Today’s agenda

This webinar is part of the Sustainable Energy Days #EUSEW2026

European Commission

- Beyond Statistics: What Energy Audit Data Can Tell Us About Manufacturing Efficiency

Janita Andrijevskaja (TalTech - Tallinn University of Technology)

- Benchmarking methodology from data of mandatory energy audits in Italy

Carlos Herce (ENEA)

- SGCIE Data Collection and Benchmarking

Paulo Calau (ADENE)

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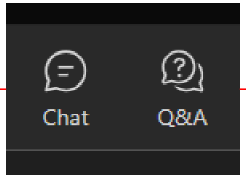
and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting author
held responsible for them.

Practical info

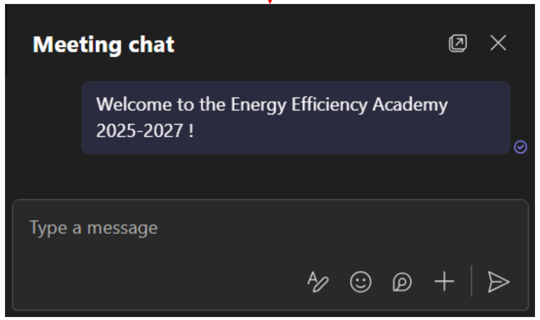
- Mics and cameras are set off for participants

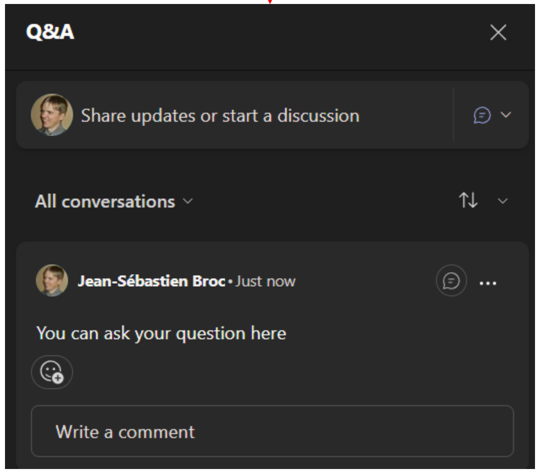
- Use the Q&A panel to ask your questions



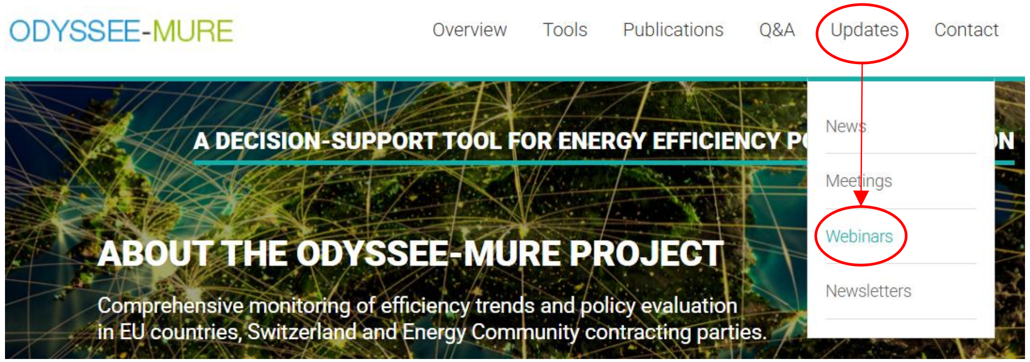
Share info and comments

Ask, upvote or comment questions



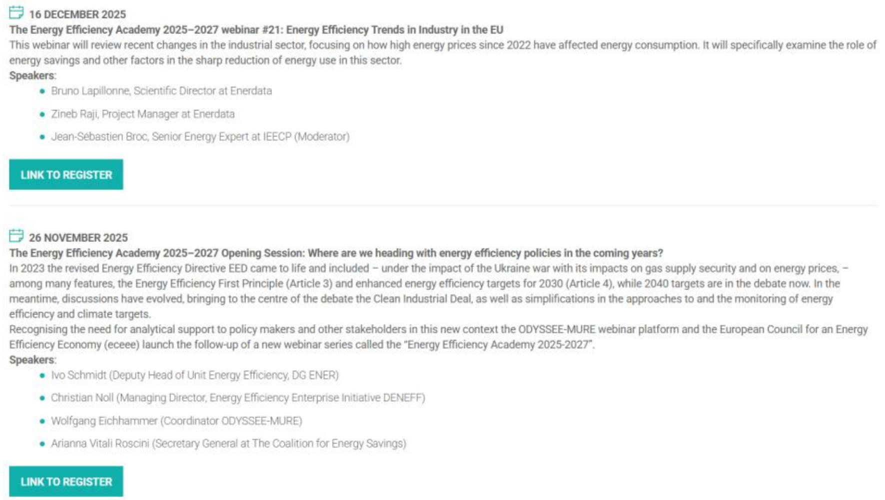


Info on webinars



All at once:

- Information about next webinars (dates, registration links, …)
- Proceedings of previous webinars (recordings, presentation files)



16 DECEMBER 2025

The Energy Efficiency Academy 2025–2027 webinar #21: Energy Efficiency Trends in Industry in the EU

This webinar will review recent changes in the industrial sector, focusing on how high energy prices since 2022 have affected energy consumption. It will specifically examine the role of energy savings and other factors in the sharp reduction of energy use in this sector.

Speakers:

- Bruno Lapillonne, Scientific Director at Enerdata
- Zineb Raji, Project Manager at Enerdata
- Jean-Sébastien Broc, Senior Energy Expert at IEECP (Moderator)

LINK TO REGISTER

26 NOVEMBER 2025

The Energy Efficiency Academy 2025–2027 Opening Session: Where are we heading with energy efficiency policies in the coming years?

In 2023 the revised Energy Efficiency Directive EED came to life and included – under the impact of the Ukraine war with its impacts on gas supply security and on energy prices, – among many features, the Energy Efficiency First Principle (Article 3) and enhanced energy efficiency targets for 2030 (Article 4), while 2040 targets are in the debate now. In the meantime, discussions have evolved, bringing to the centre of the debate the Clean Industrial Deal, as well as simplifications in the approaches to and the monitoring of energy efficiency and climate targets.

Recognising the need for analytical support to policy makers and other stakeholders in this new context the ODYSSEE-MURE webinar platform and the European Council for an Energy Efficiency Economy (eceee) launch the follow-up of a new webinar series called the "Energy Efficiency Academy 2025-2027".

Speakers:

- Ivo Schmidt (Deputy Head of Unit Energy Efficiency, DG ENER)
- Christian Noll (Managing Director, Energy Efficiency Enterprise Initiative DENEFF)
- Wolfgang Eichhammer (Coordinator ODYSSEE-MURE)
- Arianna Vitali Roscini (Secretary General at The Coalition for Energy Savings)

LINK TO REGISTER

New ODYSSEE-MURE publication

ODYSSEE-MURE | Policy brief | April 2026

1

Monitoring Manufacturing Energy Performance: What the Statistics Show

Lead authors: *Janita Andrijevskaja (TalTech), Inge Roos (TalTech), Anna Volkova (TalTech)*

Reviewers: *Bruno Lapillonne (Enerdata), Lea Gynther (Motiva)*

Key questions

- **Why is aggregate energy intensity a weak proxy for efficiency?**
- **What drives energy intensity variation across countries within the same subsector?**
- **How to monitor manufacturing efficiency credibly?**

Aggregate manufacturing indicators show relative decoupling but mix genuine efficiency gains with structural factors like product mix, process routes, and capacity utilisation. Even within narrow subsectors, energy intensity varies by factors of 2–3 across countries. Credible monitoring requires disaggregation to homogeneous categories and validation against micro-level audit data.

Manufacturing Energy Trends: Intensity, Efficiency and Structural Change

When policymakers discuss "industrial energy efficiency," they often blur the distinction between **industry** and **manufacturing**. According to the NACE Rev.2 classification, "industry" (sections B-F) encompasses mining, utilities, construction, and manufacturing, while manufacturing (section C) refers specifically to the physical transformation of materials into products. This distinction matters because manufacturing alone comprises 232 different activity classes: from dairy products to steel mills and pharmaceutical production, each with fundamentally different energy characteristics.

Even more problematic is the widespread practice of using **energy intensity**, energy consumption per value added, as a proxy for **energy efficiency**. While this substitution may work reasonably well in sectors with relatively homogeneous outputs (such as passenger transport or office buildings), it breaks down entirely in manufacturing. As studies reveal, even within narrow 4-digit NACE sector, energy intensity can vary by factors of 2 to 15, driven not by efficiency differences but by product mix, process routes, feedstock quality, system boundaries, and capacity utilisation.

Energy efficiency in its technical sense refers to the ratio of useful output to energy input for a given service or product — a concept that requires either micro-level data (company, process) or sufficiently homogeneous sectoral aggregation. At the macro level, what statistics actually capture is **energy intensity**: a descriptive indicator that mixes genuine technical efficiency with structural changes in what is being produced and how.

This is why, throughout this policy brief, we avoid claiming to measure "energy efficiency" at the aggregate manufacturing level. Instead, we present energy intensity trends and specific energy consumption by subsector, acknowledging that these indicators require careful interpretation. True statements about energy efficiency in manufacturing demand either disaggregation to homogeneous product categories (e.g., crude steel by route, cement clinker) or triangulation with expert knowledge, audit data, and process-level benchmarks.

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Co-funded by the European Union

https://www.odyssee-mure.eu/publications/policy-brief/eu-manufacturing-energy-performance.html

Policy brief discussing the **limit of using aggregate energy intensity** as a proxy for energy efficiency in industry.

Illustrated with **practical examples** showing various factors that can explain variations in specific energy consumption across countries within the same subsector.

CONCLUSION: Reliable assessment of energy efficiency progress requires **complementing top-down statistics with micro-level evidence**, notably energy audit data

Upcoming events to meet ODYSSEE-MURE

1-6
June
2026
Lac d'Ailette

All details at:

https://www.eceee.org/summerstudy/

9-11
June
2026
Brussels
and online

EUSEW 2026:

A clean, secure and competitive Energy Union

ODYSSEE-MURE part of the policy session

'Big, simple, attractive: how energy efficiency contributes to a clean, secure and competitive Union'

Wed. 10 June, 11.30 to 13.00 CEST

NH Berlaymont (room Simone Veil), and online

The webinar series will continue after the summer break: Stay tuned !

(1) register to the **ODYSSEE-MURE newsletter** !

https://www.odyssee-mure.eu/events/newsletter/

(2) Follow ODYSSEE-MURE on **LinkedIn**!

https://www.linkedin.com/company/odyssee-mure

ODYSSEE-MURE

Thank you!

Partners:

Fraunhofer ISI

IEECP Institute for European Energy and Climate Policy

Enerdata intelligence + consulting

ADEME Agency for Ecological Transition

ENEA

Statistics Poland

IDAE

MOTIVA

EIHP Energetski institut Hrvoje Požar

Austrian Energy Agency

Université de Genève

SEAI Sustainable Energy Authority of Ireland

klima agence

economie

SIEA Slovak Innovation and Energy Agency

Swedish Energy Agency

KAPE

ENVIROS Advisory

Danish Energy Agency

TNO innovation for life

MEKH Hungarian Energy and Public Utility Regulatory Authority

TAL TECH

Guvernul României Ministerul Energiei

ADENE

Cyprus Energy Agency

ΚΑΠΕ CRES

Zurich University of Applied Sciences zhaw

Netherlands Enterprise Agency

The Energy & Water Agency

AYEP SEDA

Jožef Stefan Institute, Ljubljana, Slovenia

www.odyssee-mure.eu

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Beyond Statistics:

What Energy Audit Data Can Tell Us About Manufacturing Efficiency

Janita Andrijevskaja | Tallinn University of Technology (TalTech)

27 May 2026 | Webinar: Beyond Compliance — Energy Audits as a Policy Tool

TALLINN UNIVERSITY OF TECHNOLOGY

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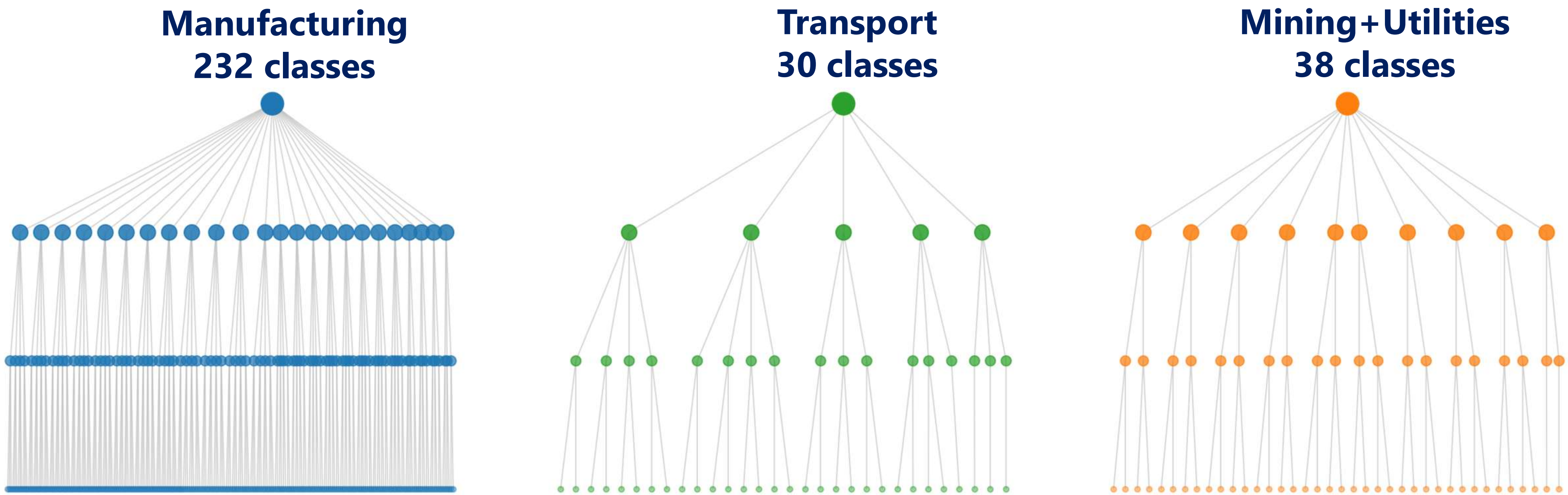
NACE Sectoral Complexity



- **Division = 2-digit**
- **Group = 3-digit**
- **Class = 4-digit**

Andrijevskaja, J., & Volkova, A. (2025). *Industrial energy use, efficiency, and savings: methods for quantitative analysis*. **Energy Efficiency**, 18, 76. https://doi.org/10.1007/s12053-025-10367-5

The Core Problem: Manufacturing Heterogeneity

Why national statistics mislead when sectors are far from homogeneous

232 NACE classes

Manufacturing spans 232 activity classes, covering technically different production systems. At 2-digit NACE level, indicators combine different outputs, process routes, feedstocks and system boundaries – producing a sectoral average, not a measure of technical performance.

Energy varies 10–15× within sectors

Even within narrow 4-digit sectors, energy use per tonne can differ by an order of magnitude. These differences stem from product mix, feedstock, and process route — not inefficiency.

The aggregation risk

At aggregate level energy intensity (energy per € value added) can improve without any technical improvement. Structural shifts, price shocks, and product mix changes all distort the signal.

The main risk is not using aggregate statistics — it is interpreting sectoral averages as technical efficiency.

The Measurement Trap: Intensity ≠ Efficiency

Energy intensity is useful for monitoring, but weak as a direct proxy for technical energy efficiency

Energy intensity change ← Technical efficiency + product mix + process route + utilisation + price effects + boundaries

EI

Energy Intensity (EI)
Energy use per value added or output index. Useful for trend monitoring. Moves whenever any of the components above change — not only when technology improves.

EE

Technical Energy Efficiency (EE)
Useful output per energy input under comparable technical conditions. Can require physical output data, homogeneous product, and consistent system boundaries to measure meaningfully.

