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EMBASSY OF DENMARK
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Danish Energy Agency

DEMONSTRATION ENERGY AUDITS

from Ideas to Mature Project

The case of the steel sector

Date 28 / 08 /2025

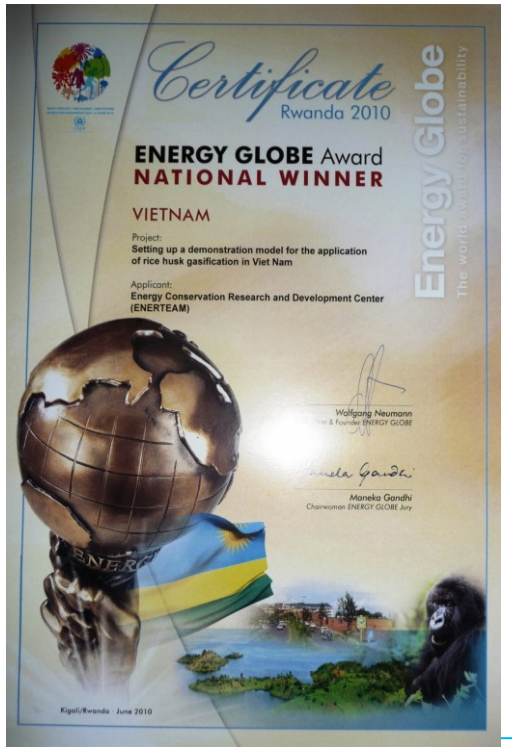
ENERTEAM

DEPP3

1 INTRODUCTION

ABOUT ENERTEAM

ENERTEAM is an independent sustainability consulting firm. We are proud of more than 25 experts, engineers and more than 20 years of experience in **promoting energy conservation, resource efficiency and renewable energy** in Vietnam and other countries in ASEAN.



a demonstration of technical and financial models for the application of rice husk gasification *which was awarded the prestigious* ***Energy Globe Award*** *in 2010 .*

1995

Established as

Trans Energ

1999

ENERTEAM is an

independent sustainability consulting firm

actively engaged in energy efficiency and renewable energy.

2025

ENERTEAM takes pride in being

the first and foremost **sustainable energy and resource efficiency service provider.**

