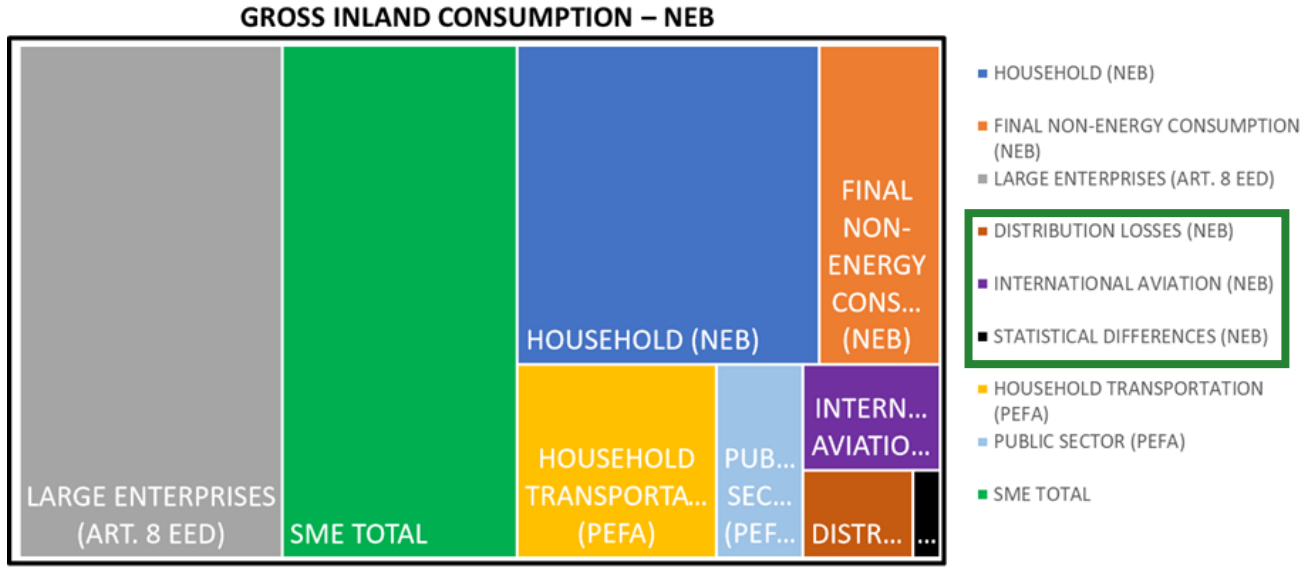
2. Methodology - energy consumption of SMEs

- "Base" and "Refined" methods depends on national definition of obligated large enterprise
  - **"Base" → Allocate Distribution Losses, International Aviation & Statistical Differences to LE**
  - **"Refined" → Exclude Distribution Losses, International Aviation & Statistical Differences**

Base Method



Refined Method



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2. Methodology - energy consumption of SMEs

- With or without “Bridge correction” (reconciliation Eurostat databases)
  - **Bridge correction allocate transportation and other discrepancies from PEFA to NEB**
  - **Main impact on household transportation calculation**

PEFA (Without Bridge Correction)

PEFA – Total Energy Use- 1495 Mtoe

NEB – GIC – 1340 Mtoe

BRIDGE Table

Bridge (With Bridge Correction)

	PEFA – Net domestic energy use (ENV_AC_PEFASU)
Land transport	50 % NACE H / 50% HH Transport
Water transport	NACE H
Air transport	NACE H
Other adjustments and statistical discrepancies	ALL ACTIVITIES (proportional to consumption)

Bridge Correction PEFA – Total Energy Use – 1340 Mtoe

NEB – GIC – 1340 Mtoe

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2. Methodology - energy consumption of SMEs