⚠

Where EI and EE diverge most sharply
In manufacturing: a sector shift towards less energy intensive products lowers EI without any EE improving. A price shock cuts production and raises EI without any plant getting worse. Neither is efficiency.

✓

When EI is still informative
As a directional indicator over long periods, or when controlling for product mix and activity. The ODEX index (Odyssee) makes progress by integrating physical data for steel, cement, and paper — a useful model.

The strongest studies combine physical, detailed data with explicit treatment of sectoral diversity — that is when efficiency estimates become credible.

From Statistics to Evidence: A Policy Brief

Key questions

- Why is aggregate energy intensity a weak proxy for efficiency?
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- How to monitor manufacturing efficiency credibly?

Lead authors: Janita Andrijevskaja (TalTech), Inge Roos (TalTech), Anna Volkova (TalTech)

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ODYSSEE-MURE Policy brief April 2026

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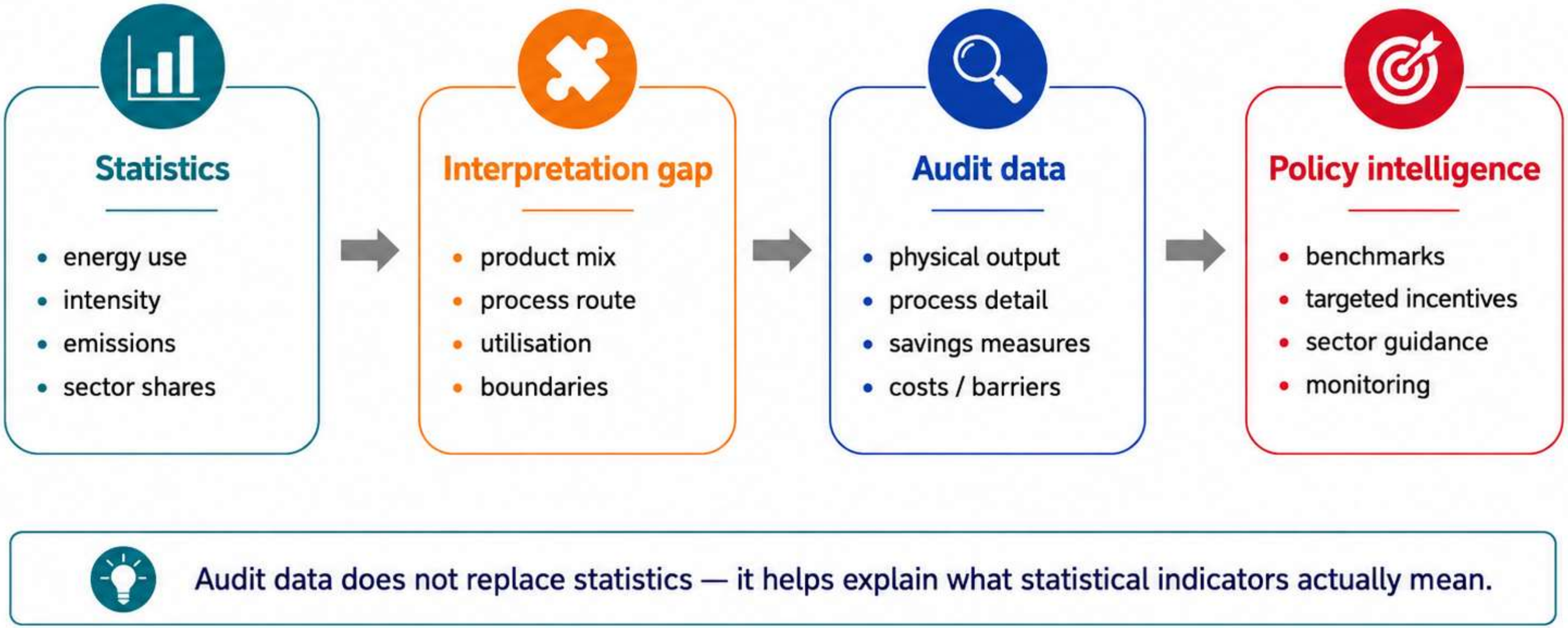
Home > Publications > Policy briefs > Monitoring Manufacturing Energy Performance: What the Statistics Show

From Statistical Monitoring to Policy Intelligence

Bridging the interpretation gap with audit data



Where Is Audit Data Collected? The Policy Architecture

EED obligations create multiple audit data streams — each with different scope and quality

EED Art. 11(2) High-Energy Consumers

- Enterprises with annual energy use >10 TJ/yr
- Mandatory audit at least every 4 years
- Usually covers whole-site energy use and main processes
- More structured than voluntary audits; coverage depends on national transposition

Good coverage of larger energy users; data is more likely to be repeated and structured.

SME Energy Audits (support schemes / incentives)

- Small and medium enterprises
- Often linked to grants, vouchers, or tax relief
- Quality varies; templates are not always standardised
- Often one-off or irregular

Large number of firms and strong savings potential — but data is often fragmented and underused.

Resource + Energy Audits (Integrated)

- Covers material flows together with energy
- Most relevant where material losses drive costs
- Used notably in Germany, Estonia, and Finland
- Captures upstream / embodied energy in materials

Richest analytical picture — but still niche and not mainstream in EU policy.

Key question before using any audit dataset: Who is included? Who is missing? Why was the audit carried out?

The Promise — and the Problems

Audit data is rich, but not automatically research-ready

What audit data offers

- **Physical output** — kWh/tonne, kWh/m^3 — not just euros
- **Process context** — Technology, route, system boundary, capacity
- **Savings evidence** — Identified measures, investment cost, payback
- **Firm-specific detail** — Plant age, feedstock, integration, constraints
- **Benchmarking basis** — Comparable SEC within homogeneous subsectors

BUT

What makes it hard to use

COVERAGE & REPRESENTATIVENESS

- **SME gap** — Small or non-obligated firms are often missing
- **Selection bias** — Audited ≠ typical; often larger or more motivated firms

DATA QUALITY & COMPARABILITY

- **Boundary mismatch** — Whole plant vs one process line — not comparable
- **Loose structure** — Templates vary; units, scope, methods inconsistent
- **Capacity effect** — Low utilisation inflates all specific energy values

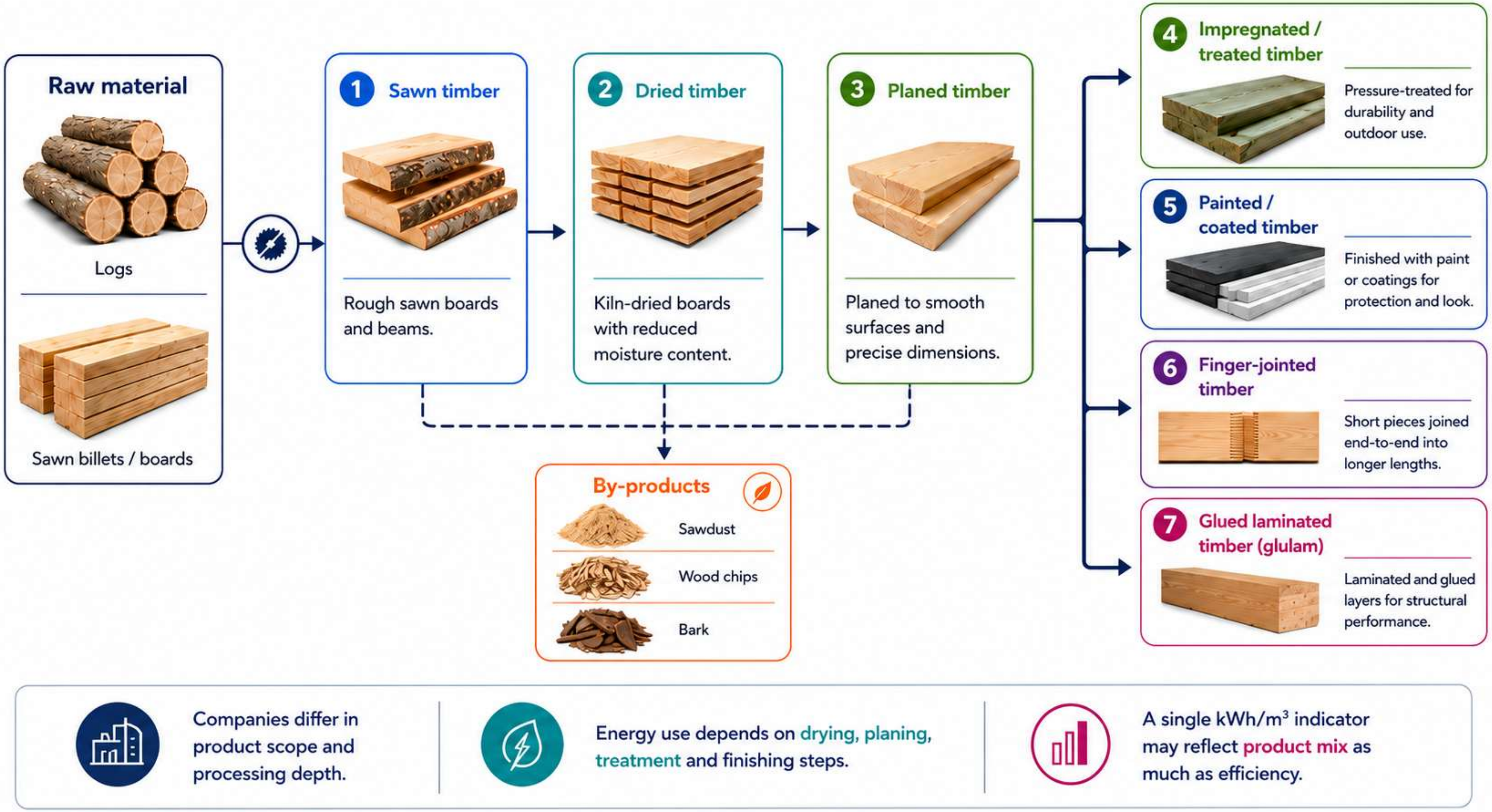
ANALYTICAL LIMITATIONS

- **Promised ≠ verified** — Projected savings, not measured post-implementation

Key takeaway: Audit data can explain what statistics cannot — but only if coverage, boundaries, and context are made explicit.

Piloting Audit-Based Analysis: The Estonian Experience

Sawmilling and planing companies can produce very different product portfolios from the same wood raw material



Design the Audit Right — Then Use It Cautiously

01 Understand competitive processes

What makes a firm competitive? For sawmilling: high-value yield, efficient drying, production load. These are the real efficiency drivers.

02 Define minimum tracking requirements

Specify what must be measured: physical input/output, key process indicators, production regime. Short and purposeful.

03 Provide a sector investment checklist

Pre-compile the most common measures. Auditors check against the list. This supports comparability across firms.

Five practical considerations for cautious benchmarking

1 Define the benchmark group narrowly

Same sector, comparable route, similar product logic. Never compare a kraft pulp mill to a recycled-fibre plant.

2 Use physical indicators first

kWh/t, kWh/m³ — with clearly defined boundaries. Monetary denominators mix price effects and product-mix shifts.

3 Record boundary and context variables

Product mix, utilisation, feedstock, process integration, technology vintage. These explain most of the variation.

4 Do not rank blindly

Use benchmarks as diagnostic ranges, not league tables. A low score may reflect boundary choice, not poor performance.

5 Design templates for future use

What is not required in the template will not exist in the dataset later. Design for benchmarking from the start.

The goal is not to collect everything. The goal is to collect enough to avoid comparing apples, pears, and firewood.

ODYSSEE-MURE

Janita Andrijevskaja
Early stage researcher | Ph.D. student | Energy Efficiency | Smart District He...

Thank you!

Janita Andrijevskaja, Tallinn University of Technology

Janita.Andrijevskaja@taltech.ee

Partners:

Fraunhofer ISI
IEECP Institute for European Energy and Climate Policy
Enerdata intelligence + consulting
ADEME Agency for Ecological Transition
eceee
ETAG PRG2701
ENEA
FEI
Statistics Poland
IDAE
MOTIVA
EIHP Energetski institut Hrvoje Požar
Austrian Energy Agency
Université de Genève
seai Sustainable Energy Authority of Ireland
klima agence
economie
SIEA Slovak Innovation and Energy Agency
Swedish Energy Agency
KAPE
ENVIROS Advisory
Danish Energy Agency
TNO innovation for life
MEKH Hungarian Energy and Public Utility Regulatory Authority
TAL TECH
Guvernul României Ministerul Energiei
ADENE
Cyprus Energy Agency
KAΠE CRES
LEI
Zurich University of Applied Sciences zhaw
Netherlands Enterprise Agency
The Energy & Water Agency
AYEP SEDA
Jožef Stefan Institute, Ljubljana, Slovenia

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ITALIAN NATIONAL AGENCY FOR NEW TECHNOLOGIES, ENERGY AND SUSTAINABLE ECONOMIC DEVELOPMENT

AGENZIA NAZIONALE EFFICIENZA ENERGETICA

Benchmarking methodology from data of mandatory energy audits in Italy

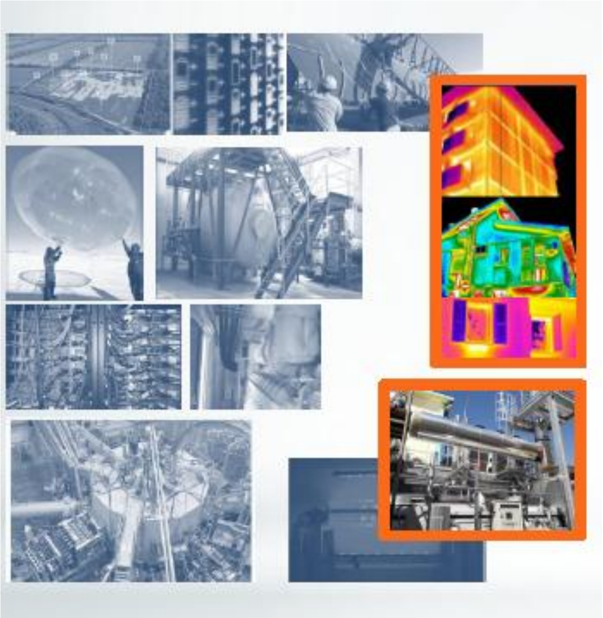
Beyond Compliance: Energy Audits as a Policy Tool

ODYSSEE –MURE Webinar , 27 May 2026

Dr. Carlos HERCE – DUEE-SPS-ESE

ODYSSEE-MURE

ENEA – AGENCY FOR ENERGY EFFICIENCY (DUEE)



ITALIAN NATIONAL AGENCY
FOR ENERGY EFFICIENCY
ENEA

Energy Efficiency Department of ENEA is the national Agency for Energy Efficiency. Our goal is to support industry and tertiary sectors in implementing EE measures, and to support the public administration and citizens.