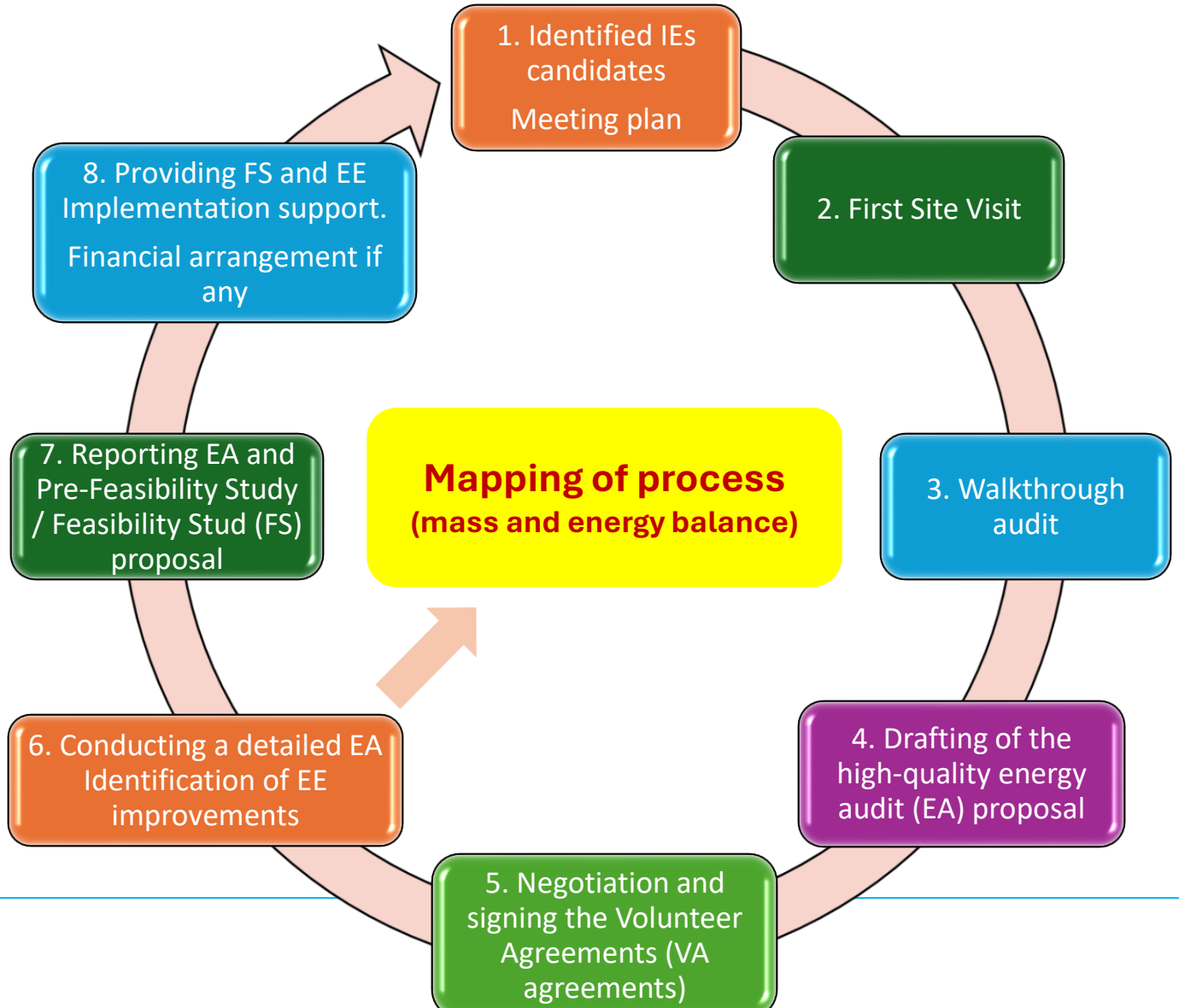
OUR VALUED CLIENTS AND SPONSORS



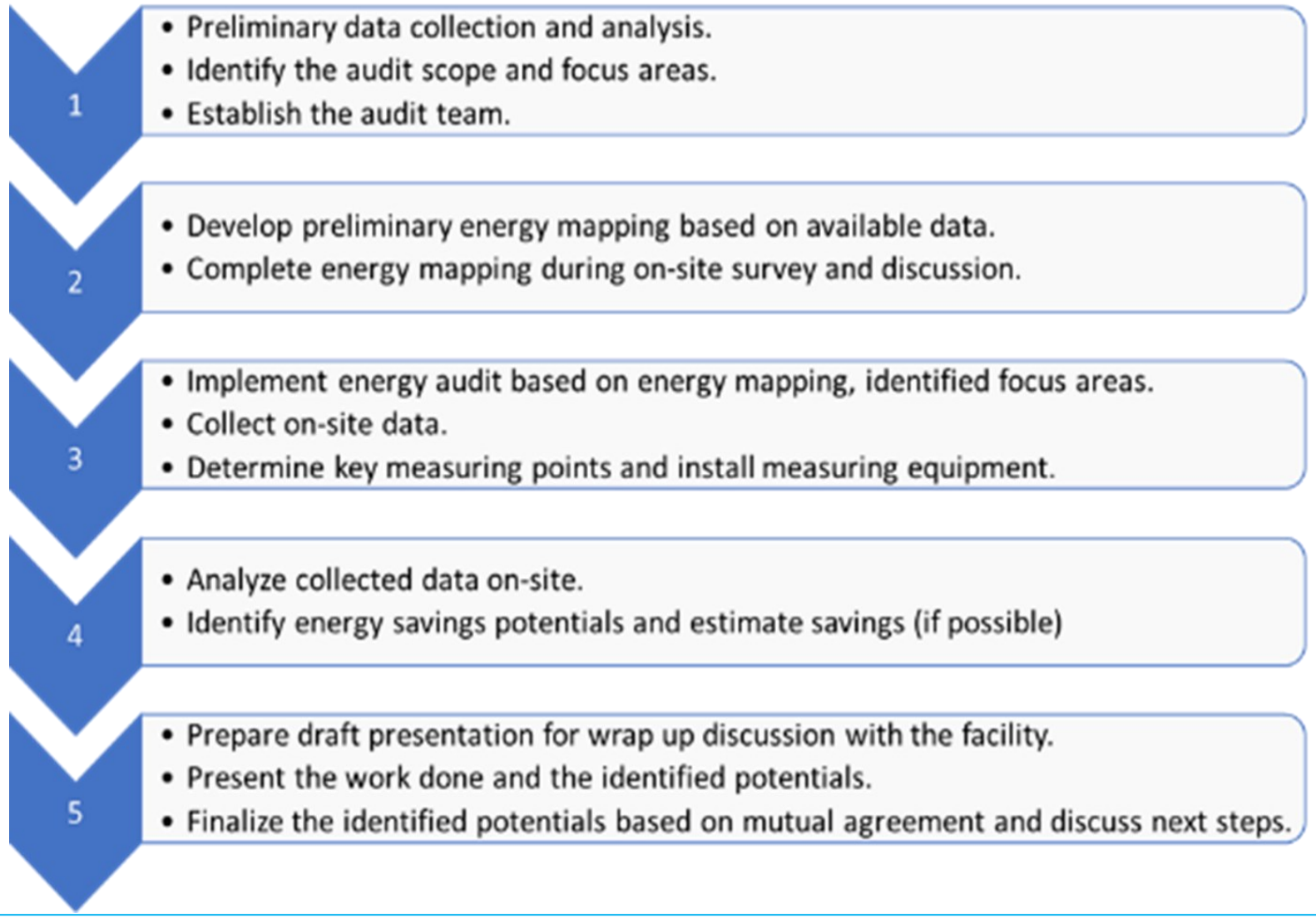


2 DEMO ENERGY AUDIT FOR STEEL SECTOR