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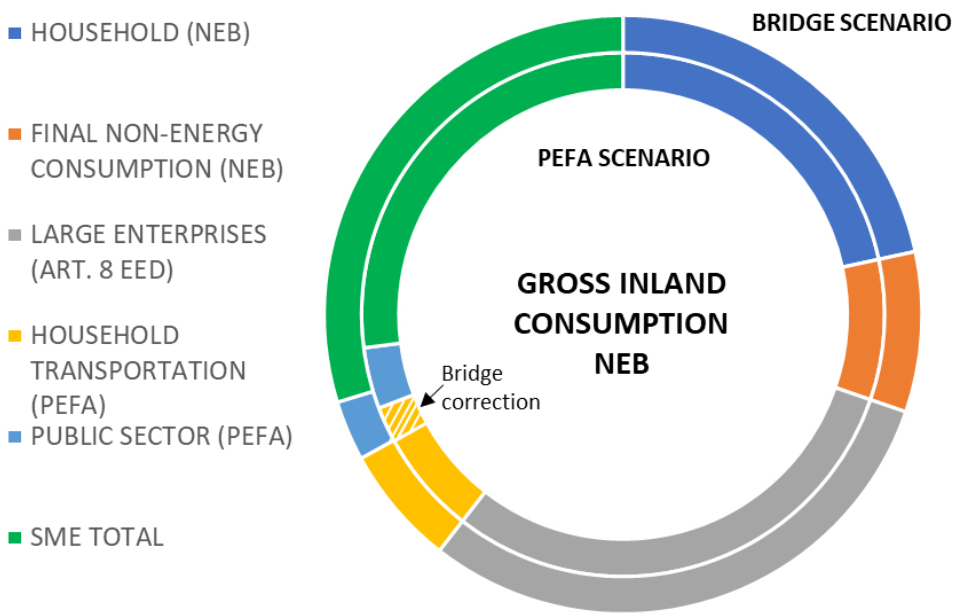
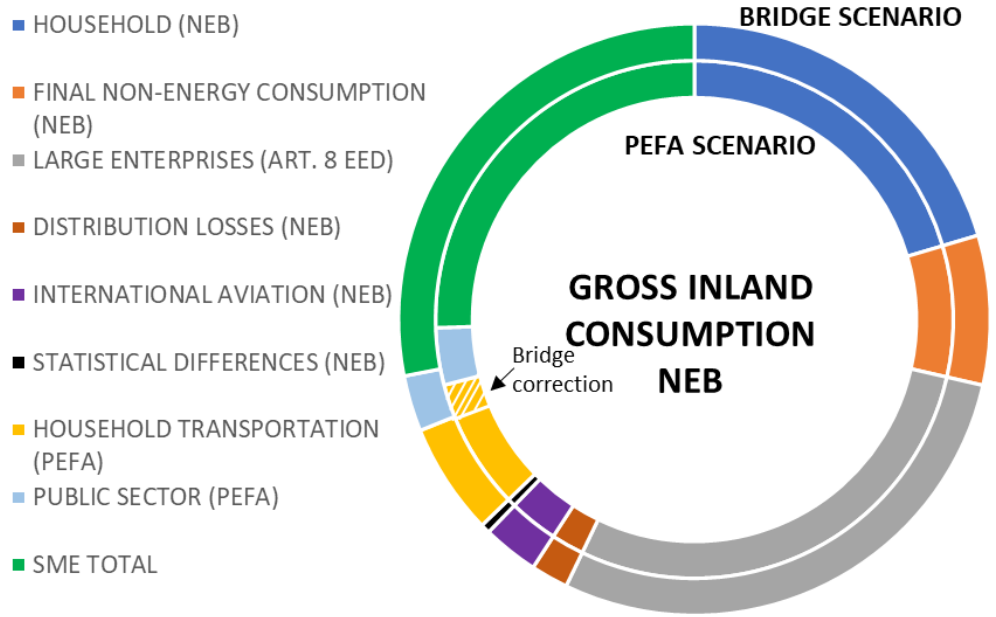
- Four scenarios:
  - **"Base" and "Refined" methods (definition of obligated enterprise)**
  - **With or without "Bridge correction" (reconciliation Eurostat databases)**

Base Method



Refined Method



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3. Estimation of national energy consumption of SMEs

- Application to Italy and Austria ITALY: 23-28% GIC (43-48% SMEs) ; AUSTRIA: 6-15% GIC (10-23% SMEs)
- Refinement of the range variable of the country → Real value Austria ~15% GIC. No refinement to Italy (~ 23-28% GIC)
- Useful estimation of Art.8 Large Enterprises consumption → Homogenization methodology