DUEE-SPS-ESE coordinates all **Energy Audits** (EAs) activities:

- Management of Italian **EA database** (Art. 8 – EED) – Link to savings
- **Quality** control and EAs verification (documentary and on-site)
- Co-creation and editing of **sectoral guidelines** for mandatory EAs
- Standardization of procedures for **energy monitoring** and accounting
- Development of sector/process energy **benchmark** and energy **indicators** (general and specific KPIs)
- Active **training and information** activities in energy management
- **International** representation (CA-EED, SET Plan, EnR, ETIPs…)

ENERGY AUDIT ECOSYSTEM – 2023-2024 Results

European Commission

EU energy efficiency directive (EED)
National Energy & Climate Plan (NECPs)

CONCERTED ACTION ENERGY EFFICIENCY DIRECTIVE

EU - Art. 8 EED (2012/27/EU)
Italy - Art. 8 D.Lgs. 102/2014

Ministry of Environment and Energy Security
Policy maker

Public companies & regulator

Regional local EE actors

Research and Academia
~ 20 peer reviewed scientific papers

ENEA

ITALIAN NATIONAL AGENCY FOR ENERGY EFFICIENCY

ENERGY AUDITS DATABASE

11,094 Energy Audits
8,600 & 25,000 Imp. & Pot. EPIAs
6,625 Large Enterprises
1,643 EII Large Enterprises
2,572 Energy Intensive SMEs
1,307 Certified Auditor/ESCO

ENTERPRISES
Large Enterprises
Energy Intensive Enterprises (CSEA)

Business Associations

Energy Auditors & ESCOs

>100 Events (5,000 part.)
25 Sectorial Guidelines
~ 20,000 emails/FAQs

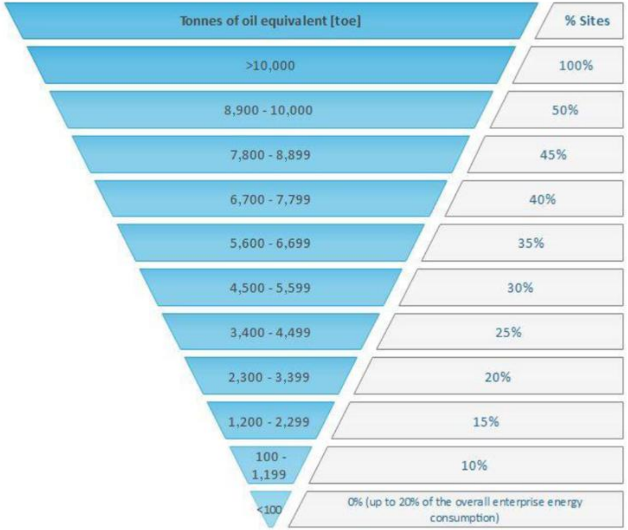
ENEA'S ROLE IN SUPPORTING IMPLEMENTATION

1. Development of **guidelines for drafting EAs for obligated companies,** coordinating and publishing guidelines and list of EPIAs for the **EIIs mechanism**, and drafting of **EA Annual report** for the Ministry
2. Control and verification of EA quality – EED + Electricity/Gas EIIs
3. Tracking implementation EPIAs and energy savings in EIIs
4. Development of **sectoral guidelines**
5. Support for **regional energy plans**
6. Development of **technical and informational tools for non obligated companies**
7. Coordination of two EU funded projects, LEAP4SME and LEAPto11, focused respectively on non obligated companies and EED art.11 transposition

EAs FOR OBLIGATED COMPANIES - Highlights

1. **Clustering** multi-site EAs → Sampling of more representative sites by consumption classes (including associated companies). «Italian Model» on EN 16247 review
2. Compulsory **monitoring** system/strategy
3. **EIIs mechanism**: Mandatory EAs Energy Intensive Enterprises, both LE & SMEs (Electric or gas consumption >1 GWh)
4. Simplified procedure for **ISO 50001 certified**
5. EAs quality ensured by **certified** Auditor and ESCOs
6. Strong engagement of **users/associations** - information and training

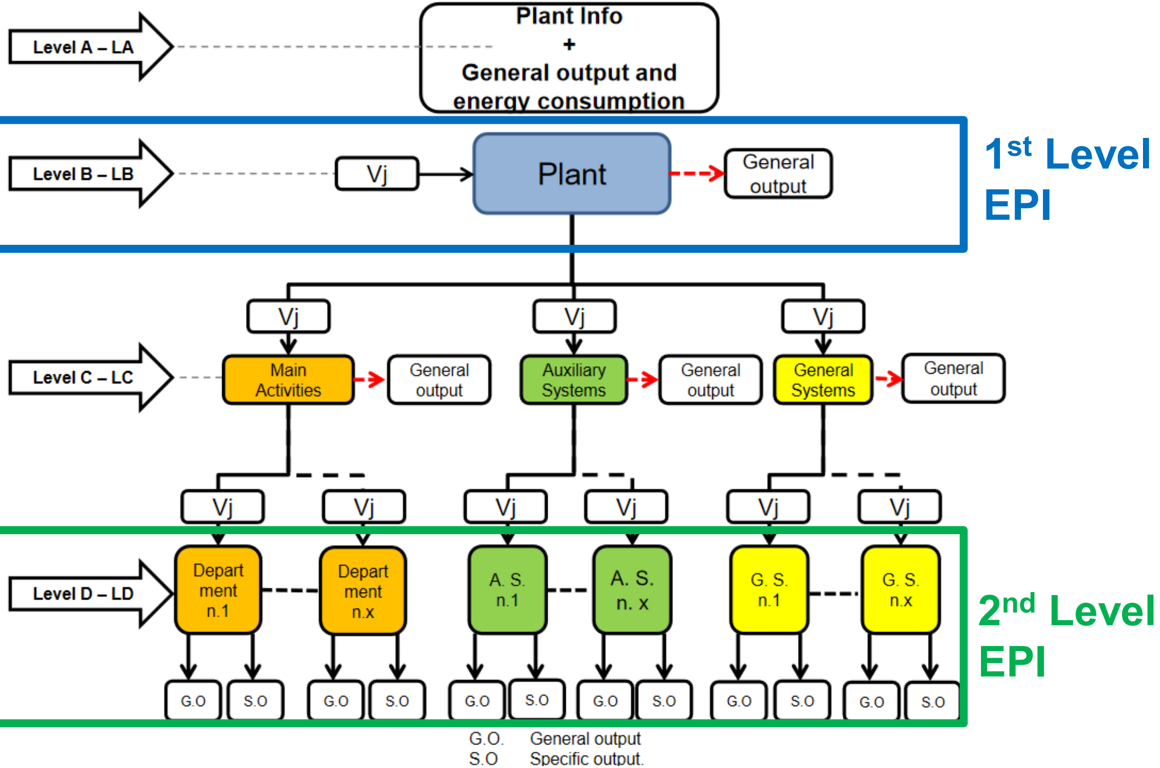
GUIDELINE FOR CLUSTER SAMPLING INDUSTRY



EAs FOR OBLIGATED COMPANIES - Database

DATA SOURCES

1. EA reports
2. Pre-compiled spreadsheet energy consumption
3. Clustering file
4. User's portal-Internal Database



EAs FOR OBLIGATED COMPANIES - Database

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Available info for First level benchmark

- General Info: sectoral and geographical
- Class size, certifications and monitoring
- Production (or equivalent)
- Energy final consumption (10 energy carriers)
- Distribution uses: main, auxiliary and general
- 17 categories of Energy Performance Improvement Actions (EPIAs) implemented and recommended

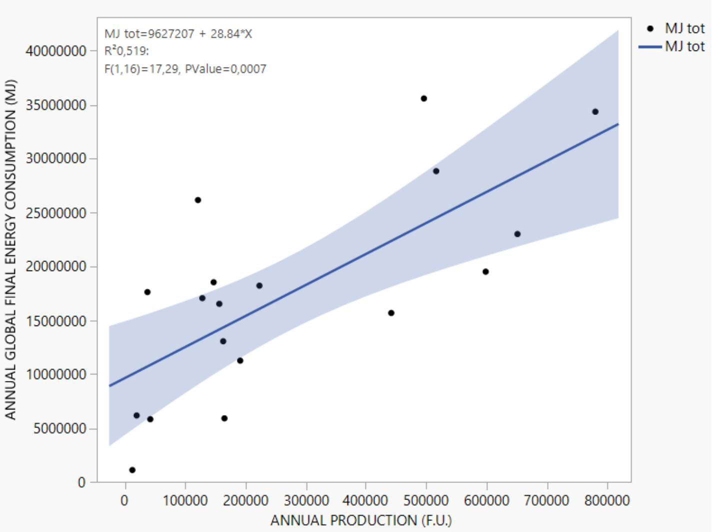
Second level benchmark

- Sectoral models, processes and BAT analysis

EAs FOR OBLIGATED COMPANIES – Benchmarking

1. Energy final use vs Production

- Data cleaning and homogenization
- Linear regression $En[MJ] = a \cdot Prod[FU] + b$
- Statistical analysis (α, p-value, R^2…)
- ~ 400 NACE-4digit sectors (4 carriers)



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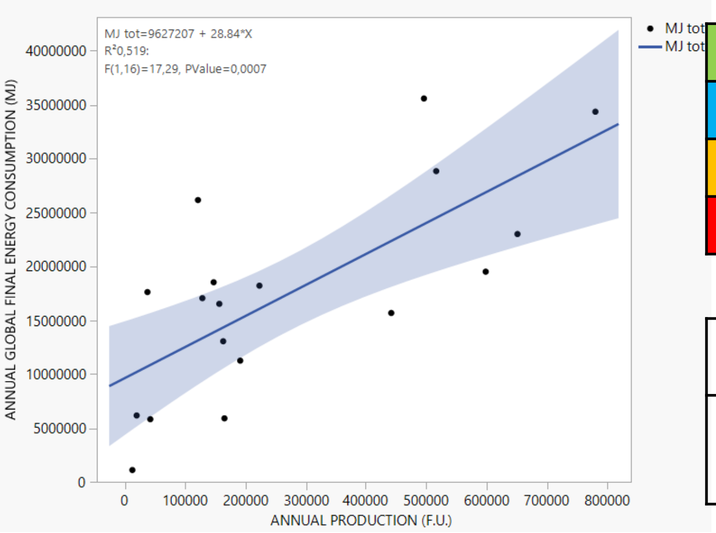

2. Real Sector EnPIs

- EPI [MJ/FU] =mean value ± standard deviation
- EPI = f (tecnologies, production range,...)

High	$\sigma \leq 20\%$
Medium	$20 < \sigma \leq 60\%$
Low	$60 < \sigma \leq 100\%$
N/A	$\sigma > 100\%$

CEMENT				
IRON & STEEL				

https://doi.org/10.3390/en14248436

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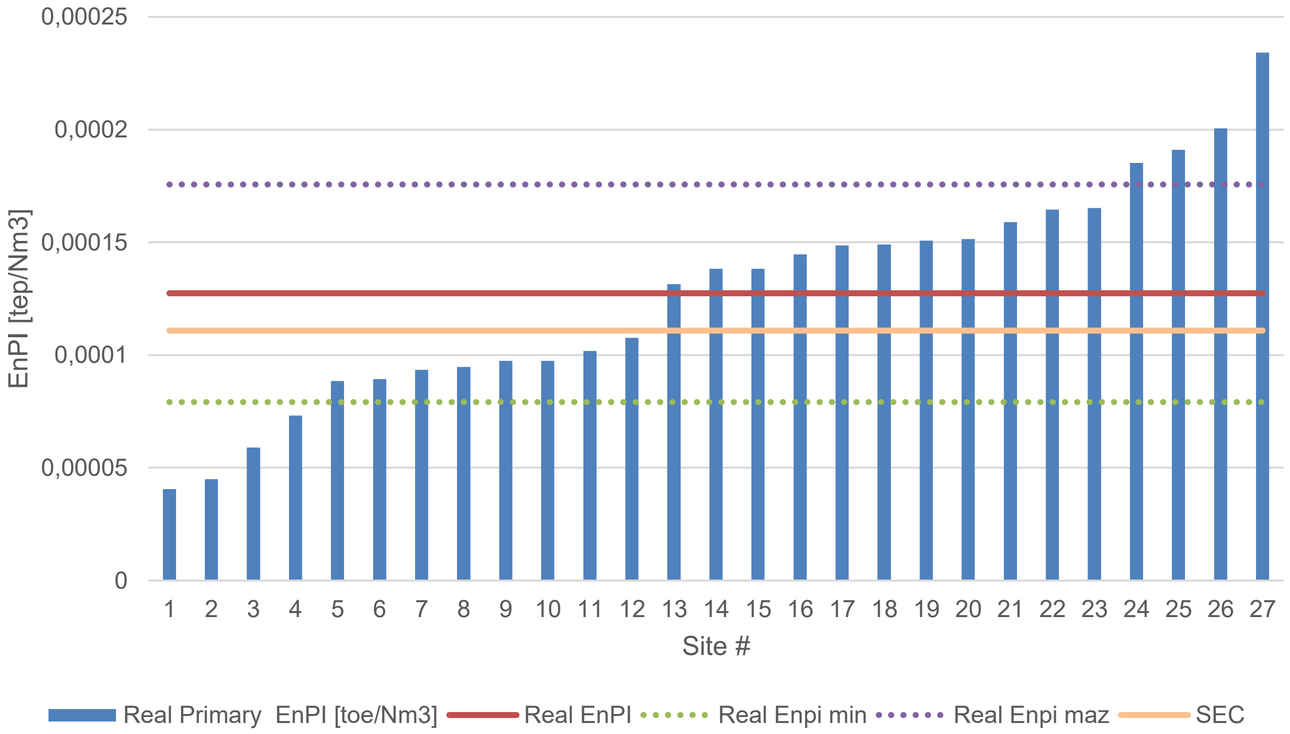

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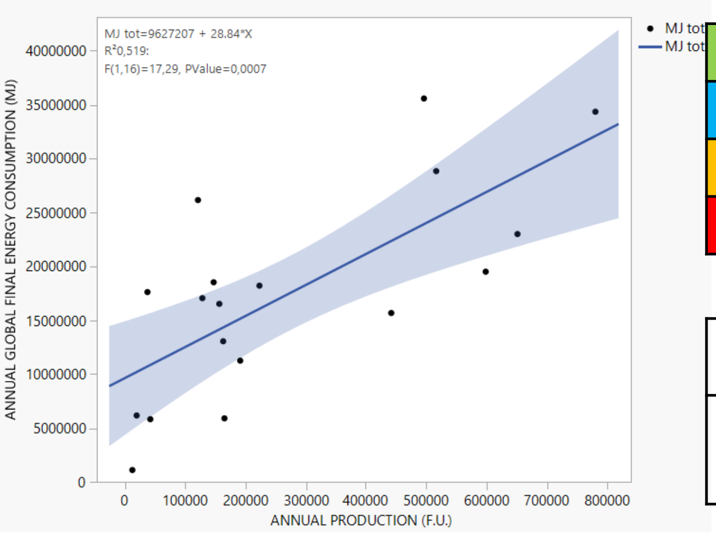
- Statistical analysis (α, p-value, R^2…)
- ~ 400 NACE-4digit sectors (4 carriers)



2. Real Sector EnPIs

- EPI [MJ/FU] =mean value ± standard deviation
- EPI = f (tecnologies, production range,...)