METHODOLOGY OF VA HIGH-QUALITY ENERGY AUDIT

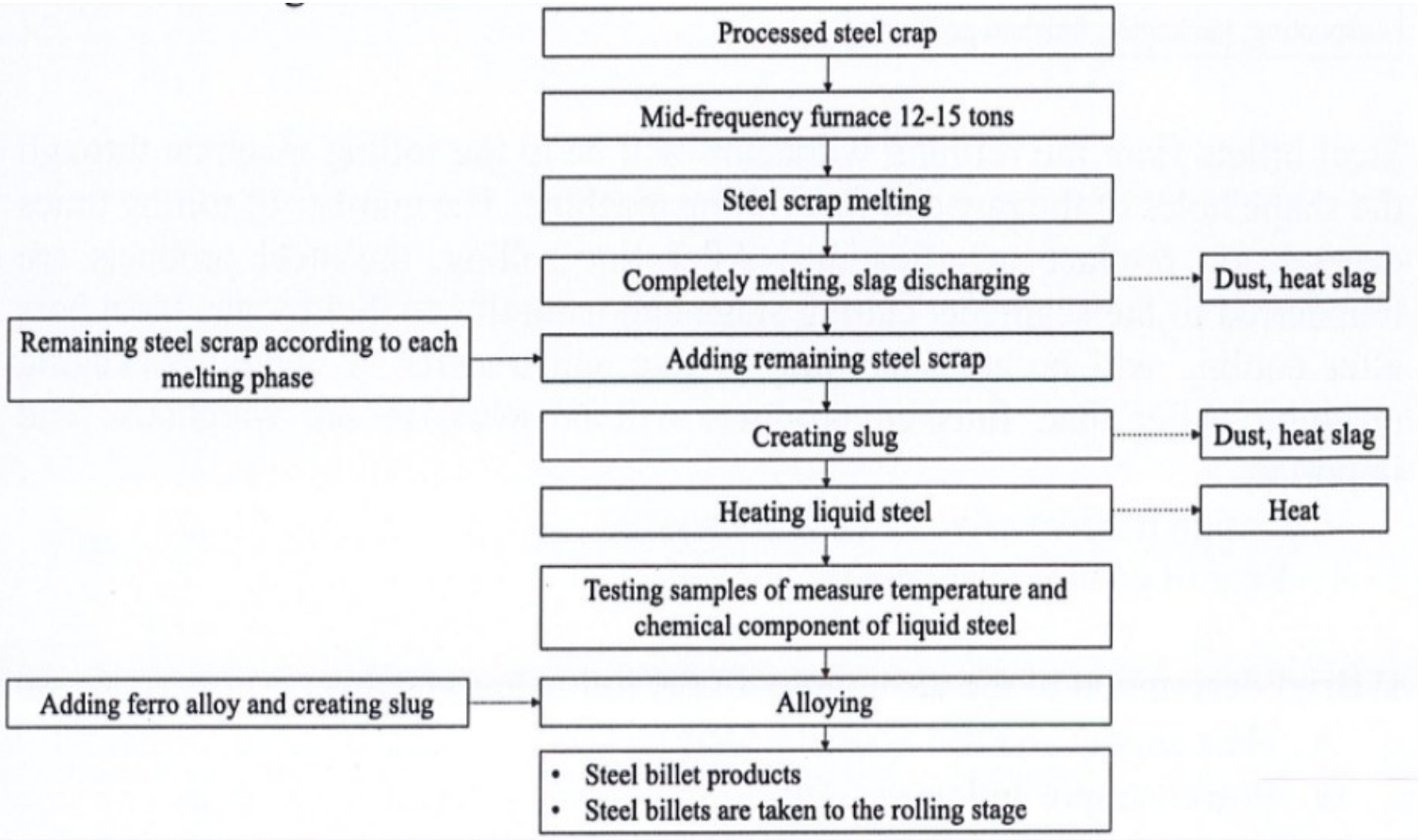


METHODOLOGY USED TO IDENTIFY EE PROJECTS



METHODOLOGY USED TO IDENTIFY EE PROJECTS

Why Energy Mapping?