		ITALY				AUSTRIA			
		BASE [ktoe]		REFINED [ktoe]		BASE [ktoe]		REFINED [ktoe]	
		PEFA	Bridge	PEFA	Bridge	PEFA	Bridge	PEFA	Bridge
GROSS INLAND CONSUMPTION	GIC [NEB]	159,513				34,423			
DISTRIBUTION LOSSES	DL [NEB]			1992				624	
INTERNATIONAL AVIATION	INTAVI [NEB]			3419				737	
FINAL NON-ENERGY CONSUMPTION	FC_NE [NEB]	7915				1652			
STATISTICAL DIFFERENCES	STATDIFF [NEB]			-352	-352			-0.8	-0.8
HOUSEHOLD (no transport)	FC_OTH_HH_E [NEB]	32,899				6594			
HOUSEHOLD TRANSPORT	HH [PEFA] - HH_TRA [NEB]	20,705	18,033	20,705	18,033	3163	4840	3163	4840
PUBLIC SECTOR	NACE O+P+Q [PEFA]	5919	5799	5919	5799	904	1040	904	1040
LARGE ENTERPRISES	Art. 8 – ENEA/AEA	49,620	49,620	49,620	49,620	17,026	17,026	17,026	17,026
SME TOTAL	Calculated	**42,456**	**45,246**	**37,396**	**40,187**	**5,082**	**3,27**	**3,721**	**1,908**
SME TOTAL	% GIC	**26.6**	**28.4**	**23.4**	**25.2**	**14.8**	**9.5**	**10.8**	**5.5**
LARGE ENTERPRISES		54%	52%	57%	55%	77%	84%	82%	90%
SMEs		46%	48%	43%	45%	23%	16%	18%	10%

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E. Biele, C. Herce, C. Martini, M. Salvio, C. Toro, G. Brandl, P. Lackner, S. Reuter. A methodology to characterize energy consumption in SMEs at national level in European countries. *17th SDEWES Conference – Paphos (CY), 8 November 2022*

3. Estimation of national energy consumption of SMEs

- Application to other 5 countries
- Limited information of LE consumption (+7 countries excluded due to statistical limitations)
- Limited information about estimation methodology
- Data from first cycle of Art.8 EED
- SMEs consumption 38.7% from Sweden to 71.1% in Malta

	GWh	ktoe	Adjustment
AT	200,554	17,245	AEA (This work) and [24]
BE	30,824	2,650	Extrapolation from 265 companies [Wallonia] to 1050 obligated companies
BG	11,190	962	Extrapolation from 69 companies to 400 obligated companies
IT		49,620	ENEA (This work)
MT	999	86	
ES	259,036	22,273	Extrapolation from 80% obligated companies
SE	182,638	15,704	

Development of recommendations on the implementation of certain aspects of Article 8 and Annex VI of the Energy Efficiency Directive (europa.eu - 2018)

[ktoe]	IT	AT	BE	BG	MT	ES	SE
GROSS INLAND CONSUMPTION	159,513	34,424	57,451	18,128	726	122,176	49,231
DISTRIBUTION LOSSES	1992	625	366	469	19	2596	904
INTERNATIONAL AVIATION	3419	737	1368	220	124	3943	633
FINAL NON-ENERGY CONSUMPTION	7915	1652	8458	496	9	4940	2178
STATISTICAL DIFFERENCES	-352	-1	-29	-170	0	-1693	210
HOUSEHOLD (no transport)	32,899	6595	8135	2254	81	15,063	7462
HOUSEHOLD TRANSPORT	20,705	3164	3417	442	110	15,508	3639
PUBLIC SECTOR	5919	904	1623	320	30	3149	701
LARGE ENTERPRISES	49,620	17,027	10,261	5578	86	27,842	15,704
SME TOTAL	37,397	321	23,853	8522	267	50,829	17,800
SME TOTAL (%GIC)	**23.4**	**10.8**	**46.3**	**49.4**	**71.1**	**48.1**	**38.7**