High	σ ≤ 20%
Medium	20 < σ ≤ 60%
Low	60 < σ ≤ 100%
N/A	σ >100%

CEMENT				
IRON & STEEL				

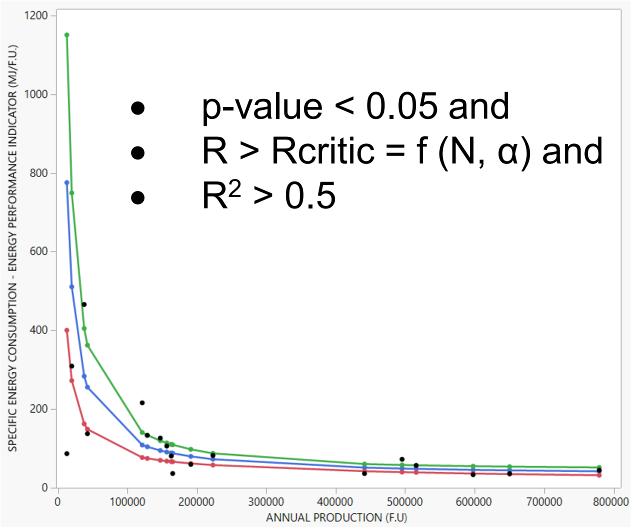
https://doi.org/10.3390/en14248436

3. Energy Performance Index Model

- Analytical physical model

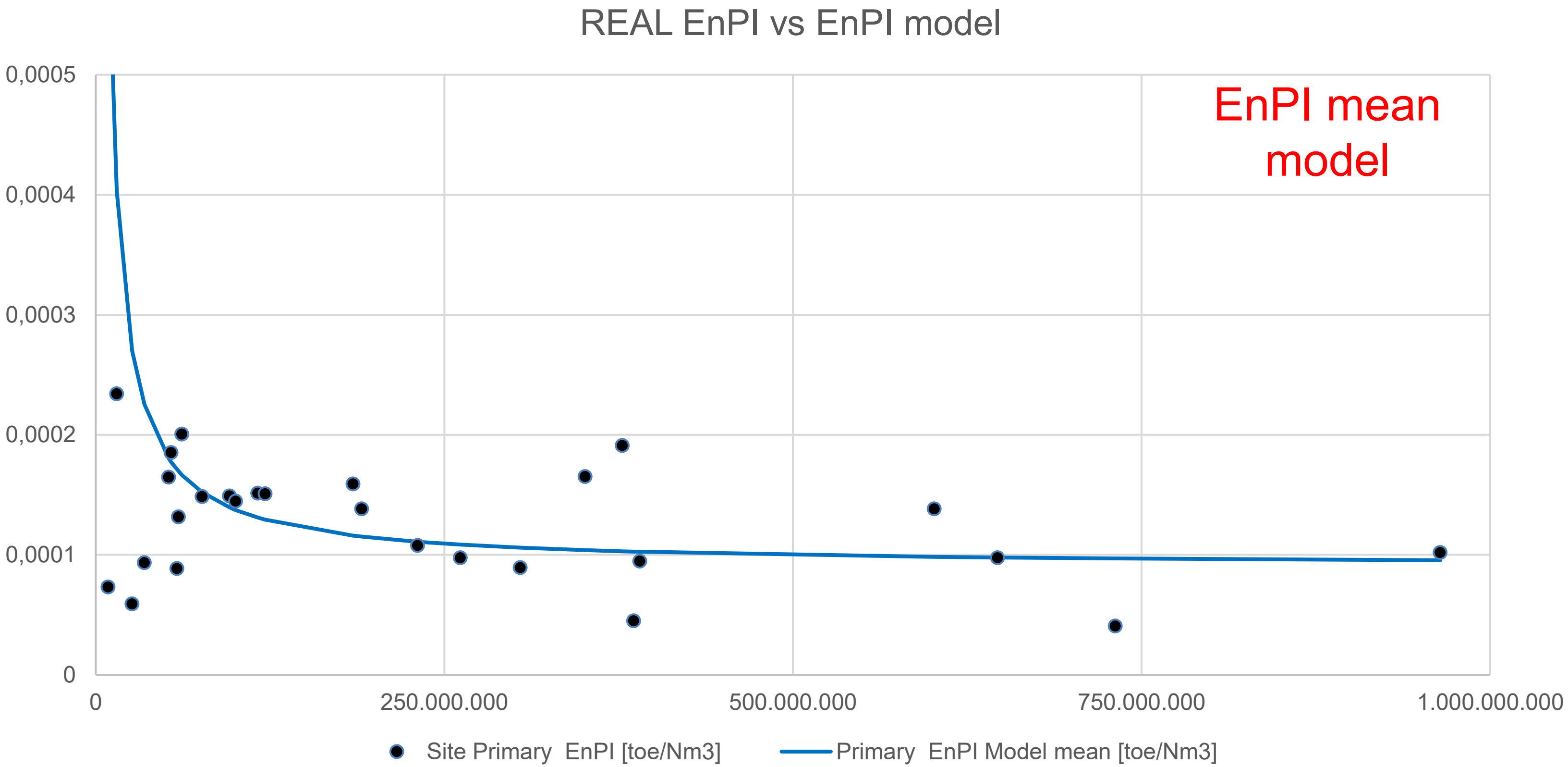
$$EPI_{model}\,(MJ/FU) = a + \frac{b}{Prod[FU]}$$

- Normal distribution (CI = 95%)



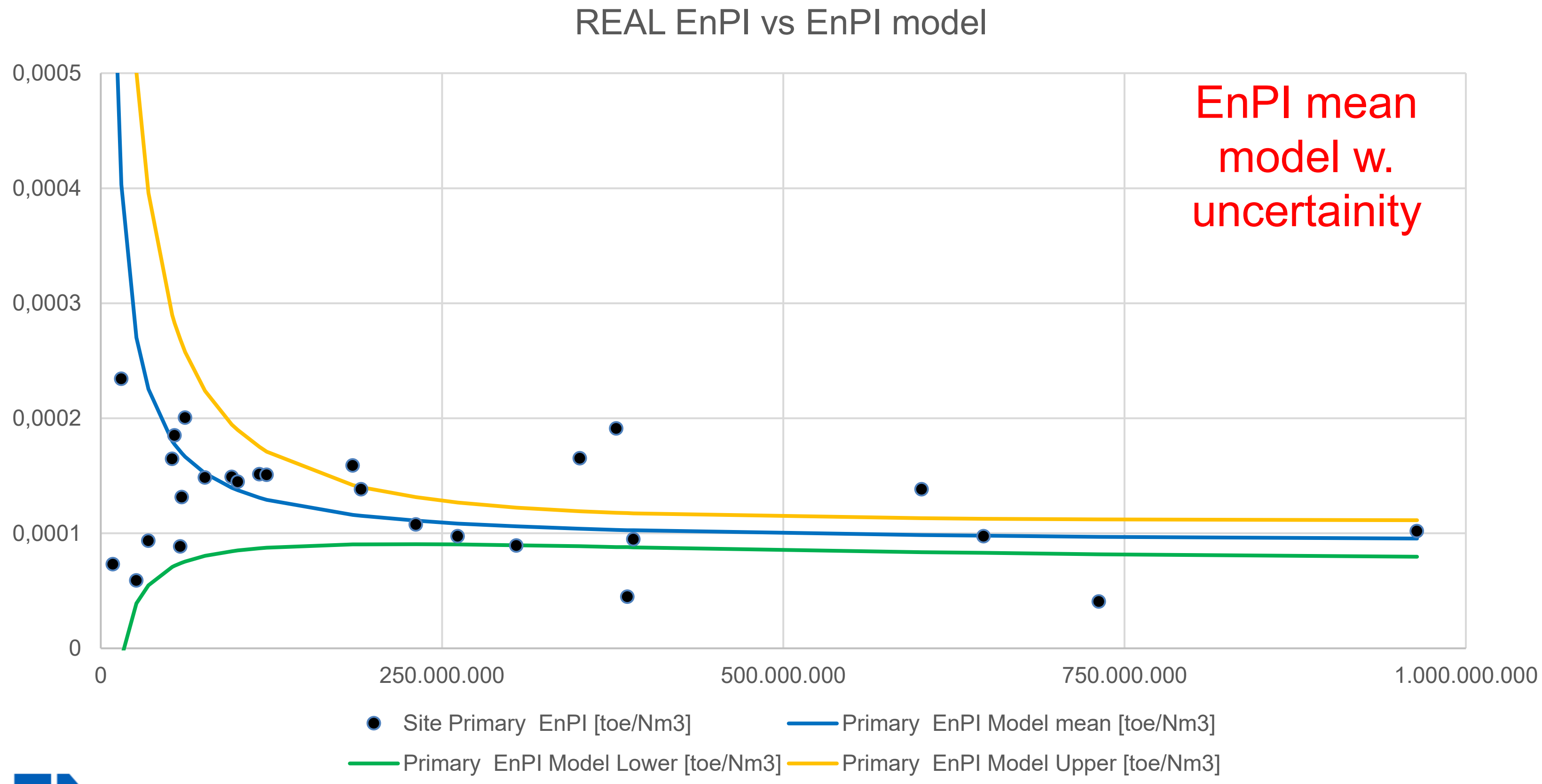
- p-value < 0.05 and
- R > Rcritic = f (N, α) and
- $R^2 > 0.5$

EAs FOR OBLIGATED COMPANIES – Benchmarking

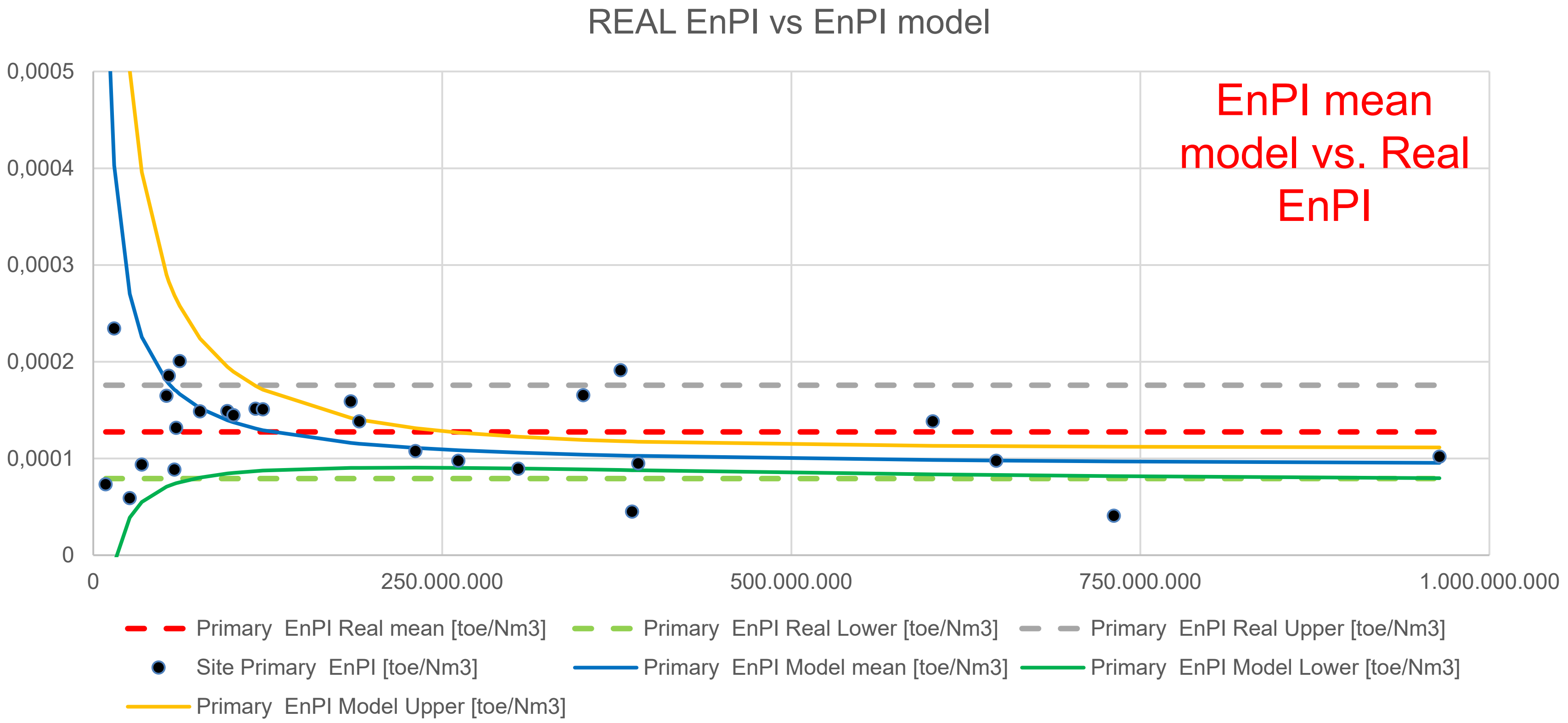


M. Bassetti et al 2025 J. Phys.: Conf. Ser. 3143 012037

EAs FOR OBLIGATED COMPANIES – Benchmarking



EAs FOR OBLIGATED COMPANIES – Benchmarking

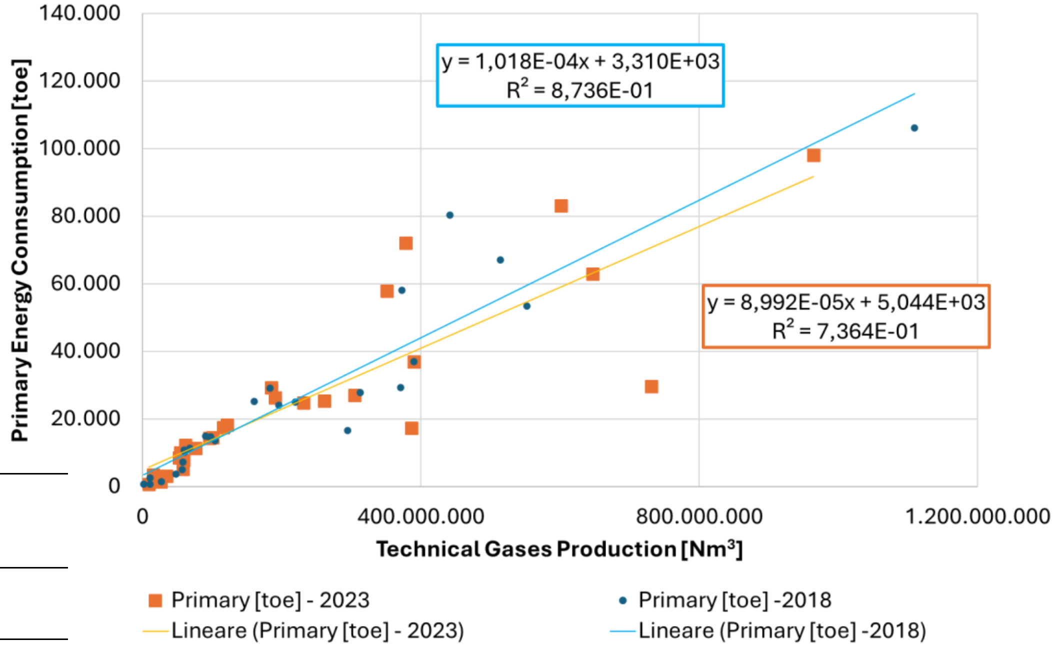


M. Bassetti et al 2025 J. Phys.: Conf. Ser. 3143 012037

EVOLUTION WITH YEARS

Energy efficiency trend with time (2018 vs 2022)

- Lower mean value (Real EnPI)
- Lower dispersion (Real EnPI)
- Lower benchmark value (EnPI model – slope reg.)

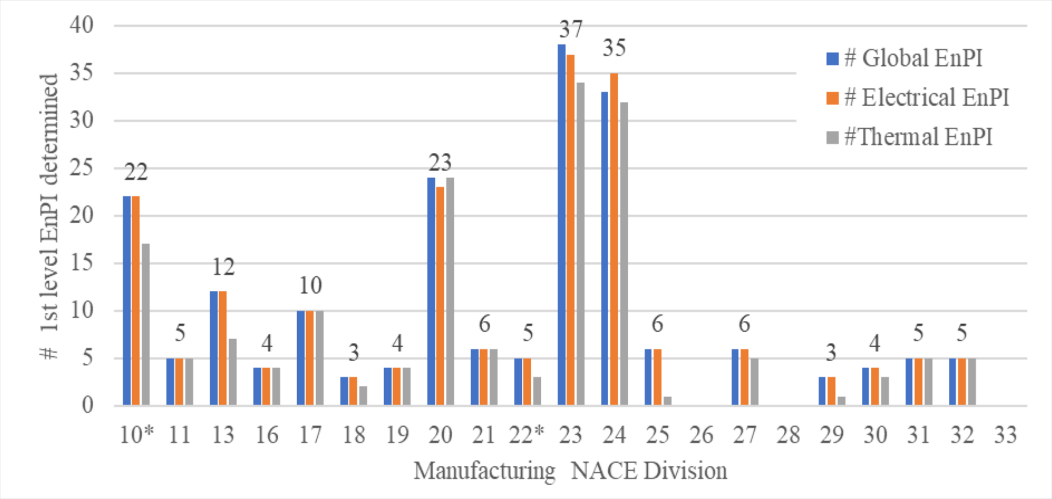


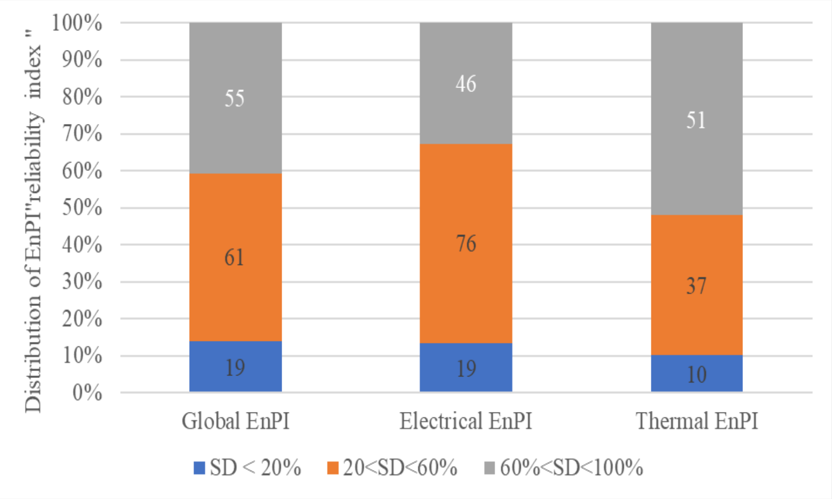
Primary	RealEnPI (Mean±SD) [toe/Nm³]	EnPI Model	R2	Production Range [MNm³]
2022	1.27 ·10-4 ± 4.83 ·10-5	8.991·10-5 + 5.043·103 / Production	0.736	10-1000
2018	1.37 ·10-4 ± 7.19 ·10-5	10.183·10-5 + 3.310·103/ Production	0.873	2-1100