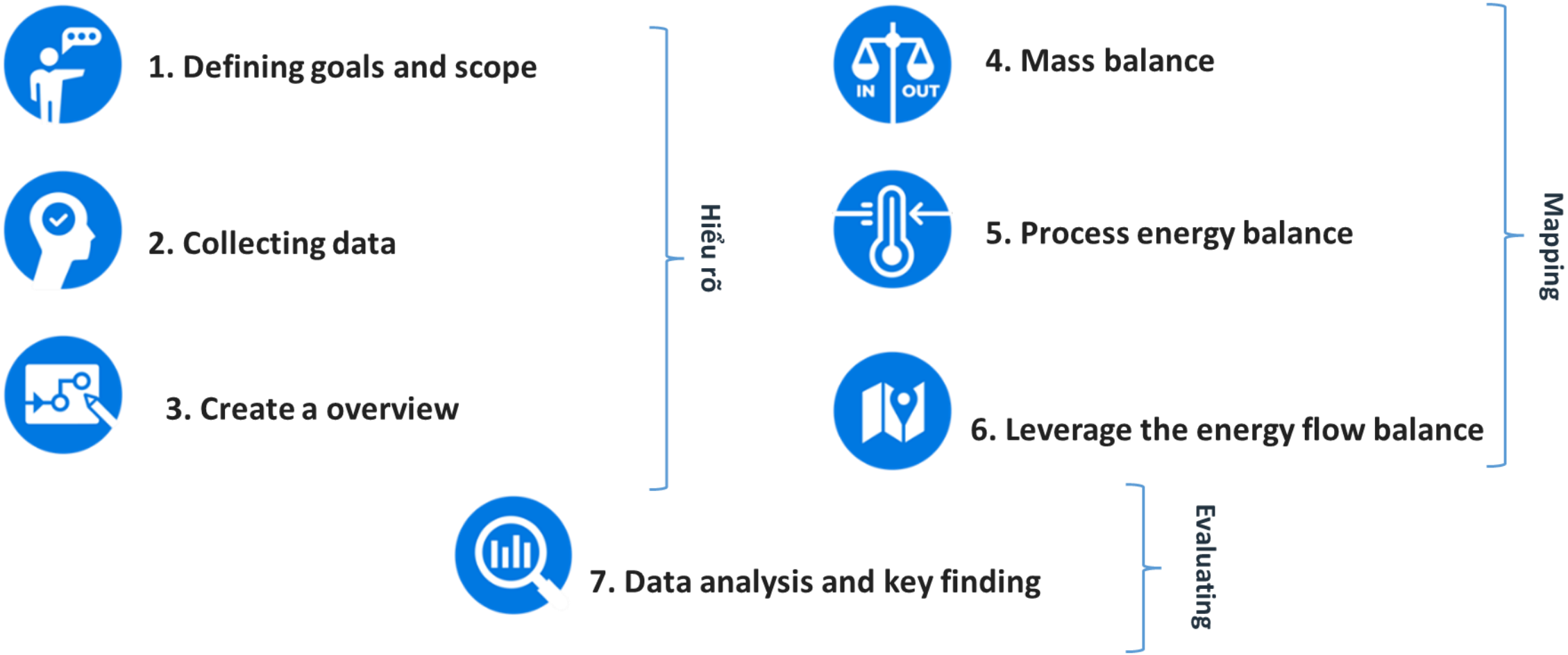


The production process diagram commonly used when conducting energy audits has the following limitations:

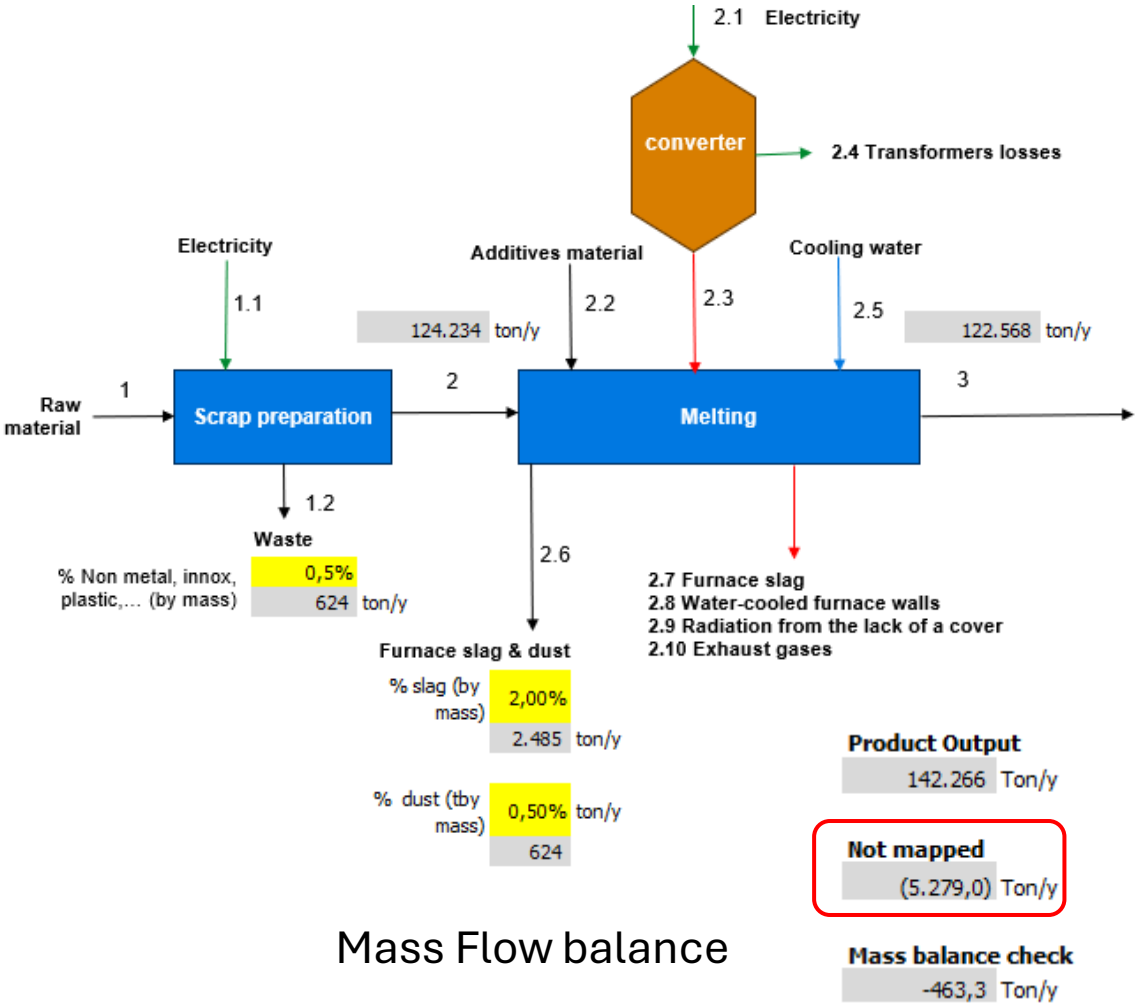
- Missing the overall energy flow picture
- Limited linkage between production processes and energy use
- Lack of visual tools makes it difficult for energy auditors