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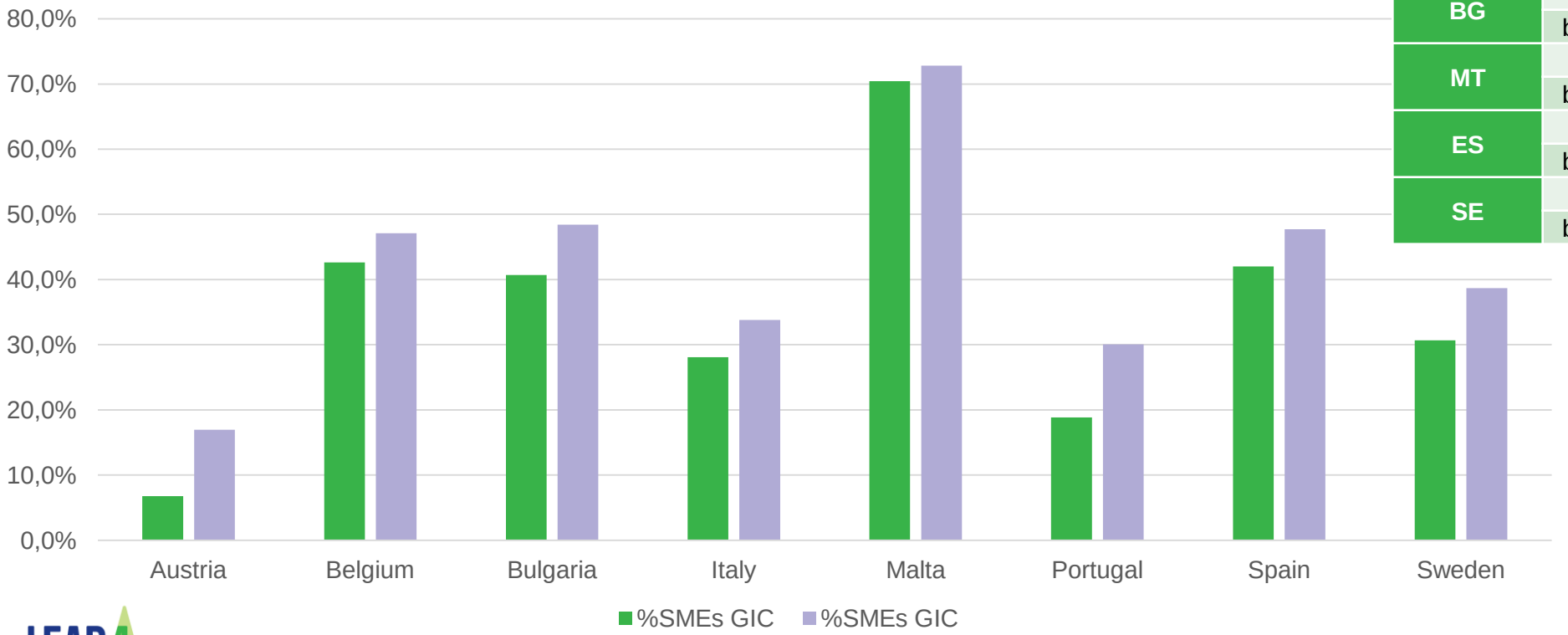
3. Estimation of national energy consumption of SMEs

- "Base case" present a higher consumption of SMEs (the difference varies from 2% of GIC in Belgium to 20% in Malta, median 3.5%).
- The range observed for the values estimated decrease with GIC. Hence, the impact of the method is also dependent on the GIC.
- Impact of the "Bridge correction" in the additional five countries smaller than in Austria (the differences are close to 1% of GIC)→ "Bridge correction" strongly dependent on the national energy structure

		BASE		REFINED	
		PEFA	Bridge	PEFA	Bridge
IT	a) % GIC	27%	28%	23%	25%
	b) % Total	46%	48%	43%	45%
AT	a) % GIC	15%	9%	11%	6%
	b) % Total	23%	16%	18%	10%
BE	a) % GIC	45%	44%	42%	42%
	b) % Total	72%	71%	70%	70%
BG	a) % GIC	49%	50%	46%	47%
	b) % Total	61%	62%	60%	60%
MT	a) % GIC	57%	57%	37%	37%
	b) % Total	83%	83%	76%	76%
ES	a) % GIC	45%	46%	41%	42%
	b) % Total	66%	67%	64%	65%
SE	a) % GIC	40%	40%	36%	36%
	b) % Total	55%	55%	53%	53%



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4. Identification and analysis of uncertainties

1.- Uncertainties due to energy calculation methods for EED Art.8 LEs

- **The main source of uncertainty is the value of energy consumption of large: public available data could be partial and uncomplete; and calculation method is unknown and/or heterogenous**

- **Italy:**

  - Large enterprises that have not complied with the obligation are not included in the analysis (7% of total obligated companies in 2019).
  - The 3% of the analysed energy audits reports a null energy consumption. These audits are being reviewed individually and they could account between 0,19 and 0,56 Mtoe.
  - The Italian regulation allows the companies to present the energy audits of a representative sample of the most relevant production sites, instead of the EA of every site .The consumption of "clustered" sites has been estimated in a 2.5%.
  - The consumption of 2022 is estimated on the basis of the EAs submitted in 2021 (0.72 Mtoe). This value can vary due to the difference on yearly obligation to submit the audit during the 4-year cycle from EED. The consumption of large companies audited was 43.52 Mtoe, 4.67Mtoe and 0.72 Mtoe in 2019, 2020 and 2021, respectively.