M. Bassetti et al 2025 J. Phys.: Conf. Ser. 3143 012037

Real Sectoral EnPI

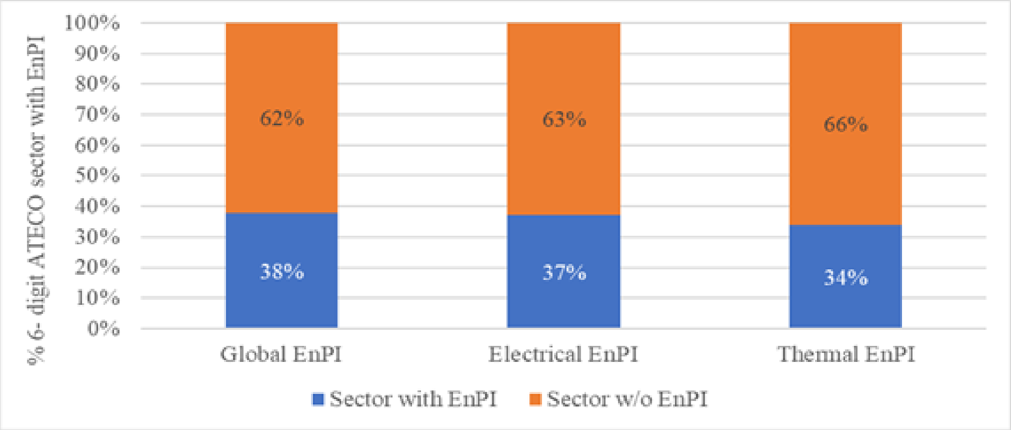
- Analysis of 45% of industrial demand (75% thermal -25% electrical)
- EnPIs calculated in total (multiple in some sectors):
  - 195 Global, 195 Electrical, 168 Thermal
- Reliability Index of EnPIs calculated:13% High, 46% Medium, 41% Low

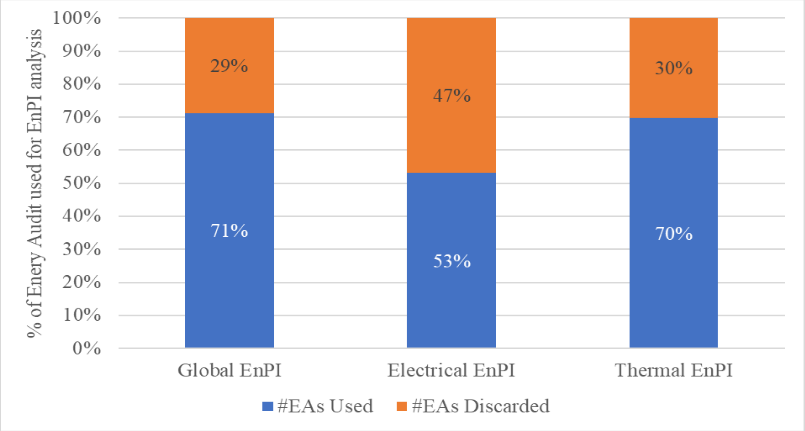




Real Sectoral EnPI

- EnPI has been only obtained in limited sectors:
  - 38% Global, 37% Electrical, 34% Thermal
- Data cleaning exclude several audits:
  - 30% Global and thermal, 47% Electrical





Real Sectoral EnPI

One of the fundamental aspects of an energy diagnosis is the comparison of specific consumers with the average of the sector.
Fully accesible – free-of-charge, database of EnPI (1° and 2° level)
more then 700 EnPI

IPE_DB
KPI Database for Energy Performance

This tool allows a quick consultation of all the IPE published by ENEA in the scope of **article 8 of D.Lgs.102/2014**

IPE | Processi | Settori Produttivi | Sottoprocessi | Aree funzionali

Codice Ateco

Settore Produttivo: Tabacco

Cerca...

Esporta XLS

Codice Ateco: 43.29.02 - Settore Produttivo: Ghisa, Tabacco, Abbigliamento, Carta, Cartone

IPE di primo livello

Tipologia	Udm campo	Produzione min	Produzione max	Ipe media	Ipe stdv	Stdv %	Affidabilità	Udm Ipe	Anno	Note
Totale	t	400	3700	0.484	0.176	36%	Medio	tep/t	2023	
		3701	35000	0.269	0.059	22%	Medio	tep/t	2023	
	mq	400	3700	0.484	0.176	36%	Medio	tep/mq	2023	
		3701	35000	0.269	0.059	22%	Medio	tep/mq	2023	
Elettrico	kWh/t	400	3700	2356	847	36%	Medio	tep/t	2023	
		3701	35000	1325	301	23%	Medio	tep/t	2023	
Termico	MJ/t	400	35000	1085	801	73%	Basso	tep/mq	2023	

IPE di secondo livello

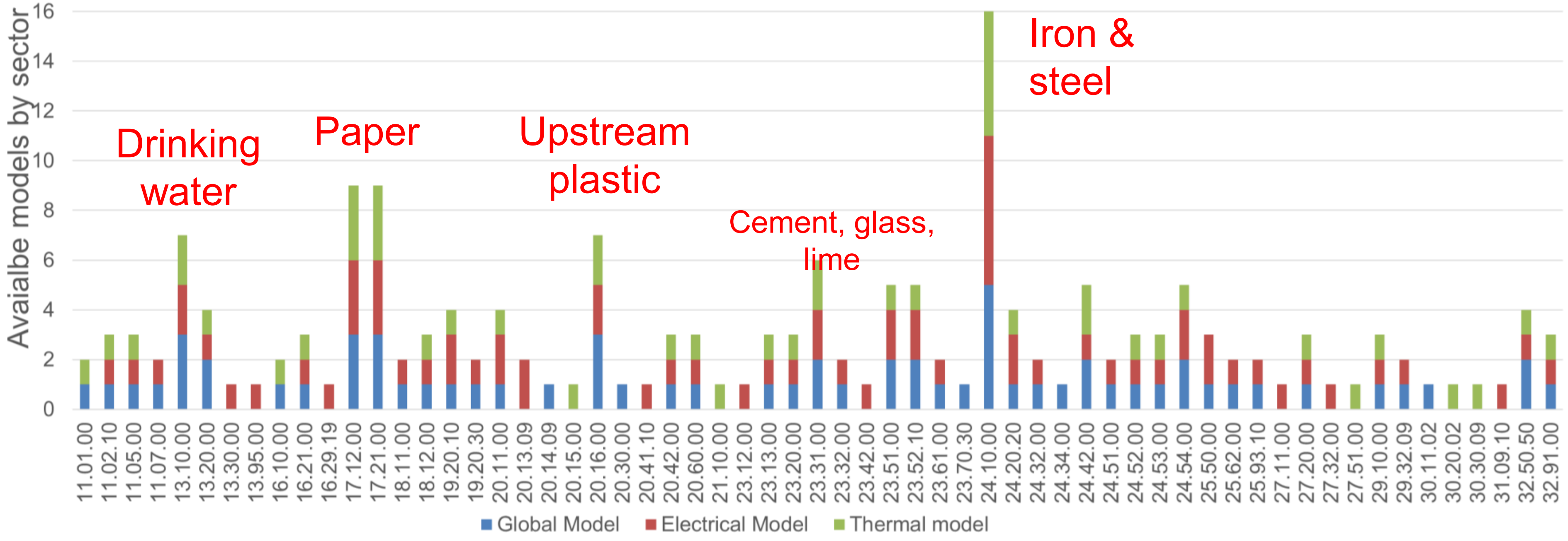
RdS
RICERCA DI SISTEMA

https://ipedb.enea.it/

ENEA

EnPI Models

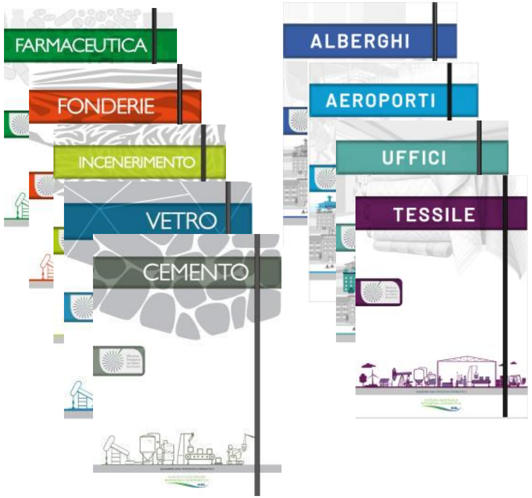
- EnPI models are reduced compared to Real Sectoral EnPIs calculated in total (181 vs 558, 32%): 65 Global, 69 Electrical, 47 Thermal



SECTORAL GUIDELINES – General information

Results of Project «Ricerca di Sistema Elettrico», funded by a specific component of the electricity tariff

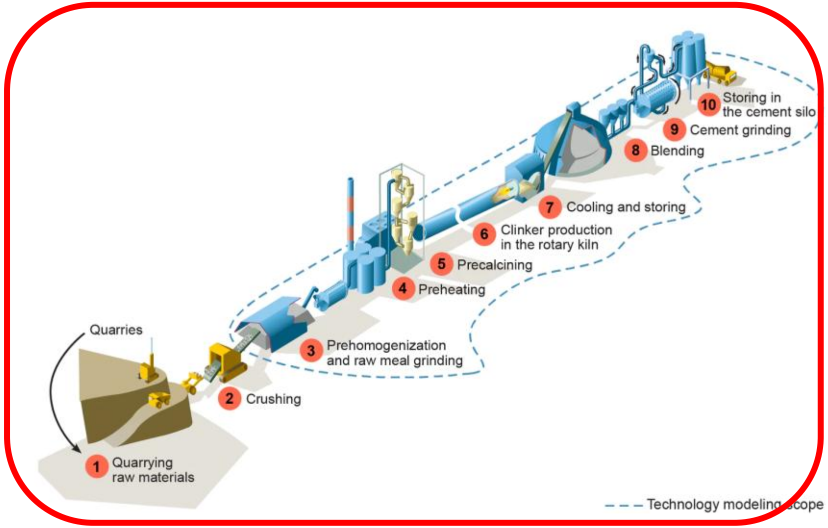
RdS
RICERCA DI SISTEMA



- Development Level A-D EnPIs and tools (self-assessment)
- Market-driven implementation EPIAs and BAT
- Trends of EPIAs and cost effectiveness analysis
- Specific analysis: SMEs, EnMS, monitoring,etc
- Continuous feedback with industrial associations
- Scientific open access articles

SECTORAL GUIDELINES – Cement sector

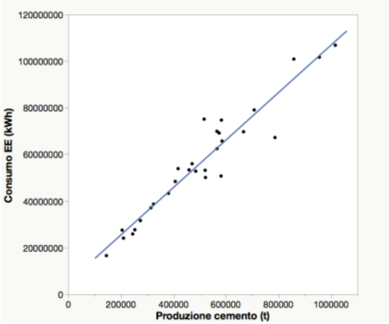
GLOBAL PLANT ANALYSIS



https://www.iea.org/articles/driving-energy-efficiency-in-heavy-industries

Production Range t	Production Range t	EPI kWh/t	# Eas	Standardization Potential
145.000	521.000	119 ± 10	15	HIGH
521.000	1.015.000	108 ± 13	14	HIGH

Electrical EnPI

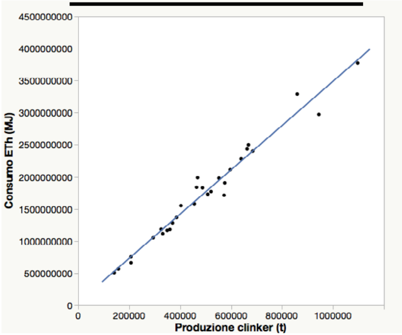


Electric Consumpt. (kWh) = 5.061.920 + 101,88 * Cement Prod. (t)

Int. Conf. = 99%

	R^2	R	P_{value}	N	R_{crit} (bidirezionale) α=0,05	R_{crit} (bidirezionale) α=0,01
kWh	0,917	0,958	< 0,0001	29	0,3809	0,4869

Thermal EnPI



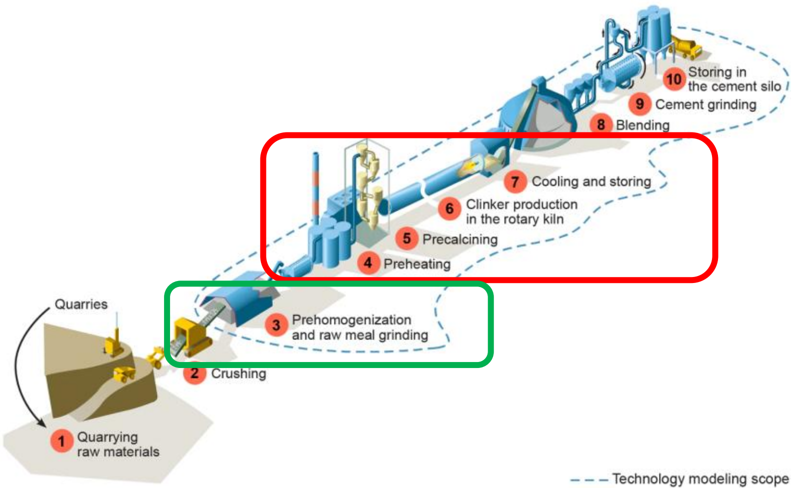
Themal Consumption (MJ) = 3,913 * 10^7 + 3.448,72 * Clinker Prod(t)

Int. Conf. = 99%

	R^2	R	P_{value}	N	R_{crit} (bidirezionale) α=0,05	R_{crit} (bidirezionale) α=0,01
MJ Tot	0,969	0,984	< 0,0001	29	0,3809	0,4869

Production Range t	Production Range t	EPI MJ/t	# Eas	Standardization Potential
142.000	509.000	3.585 ± 264	16	HIGH
509.000	1.097.000	3.468 ± 230	13	HIGH

SECTORAL GUIDELINES – Cement sector



https://www.iea.org/articles/driving-energy-efficiency-in-heavy-industries

3 Prehomogeneization Electrical EPI

Production Range		EPI	# EAs	Standardization Potential
t	t	kWh/t		
219.000	740.000	23,51 ± 5,71	15	MEDIUM
740.000	1.733.000	19,09 ± 4,70	11	MEDIUM

4-6 Clinker production EnPI

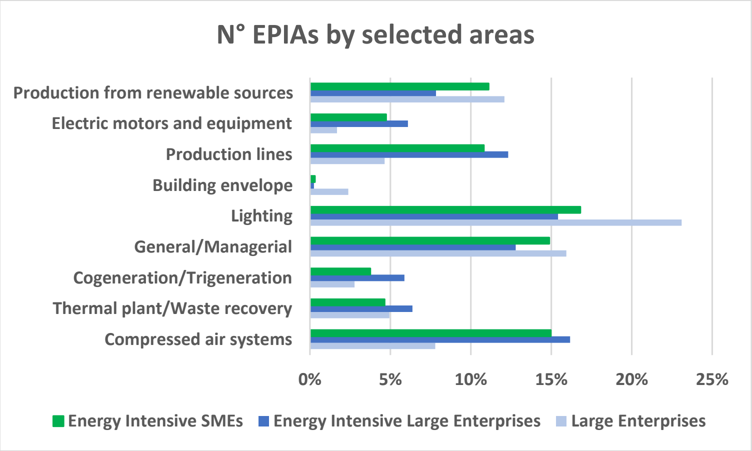
Production Range		EPI	# EAs	Standardization Potential
t	t	MJ/t		
141.558	1.097.000	3.505 ± 247	29	HIGH