USING THE ENERGY MAPPING

TYPICAL ENERGY MAPPING APPROACH BASED ON EA GUIDANCE



USING THE ENERGY MAPPING



Mass Flow balance

The data to be collected when building energy mapping includes:

+ Identifying the flow of raw materials in and the flow of materials out at each stage of the production process.

+ Quantifying the material flows in and out at each stage of the production process.

+ The iteration process if the amount of unmapped data is excessive

Completing an energy map requires substantial data, time, and resources

USING THE ENERGY MAPPING

Role of auditors (incl in-house or external of EAC)

In-house auditors

- Collect and provide complete and accurate input data:

✓ Process flow diagrams and production line layouts; the flow of raw materials in and out at each stage.

✓ Production output, energy consumption flow (fuel, electricity, water, steam, ...).

✓ ...

- Act as the data focal point to ensure completeness and accuracy.
- Serve as the link between the external audit team and production/operation departments.
- Ensure that recommendations from Energy Mapping are practical and feasible for implementation.

External auditors of EAC

Before conducting an energy audit:

- Collect complete initial data
- Identify specific goals and scope
- Build a draft energy map based on available data.
- Analyze production and energy consumption data.

On-site assessment:

- Explain clearly to the factory about building energy mapping in energy audit activities
- Lead and coordinate with internal audit to complete energy map
- Complete energy mapping on first day of work
- Identify loss sources and build measurement strategy

USING THE ENERGY MAPPING

The energy mapping approach has the following advantages:

- Provides a complete visual representation of energy and mass flows for the entire facility.
- Quickly identifies SEUs, major losses, and potential areas for heat recovery.
- Helps prioritize measurement points, saving audit time and resources.
- Links energy consumption with production stages, enabling more targeted and economically viable solutions.

Necessary conditions for successful energy audit according to energy mapping:

- Auditors must have a clear understanding base on the energy mapping approach
- Close cooperation between external auditors and internal auditors in the factory
- The sharing of the factory's information and data

DEMONSTRATION ENERGY AUDIT

Company/Factory: STEEL SECTOR

Sector: Steel manufacturing industry

Brief information

Main products:

- Steel billets, construction steel

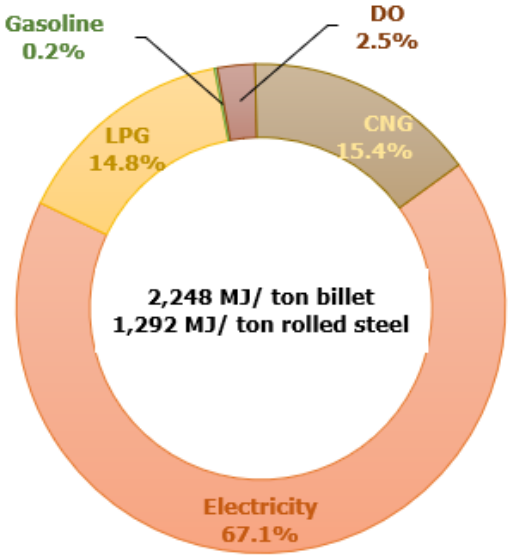
Designed capacity:

- Steelmaking line: 170,000 ton/year
- Steel rolling line: 120,000 ton/year



DEMONSTRATION ENERGY AUDIT

ENERGY CONSUMPTION SUMMARY IN 2023

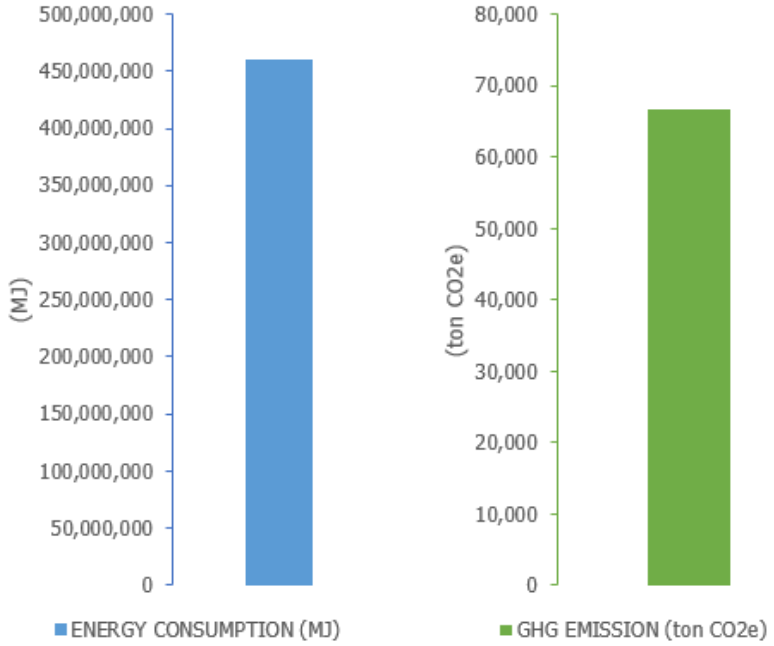


TOTAL ENERGY CONSUMPTION IN 2023

460,745,867 (MJ)

TOTAL GHG EMISSION

66,760 (ton CO2e)