- **Austria**: structure of the Art.8 measure exhibits high robustness and data reconciliation. Almost 2,000 companies reported 1,500 Eas. The estimation based on energy threshold consumption provides a consumption of SMEs close to 16.3% of GIC. This value is close to the consumption obtained with "Base method without Bridge correction".

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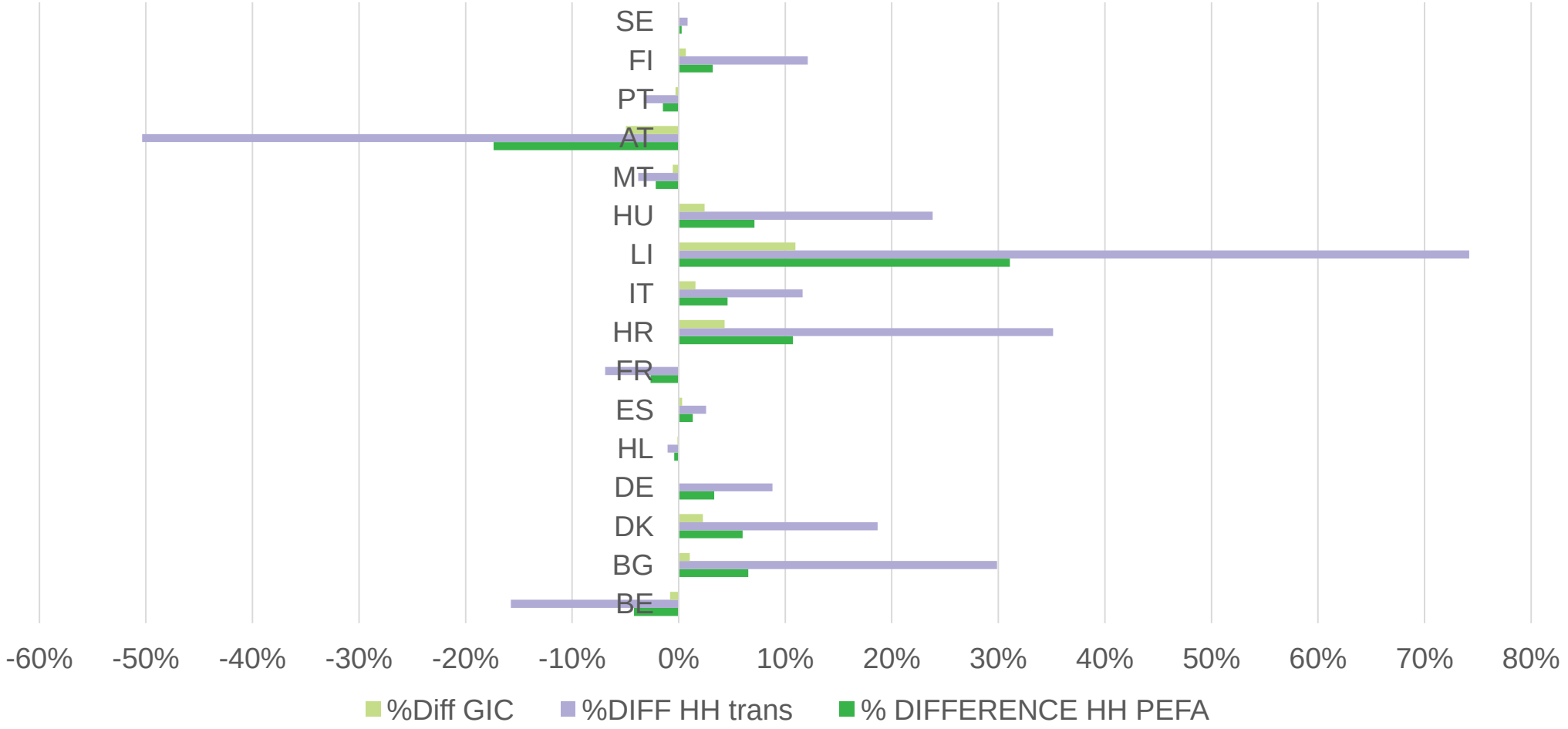
4. Identification and analysis of uncertainties