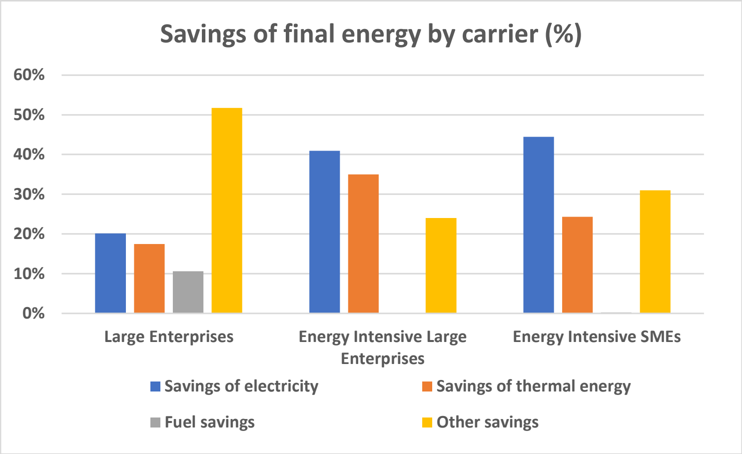
Preheating cyclons

Production Range		EPI	# Preheat Cyclons	# EAs	Standardization Potential
t	t	MJ/t			
142.000	860.000	3.609 ± 291	4	11	HIGH
207.000	1.097.000	3.431 ± 214	5	12	HIGH

ANNUAL REPORT – EPIAs available information

- Data available or derived from EA
  - EPIAs by category per site and company
  - Energy savings in absolute values and % of consumption
  - Investments and PBT (average and per site)
  - Cost effectiveness by intervention category
- Further info available at site level, such as ISO 50001, monitoring system, EII SMEs

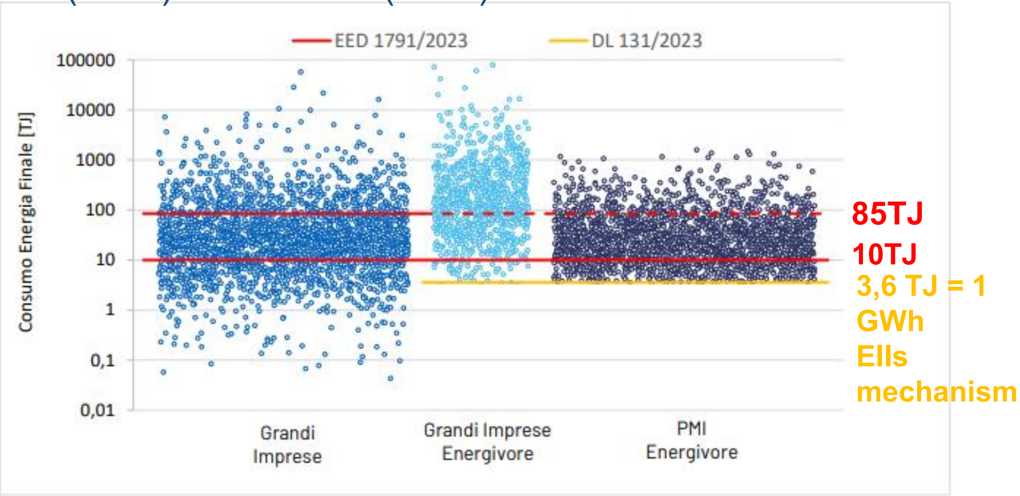




ANNUAL REPORT – EnMS obligation under EED art.11

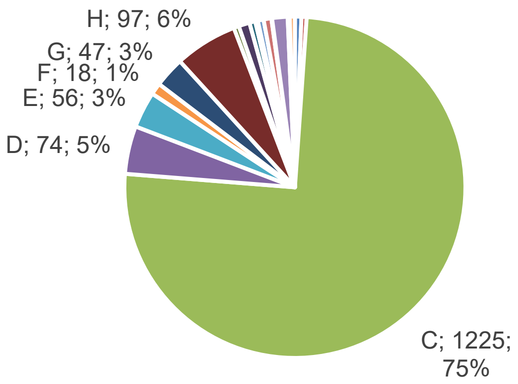
- More than 1200 additional enterprises (almost 4,000 sites) must implement a EnMS by Oct. 2027; 20% of total Art.11 obligated are currently certified under Art.8 EED
- Current ISO 50001 certified companies in Italy = 1232 Accredia (Jan. 2025) vs 1925 ISO Survey (2023)
- Mainly in Manufacturing (75% - NACE C sector), but also in Transport (6% - NACE H sector)

EA (10TJ) AND EnMS (85TJ) OBLIGATED COMPANIES



ESTIMATED NEW EnMS BY NACE SECTOR

Annual Rep2023



ANNUAL REPORT – EnMS obligation under EED art.11

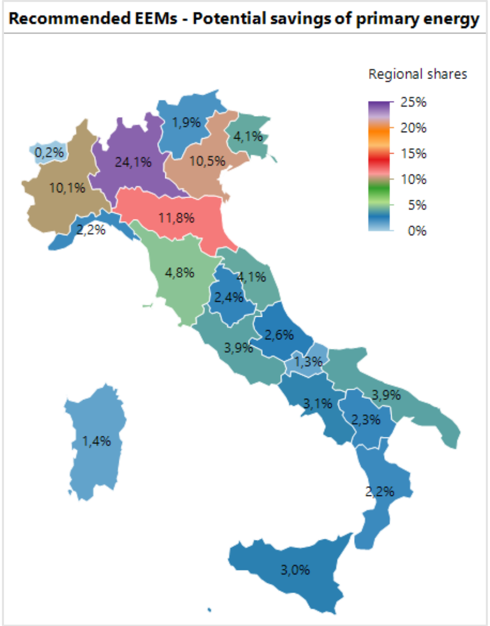
The information from EAs was exploited to

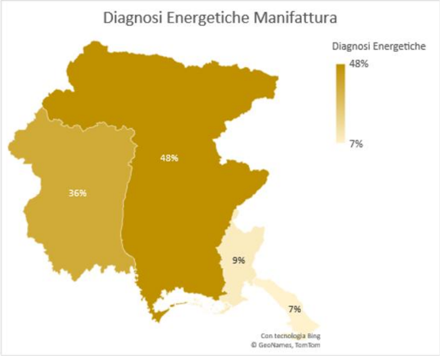
- Analyse the energy consumption in industry, in comparison with regional energy balances
- Analyse the achieved and potential energy savings
- Develop energy efficiency scenarios

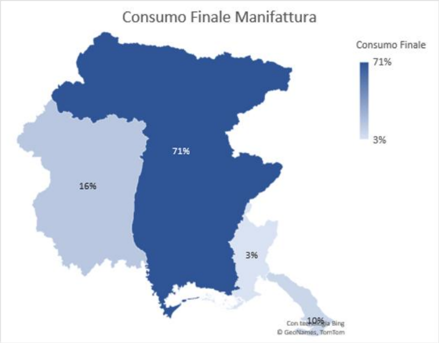
In the following regions

- **Friuli Venezia Giulia**
- **Calabria**
- **Basilicata** (undergoing)

Shorter analyses were supported for further regions







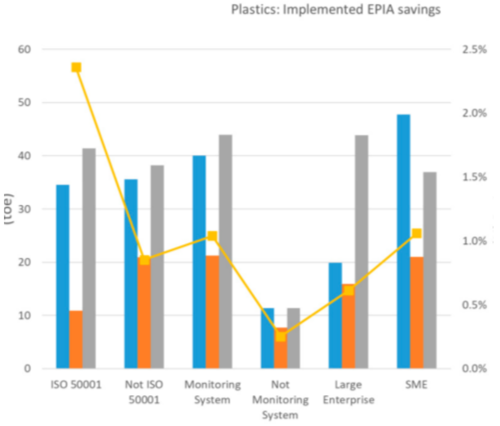
IMPLEMENTATION OF MONITORING SYSTEMS

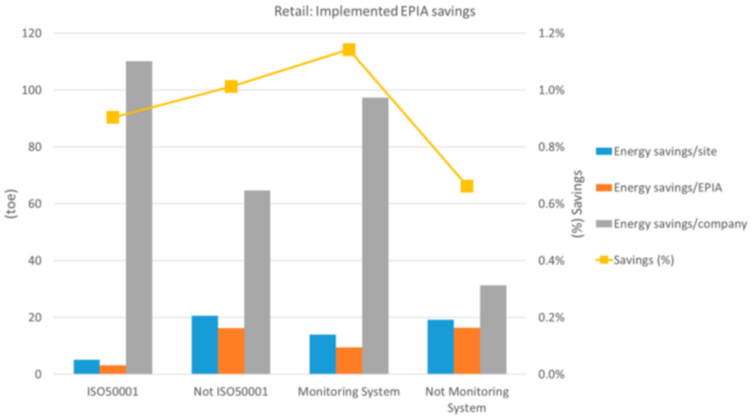
Monitoring is mandatory by law in the second cycle of mandatory EAs

- “Energy Savings/company” and “EPIAs/site” ratios are higher in enterprises (industrial and services) with EnMS and monitoring system. Better planning of EPIAs with EnMs and monitoring.
- Sectoral savings are higher with monitoring systems. Not conclusive results for EnMs.

Monitoring of industrial consumption minimum limits

Total consumption in the reference year (toe/year)		Main activities	Ancillary services	General services
>10000		85%	50%	20%
8900	10000	80%	45%	20%
7800	8899	75%	40%	20%
6700	7799	70%	35%	20%
5600	6699	65%	30%	20%
4500	5599	60%	25%	10%
3400	4499	55%	20%	10%
2300	3399	50%	15%	10%
1200	2299	45%	10%	5%
100	1199	40%	5%	5%





Herce, C.; Biele, E.; Martini, C.; Salvio, M.; Toro, C. Impact of Energy Monitoring and Management Systems on the Implementation and Planning of Energy Performance Improvement Actions: An Empirical Analysis Based on Energy Audits in Italy. *Energies* **2021**, *14*, 4723. https://doi.org/10.3390/en14164723

Project conclusions

- In Italy EED art.8 covers approximately 1/3 of Gross Inland Consumption (the remaining equally distributed between Households and Small Medium Enterprises)
- Key relevance of quality in EA data collection → **involvement of stakeholders and continuous improvement of database as well as of its analysis**
- Human factor in auditing (more than 1000 Auditors) → **Sectoral guidelines elaborated with business associations, training and support**
- Key role of sectoral characteristics in affecting achieved and potential savings, intervention mix, PBT and access to existing incentives
- Need to enhance the identification and adoption of EPIAs
  → **Combination with benchmark analyses at sectoral level**
  → **Promotion of incentive measures for energy audits and energy efficiency**
  → **Development of regional analyses**
- Further research: decarbonization impacts and other EE multiple benefis, sensitivity analysis e.g. on energy price surge, analysis on not obligated SMEs, identification of factors affecting the capacity to introduce EPIAs

THANK YOU FOR YOUR ATTENTION

HELPING TO TRANSFORM AN OBLIGATION INTO AN OPPORTUNITY

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DUEE-SPS-ESE

Energy Efficiency in the Economic Sectors Technical Unit

Energy Audits Working Group

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ODYSSEE-MURE

RdS RICERCA DI SISTEMA

LEAP4SME ENERGY AUDIT POLICIES TO DRIVE ENERGY EFFICIENCY

LEAP4SME received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 893924.

LEAPto11

Co-funded by the European Union

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ENEA

ODYSSEE-MURE

SGCIE Data Collection and Benchmarking

SISTEMA DE GESTÃO DOS CONSUMOS INTENSIVOS DE ENERGIA

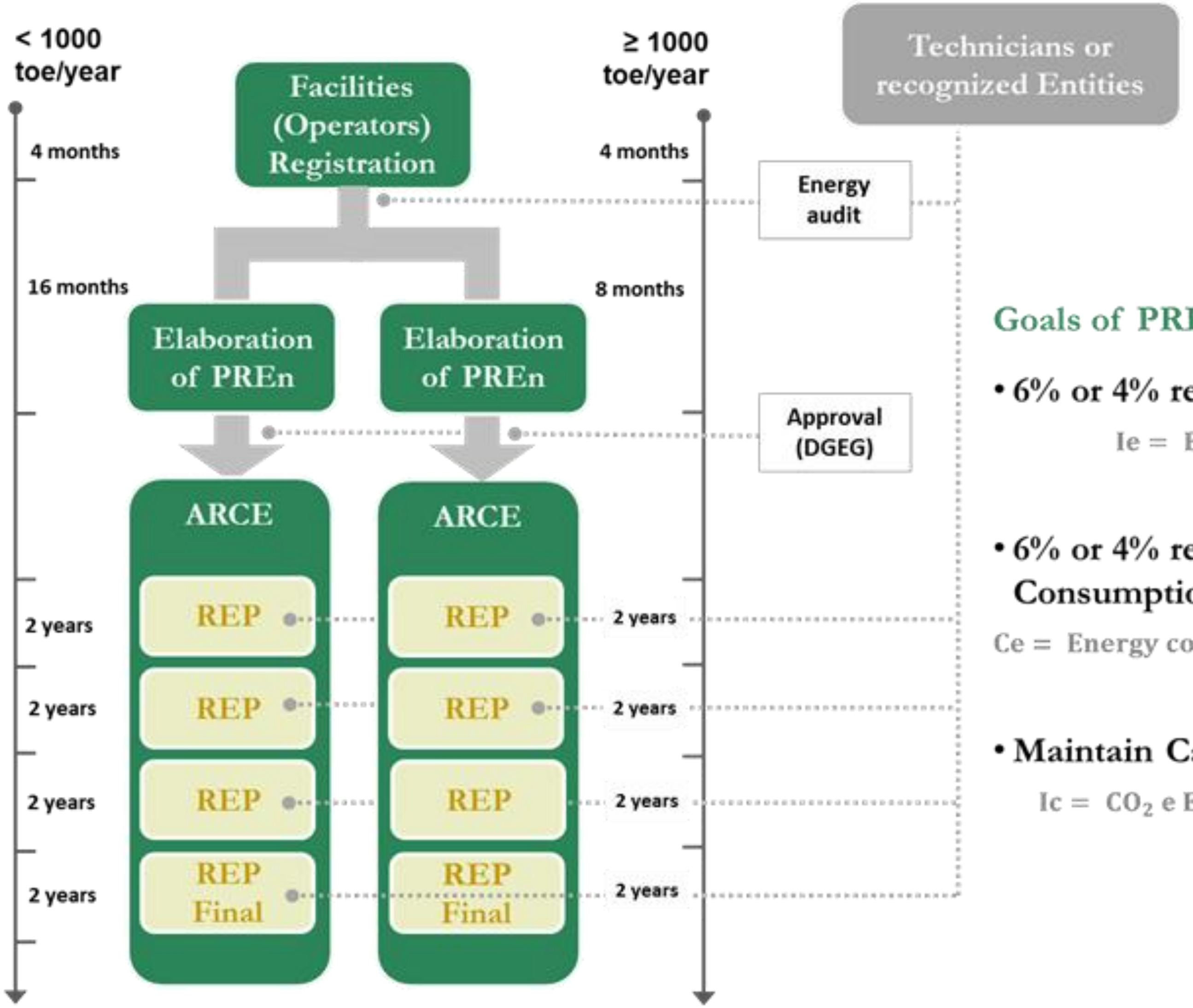
Paulo Calau

Industry area coordinator of

Directorate of Industry and Energy Transition - DITE

Co-funded by the European Union under project ID 101215674. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

SGCIE workflow



Goals of PREn:

- 6% or 4% reduction of Energy Intensity

  Ie = Energy consumption/GVA

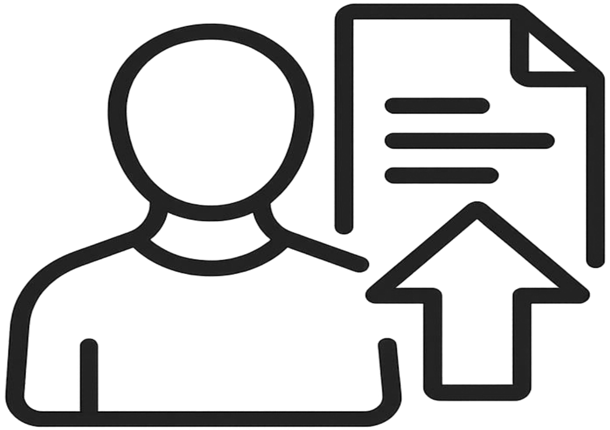
- 6% or 4% reduction of Specific Energy Consumption

  Ce = Energy consumption/Production unit

- Maintain Carbon Intensity

  Ic = CO_2 e Emissions/Energy consumption

How do we get data form energy audits and Rationalization Plans



Data Collection at the SGCIE

Stage	What happens	Type of data collected	Internal Sources/Evidence
Registration of Operators and Technicians	Manual data entry into the portal during pre-registration and registration.	Name, address, contacts, CAE, location, installation data.	SGCIE Personal Data Inventory (BD SGCIE – Pre-registration and Registration)
PREn and REP submission (main energy data input)	Operators and technicians submit plans, reports and attachments on the SGCIE portal.	Detailed energy consumption, efficiency measures, calculation files, fuel data, toe, tCO_2, annual savings, investment, PRI, Schedule.	SGCIE Platform Base Documents ; uploads TR/OP
Uploading files and supplemental attachments	The system automatically collects files sent by users (TR/OP).	Invoices, certificates, work orders, photographs, technical and financial proofs.	Document validation rules (invoices, work orders, photographs, UPAC certificates, etc.)