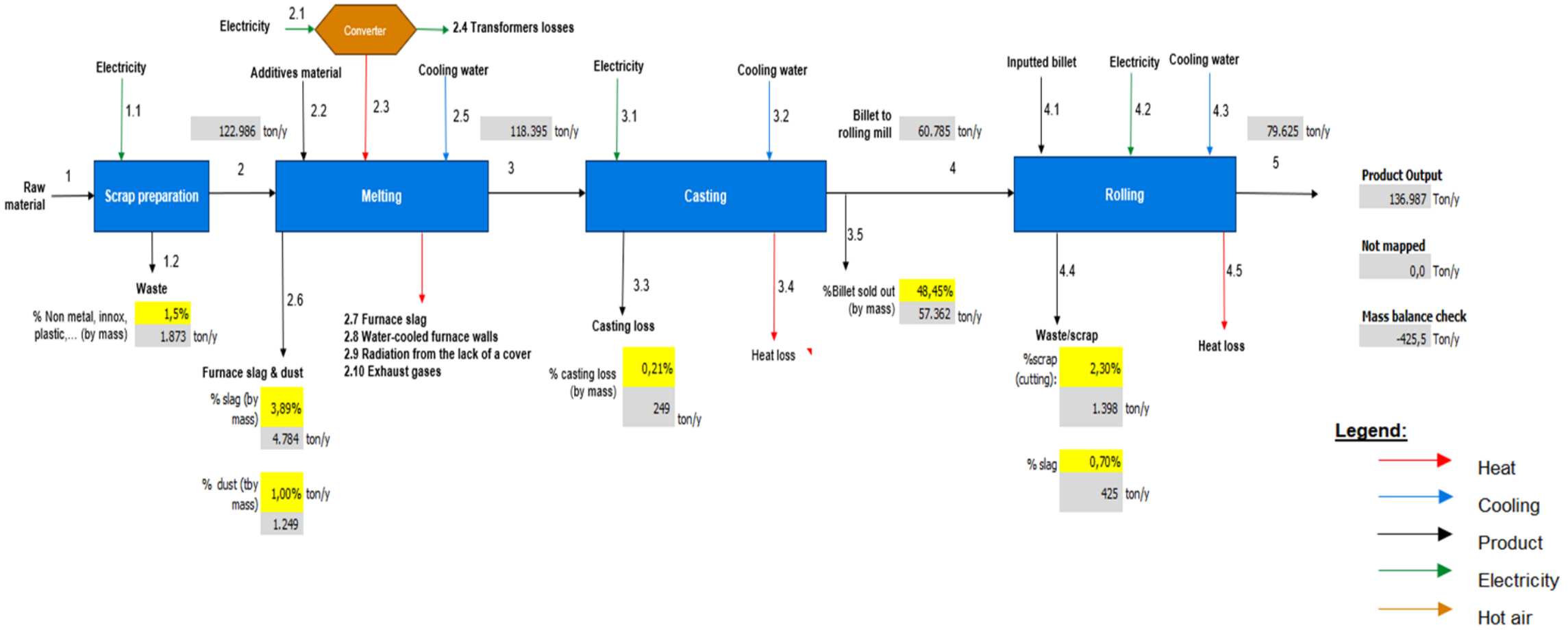


ENERGY CONSUMPTION

TYPE OF ENERGY	CONSUMPTION	UNIT	CONVERTION ENERGY (MJ)	RATE	GHG EMISSION (ton CO_2e)
ELETRICITY	85,890,000	kWh	309,204,000	67.1%	58,113
LPG	1,499,810	kg	68,391,336	14.8%	4,319
GASOLINE	20,000	liter	880,000	0.2%	48
DO	267,255	liter	11,411,789	2.5%	730
CNG	1,679,000	Sm3	70,858,743	15.4%	3,549