2.- Bridge correction present a high impact in Austria, Lithuania, Croatia, Bulgaria and Hungary



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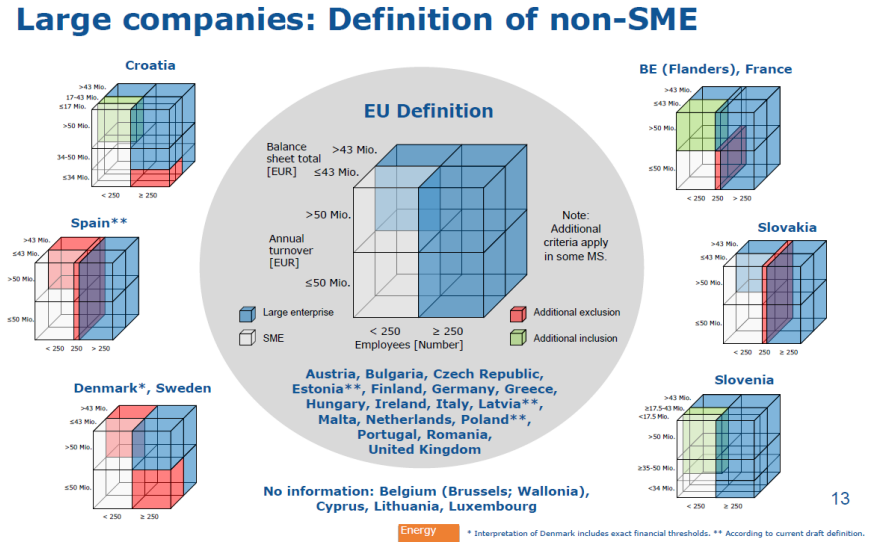
4. Identification and analysis of uncertainties

3.- Harmonization of definition of obligated companies

- The EED Art.8 obliges LEs to carry out an EA every 4 years.
- Definition of LE varies among countries and it has a great impact on the evaluation of the overall energy consumption
- Definition of SME would need to be harmonized.



Technical assistance on assessing the effectiveness of the implementation of the definition of small and medium-sized enterprises for the purposes of Article 8(4) of the Energy Efficiency Directive - Publications Office of the EU (europa.eu - 2021)

Table 2- What type of information is being collected by the entities?

	General Information of the company	General energy performance of the company	Detailed energy performance of the company, divided by the type of facilities, uses, etc.	Overall potential energy savings	Only general information on the type of energy saving measures	Information on individual energy savings, measure per measure	Other
Austria	X	X		X			
Belgium	X		X			X	
Bulgaria			X				
Croatia	X	X					
Cyprus	X	X		X			
Czechia			X		X		
Denmark	X	X	X	X			
Estonia	X	X	X				
Finland	X		X			X	
France	X						
Germany	X						
Greece	X		X	X		X	
Hungary	X	X	X	X		X	
Ireland							X
Italy	X	X	X	X			X
Latvia	X					X	
Lithuania	X	X		X		X	
Malta	X	X	X	X		X	
Netherlands	X	X	X	X		X	
Portugal	X	X	X	X		X	
Romania	X	X				X	X
Slovakia	X	X		X	X		
Slovenia	X					X	
Spain	X	X		X			
Sweden	X	X	X				
United Kingdom							X

Analysis on the practices to collect, store and assess information arising from energy audits in the EU-28 - Publications Office of the EU (europa.eu - 2019)

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5.Conclusions

- A methodology to characterize the energy consumption of EU countries has been developed and tested in Italy and Austria
- In order to extend the methodology at the European level, further work is needed to harmonize the quality of information provided by mandatory energy audits and to homogenize different public statistics. The proposed method needs further investigation, and future work will focus on other aspects, such as the breakdown of consumption between the "Basic" and "Refined" methods, or the impact of the reference year.
- The analysis provides a first set of policy insights, which could also help to improve the implementation of Article 8 of the EED:
    1. It is necessary for Member States to define a common methodology for accounting the national consumption of large enterprises detailing which items are included or not (transportation, distribution losses etc) and that these numbers are made public and updated.
    2. The NEB and PEFA databases are the cornerstones of Eurostat's public energy information: an official merging of both databases will be very useful to obtain a common, multilevel, and aggregated energy database for subsequent independent analysis at sectoral level.
    3. A harmonized application of the definition of SME at European and national level will be necessary to compare the energy structure across countries.

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Thank you for your attention!

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