Processing of information

Processing of information

Stage	What happens	Type of data collected/generated	Internal Sources/Evidence
ADENE Analysis	ADENE technically validates PREn and REP, identifies errors, requests clarifications, analyses new versions and carries out technical visits, collecting complementary information not initially submitted by operators/technicians.	Additional data from OP/TR iterations, analysis notes, technical justifications, visit reports, internal observations, audit evidence.	Technical Visit Report, energy audit and Rationalization Plan
Flux ADENE – DGEG	ADENE communicates non-compliances, exceeded deadlines. DGEG issues notifications, orders, audit requests and approval or non-approval decisions.	Non-compliance data, notifications, changes of status, extinction decisions, audit requests, orders, formal communication records.	ADENE-DGEG flows under procedural status rules
Exports, Statistics and BI	Consolidated information feeds statistical systems, analytical dashboards and external platforms. Consumption, measurements, energy savings, sectoral indicators and procedural history are exported.	Data aggregated by CAE, region, consumption, energy indicators, measurements, annual and total savings, annual and historical datasets, monitoring metrics.	SGCIE Platforms

Benchmarking tools in Power BI

Business intelligence – Rationalization Plans Indicators

adene
Agência para a Energia

sgcie

Evolution of Energy Indicators | PREN

Operator:
To search for
- OP00001
- OP00002
- OP00004

State Press:
- Analysis I
- Analysis II
- Operator Analysis
- Approved

Reference Year:
- 2006
- 2007
- 2008
- 2009

Meta:
?

Code	Operator	Technician/Entity	State Press	Duration Years	Presented	VAB Presented
OP1000-PREN (2010-2015)	OP01000	TR-227	Approved	6	Multi-Products	Globally
OP1000-PREN (2016-2023)	OP01000	TR-287	Approved	8	Globally	Multi-Products
OP1000-PREN (2024-2031)	OP01000	TR-1375	Approved	8	Globally	Multi-Products
OP1001-PREN (2010-2017)	OP01001	ER-022	Approved	8	Globally	Multi-Products

Indicator: Energy Intensity

Code	Activity	Product Designation	Unit	Energy Consumption, E0 (toe/year)	VAB WOOD	Energy Intensity, IE0 = E0/VAB0 (kgep/EUR)	Mandatory Target IE (kgep/EUR)	Esti(
OP1605-WOOD (2015-2022)	10202 - Freezing of fishery and aquaculture products	Transformed product	ton	513	1	513.200	492.672	
OP233-PREN (2016-2023)	16295 - Manufacture of other cork products	Composite Agglomerates	tons	6.985	21.624	323	304	
OP53-PREN (2020-2027)	10510 - Milk and dairy product industries	powdered milk	ton	3.665	19.378	189	178	
OP411-PREN (2020-2027)	10510 - Milk and dairy product industries	Cheese	t	605	5.861	103	99	
Total				6.694.777	33.087.874.362	514.898	494.290	

Indicator: Specific Energy Consumption

Code	Activity	Product Designation	Unit	Energy Consumption, E0 (toe/year)	Production, P0 (UNITS/year)	Specific Consumption, CE0 = E0/P0 (kgep/UNIT)	Mandatory CE Target (kgep/UNIT)	Estim CE (k
OP1688-PREN (2016-2023)	01470 - Poultry Farming		birds				0	
OP1553-PREN (2015-2022)	08112 - Extraction of ornamental granite and similar rocks		tons	737	696.606	1	1	
Total				6.694.777	13.757.950.538	4.301.348	4.122.487	3.8

Indicator: Carbon Dioxide Intensity

	Activity	Product Designation	Unit	Energy Consumption, E0 (toe/year)	Emissions, Em0 (t CO2e/year)	Carbon Intensity, IC0 = Em0/E0 (t CO2e/tep)	Mandatory IC Target (t CO2e/toe)	Valor Previsto I(CO2e/tep)
60-PREN (2024-2031)	01130 - Crops of horticultural products, roots and tubers	Horticultural Production	t	17	836	51	51	-331
17-PREN (2025-2032)	38212 - Treatment and disposal of other non-hazardous waste	urban solid waste	ton	66.657	677.181	10	10	10
				6.694.777	14.931.423	7.850	7.850	7.456

Business intelligence – Rationalization Plan Measures

Measures Provided for in the Energy Rationalization Agreement | PREN

Meta

6%

Code	Operator	Technician/Entity	State Press	Duration Years	PREN Presented	VAB
OP1-PREN (2008-2013)	OP00001	TR-318	Approved	6	Multi-Products	Multi-I
OP1-PREN (2014-2021)	OP00001	TR-758	Extinct	8	Multi-Products	Multi-I
OP1-PREN (2017-2024)	OP00001	TR-1109	Approved	8	Multi-Products	Globa
OP2-PREN (2009-2014)	OP00002	TR-018	Approved	6	Globally	Multi-I

Activity:

- 13101 - Preparation and spinning of cotton-type fibers
- 20600 - Manufacture of synthetic or artificial fibers

Product Designation:

- Cape + Branch
- Wire
- Top

Code	Activity	Tep / year	€ / again	t CO2 / ano	€ Investment	PRI Years
OP1-PREN (2014-2021)	13101 - Preparation and spinning of cotton-type fibers	66	27.104	145	122.000	5
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	2.555	594.256	6.785	537.000	1

Code	Activity	Cross-sectional Measurement Code	Description: Cross-sectional Measurement	Sub Description Cross-sectional Measurement	Measurement
OP1-PREN (2014-2021)	13101 - Preparation and spinning of cotton-type fibers	MT09	Lighting	Efficient lighting	LED lighting in the OE
OP1-PREN (2014-2021)	13101 - Preparation and spinning of cotton-type fibers				Replacement of Marzoli carding machines with TC11 units in the OE Area
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT09	Lighting	Efficient lighting	LED lighting in the DP and SP areas.
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT09	Lighting	Efficient lighting	LED lighting in the APA
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT07	Heat and Cold Production	Heat recovery	Optimization/Replacement of steam traps in extrusion lines (SP Area)
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT07	Heat and Cold Production	Heat recovery	Condensate recovery in the DP and SP areas.
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT09	Lighting	Efficient lighting	LED lighting in the CB area.
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT09	Lighting	Efficient lighting	LED lighting in the TTT area.
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT18	Others	Others	Injection of A11 into the rotary filter.
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT01	Electric Motors	Engine optimization	Replacing the motor in a Seydel converter with an IE3 motor.
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT18	Others	Others	Dismantling of Autoclave C
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT18	Others	Others	Optimizing SPM washing
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT18	Others	Others	A11 flow optimization
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT01	Electric Motors	Engine optimization	Direct attack crimpers
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT14	Industrial Process Efficiency/Other	Thermal insulation	Thermal Insulation Restoration
OP1-PREN (2014-2021)	20600 - Manufacture of synthetic or artificial fibers	MT01	Electric Motors	Engine optimization	Replacement of mechanical variators with frequency inverters in DP-116E pumps.

Business intelligence – Report Measures

Measures Provided for in the Energy Rationalization Agreement | REP Biennium 4

Code REP	Biennium Year	Technician/Entity	State of REP	PREN Presented	VAB Presented
OP1000-PREN (2016-2023) - BF	2023	TR-287	ADENE	Globally	Multi-Product
OP1001-PREN (2010-2017) - BF	2017	TR-068	Approved	Globally	Multi-Product
OP1004-PREN (2010-2017) - BF	2017	TR-1273	Approved	Globally	Multi-Product
OP1005-PREN (2016-2023) - BF	2023	TR-1480	ADENE	Globally	Multi-Product

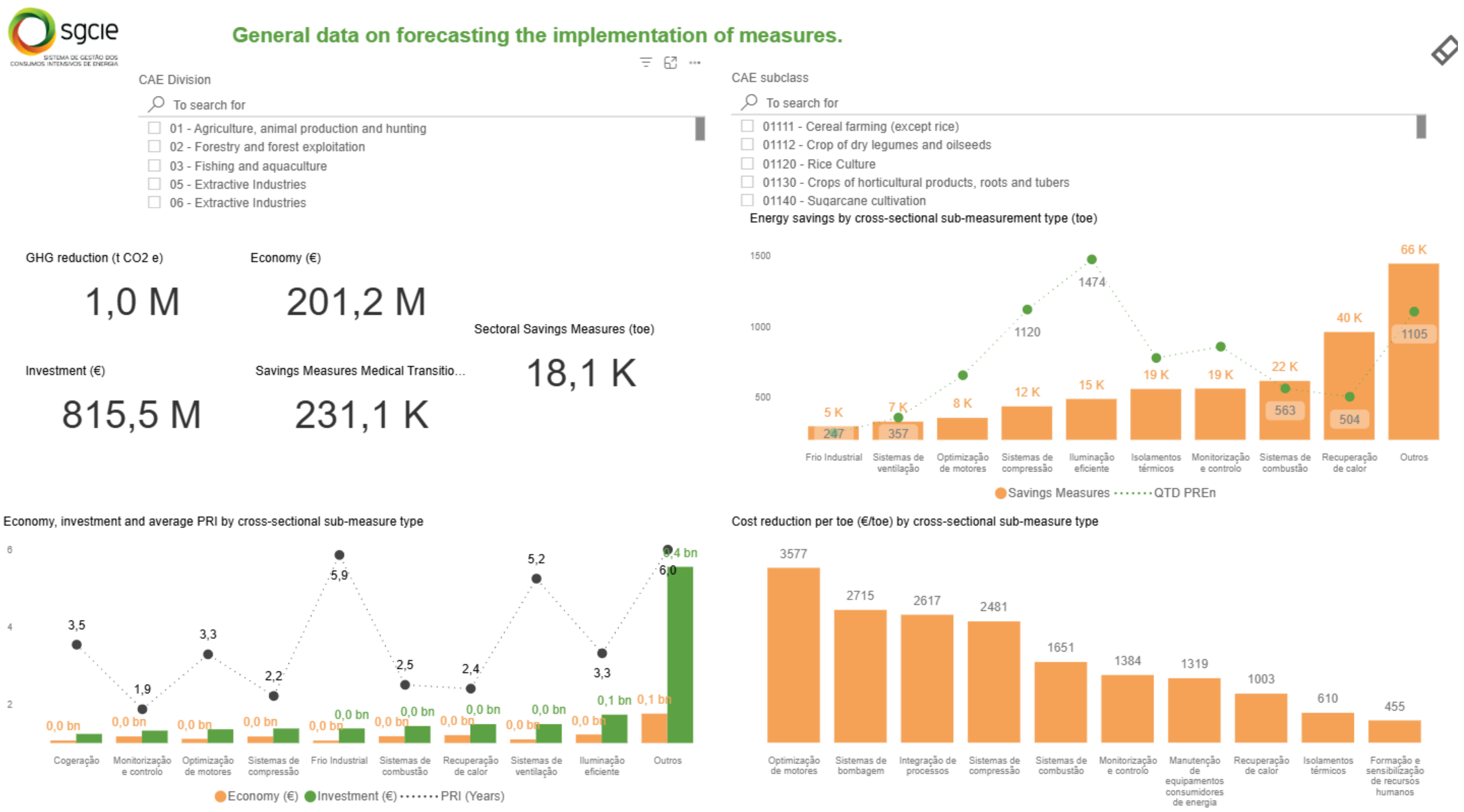
Activity: 10611 - Cereal milling

Product Designation: Wheat Flour and Bitter Semolina Mix

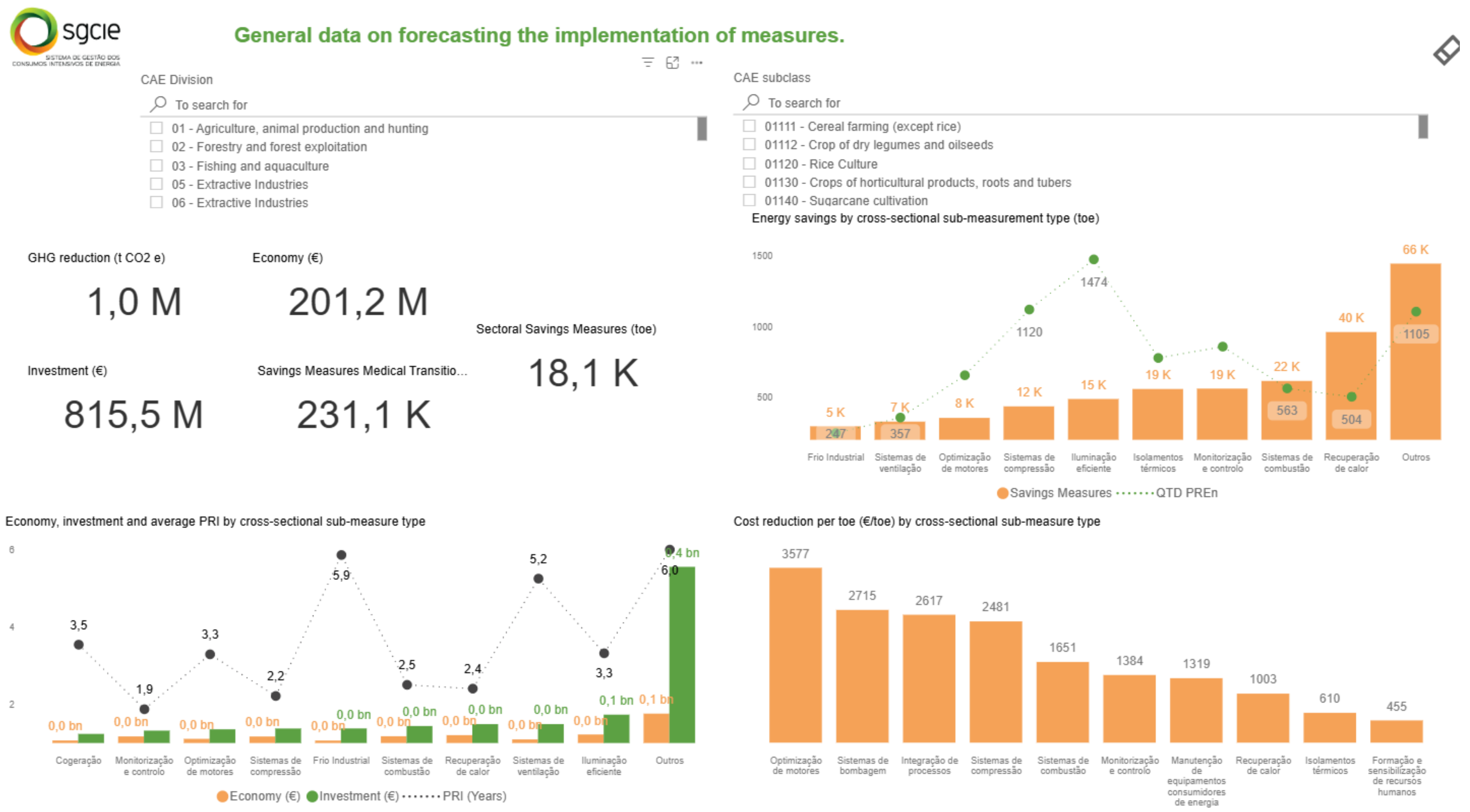
CodigoRep	Activity	Tep / year	€ / again	t CO2 / ano	€ Investment	PRI Years
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	33	15.991	80	652.799	41

CodigoRep	Activity	Cross-sectional Measurement Code	Description: Cross-sectional Measurement	Sub Description Cross-sectional Measurement	Measurement
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT03	Electric Motors	Ventilation systems	Automatic VEV control of the main suction fan (110 kW)
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT10	Industrial Process Efficiency/Other	Monitoring and control	Energy Management System
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT04	Electric Motors	Compression systems	Exhaust air to the outside for cooling compressor service.
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT10	Industrial Process Efficiency/Other	Monitoring and control	Implementation of a diesel consumption management system.
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT04	Electric Motors	Compression systems	Installation of VEV on the service compressor and slight reduction in
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT03	Electric Motors	Ventilation systems	Installation of VEV on the dust collection fan (22 kW)
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT13	Industrial Process Efficiency/Other	Maintenance of energy-consuming equipment	Reducing leaks Compressed air
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT01	Electric Motors	Engine optimization	Voltage regulator - 30 kW motor for T2.1 mill.
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT01	Electric Motors	Engine optimization	Voltage regulator - 37 kW motor, T1.1 mill.
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT15	Industrial Process Efficiency/Other	Transportation	Continuous fleet renewal
OP1004-PREN (2010-2017) - BF	10611 - Cereal milling	MT09	Lighting	Efficient lighting	Replacing T8 local lighting with equivalent T5 lighting.

Power BI public dashboard

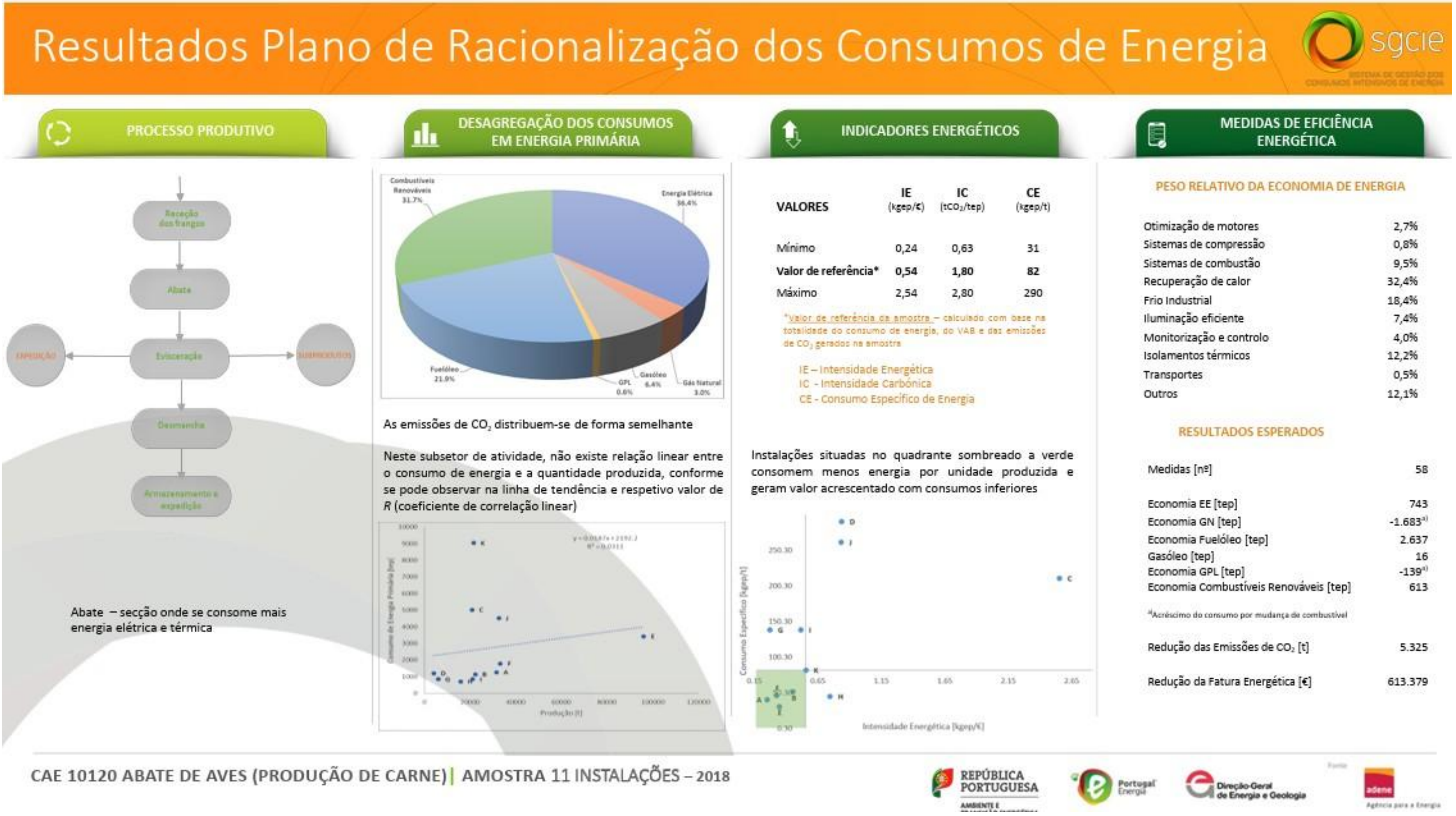


Power BI public dashboard



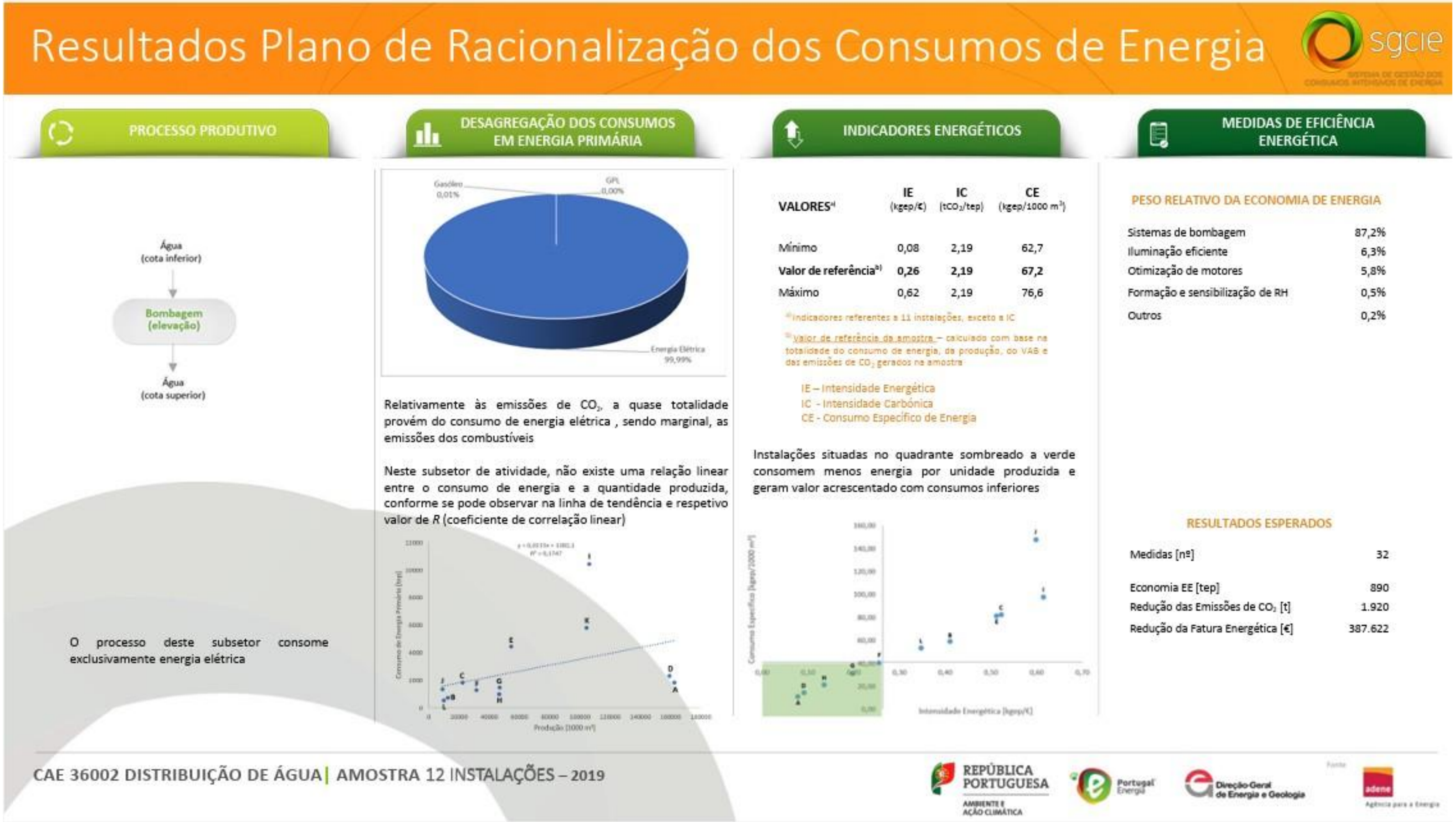
Benchmarking reports

Bird
Shoot



Benchmarking reports

Water distribution



Resultados Plano de Racionalização dos Consumos de Energia

sgcie

PROCESSO PRODUTIVO

Água (cota inferior) → Bombagem (elevação) → Água (cota superior)

O processo deste subsetor consome exclusivamente energia elétrica

DESAGREGAÇÃO DOS CONSUMOS EM ENERGIA PRIMÁRIA

Gasóleo 0,01%
GPL 0,00%
Energia Elétrica 99,99%

Relativamente às emissões de CO_2, a quase totalidade provém do consumo de energia elétrica , sendo marginal, as emissões dos combustíveis

Neste subsetor de atividade, não existe uma relação linear entre o consumo de energia e a quantidade produzida, conforme se pode observar na linha de tendência e respetivo valor de *R* (coeficiente de correlação linear)

INDICADORES ENERGÉTICOS

VALORES[a]	IE (kgep/€)	IC (tCO_2/tep)	CE (kgep/1000 m^3)
Mínimo	0,08	2,19	62,7
Valor de referência[b]	**0,26**	**2,19**	**67,2**
Máximo	0,62	2,19	76,6

[a] Indicadores referentes a 11 instalações, exceto a IC

[b] Valor de referência da amostra – calculado com base na totalidade do consumo de energia, da produção, do VAB e das emissões de CO_2 gerados na amostra

IE – Intensidade Energética
IC - Intensidade Carbónica
CE - Consumo Específico de Energia

Instalações situadas no quadrante sombreado a verde consomem menos energia por unidade produzida e geram valor acrescentado com consumos inferiores

MEDIDAS DE EFICIÊNCIA ENERGÉTICA

PESO RELATIVO DA ECONOMIA DE ENERGIA

Sistemas de bombagem	87,2%
Iluminação eficiente	6,3%
Otimização de motores	5,8%
Formação e sensibilização de RH	0,5%
Outros	0,2%

RESULTADOS ESPERADOS

Medidas [nº]	32
Economia EE [tep]	890
Redução das Emissões de CO_2 [t]	1.920
Redução da Fatura Energética [€]	387.622

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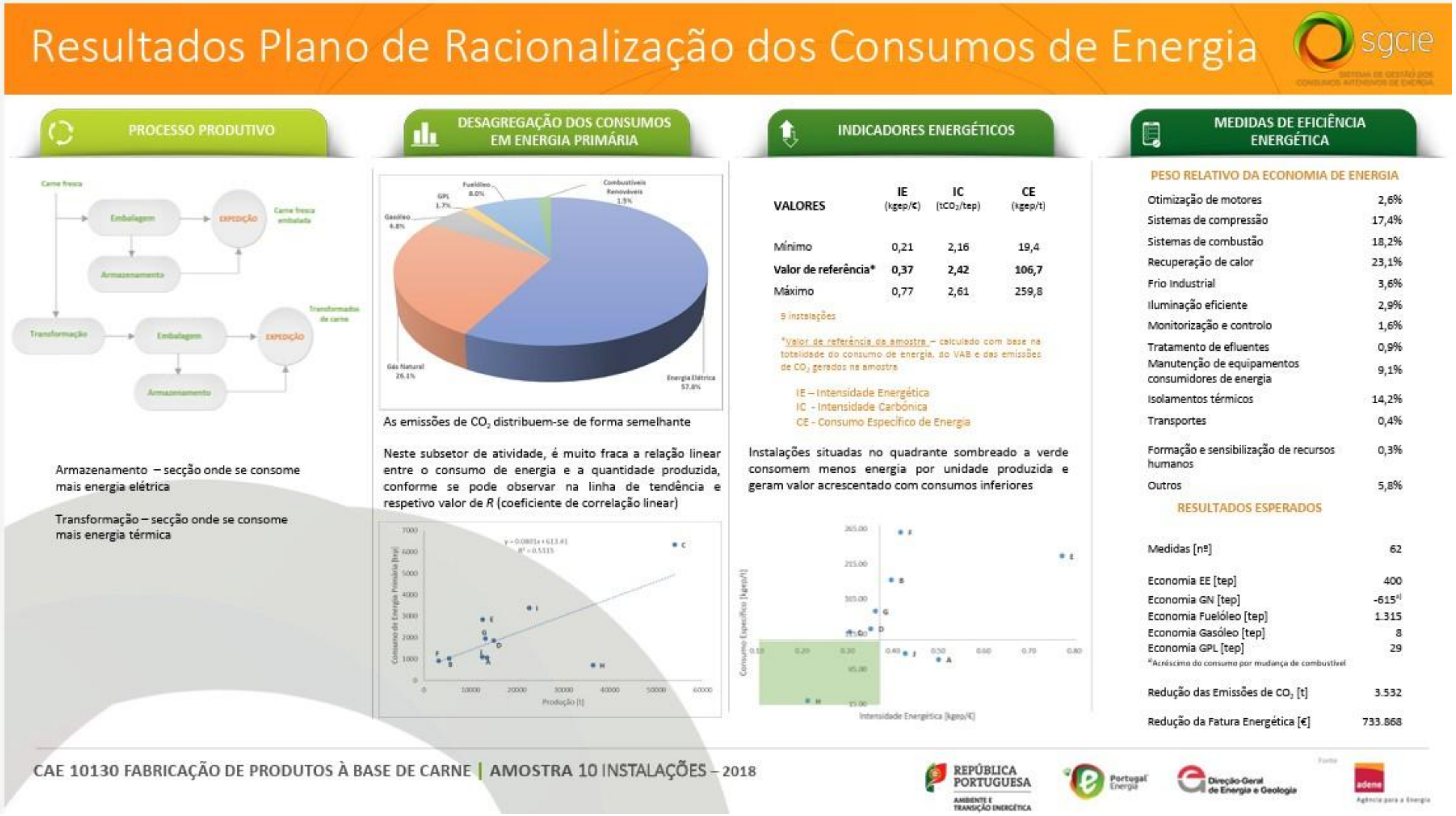
Benchmarking reports

Meat products



ODYSSEE-MURE

Thank you!

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Partners:

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