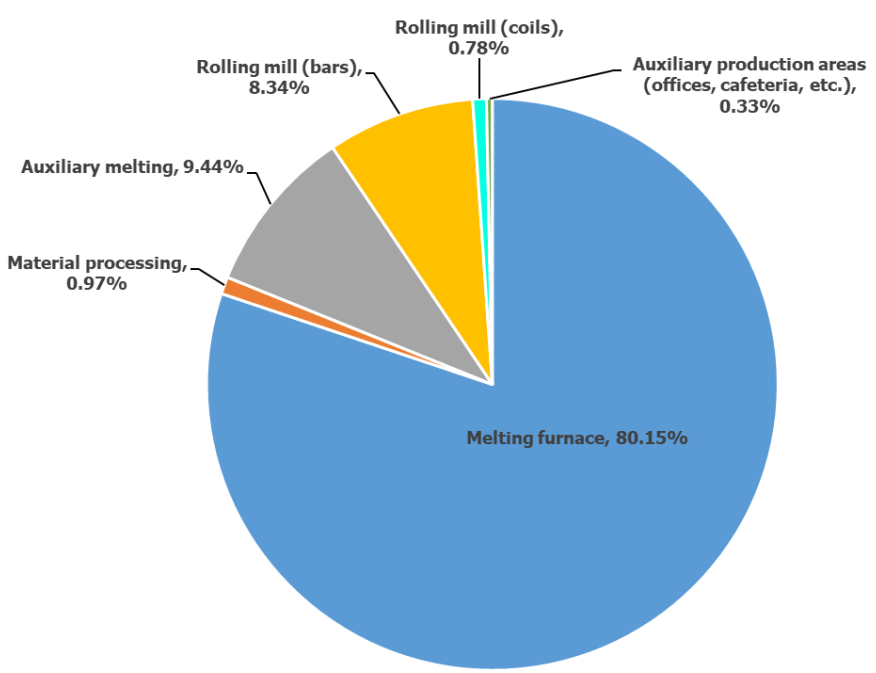
ENERGY MAPPING RESULTS

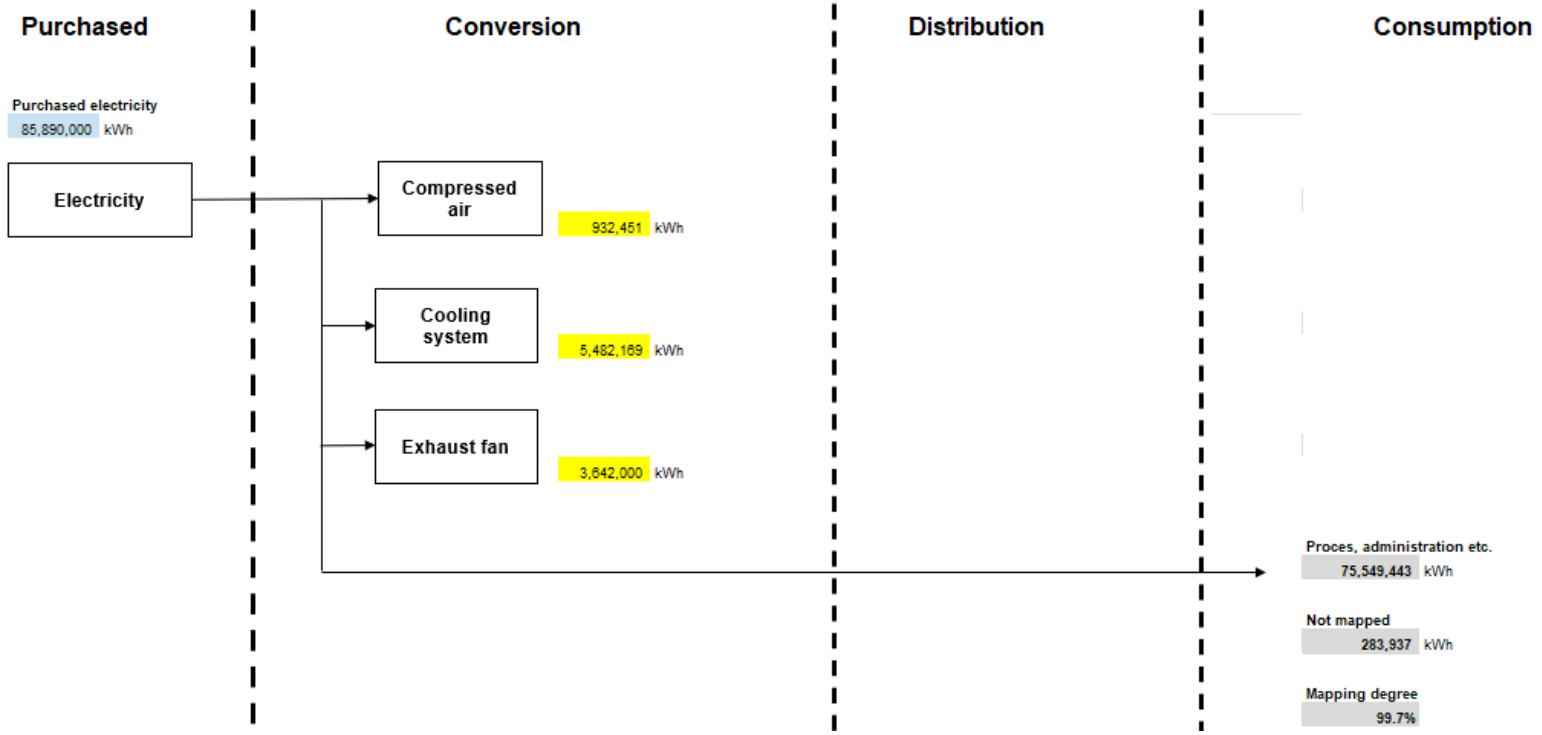
THE MASS FLOW BALANCE DIAGRAM



ENERGY MAPPING RESULTS

Schematic of the utility mapping process

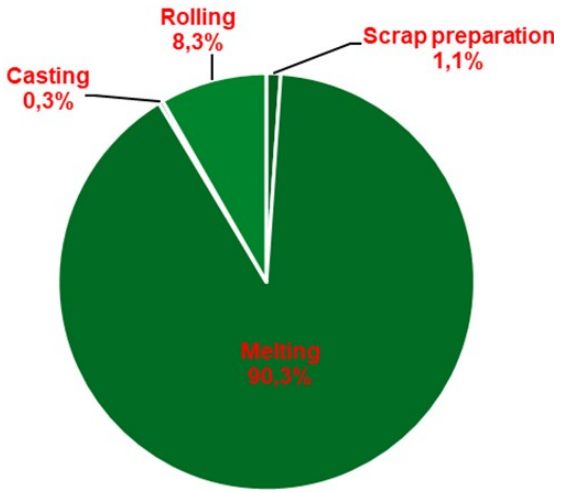




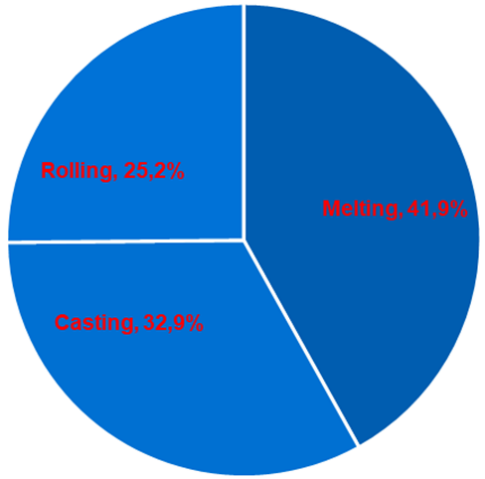
Melting process is largest electricity users with consumed up to 90.3% of the total electricity consumption.

ENERGY MAPPING RESULTS

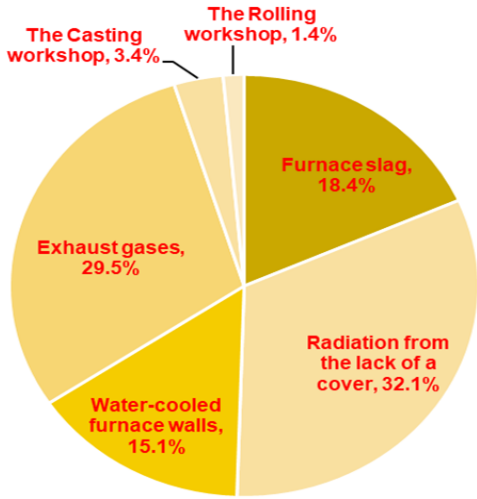
ELECTRICITY CONSUMPTION



COOLING - WATER



WASTE HEAT



Melting
- Raw-material handling
- KPIs for Melting

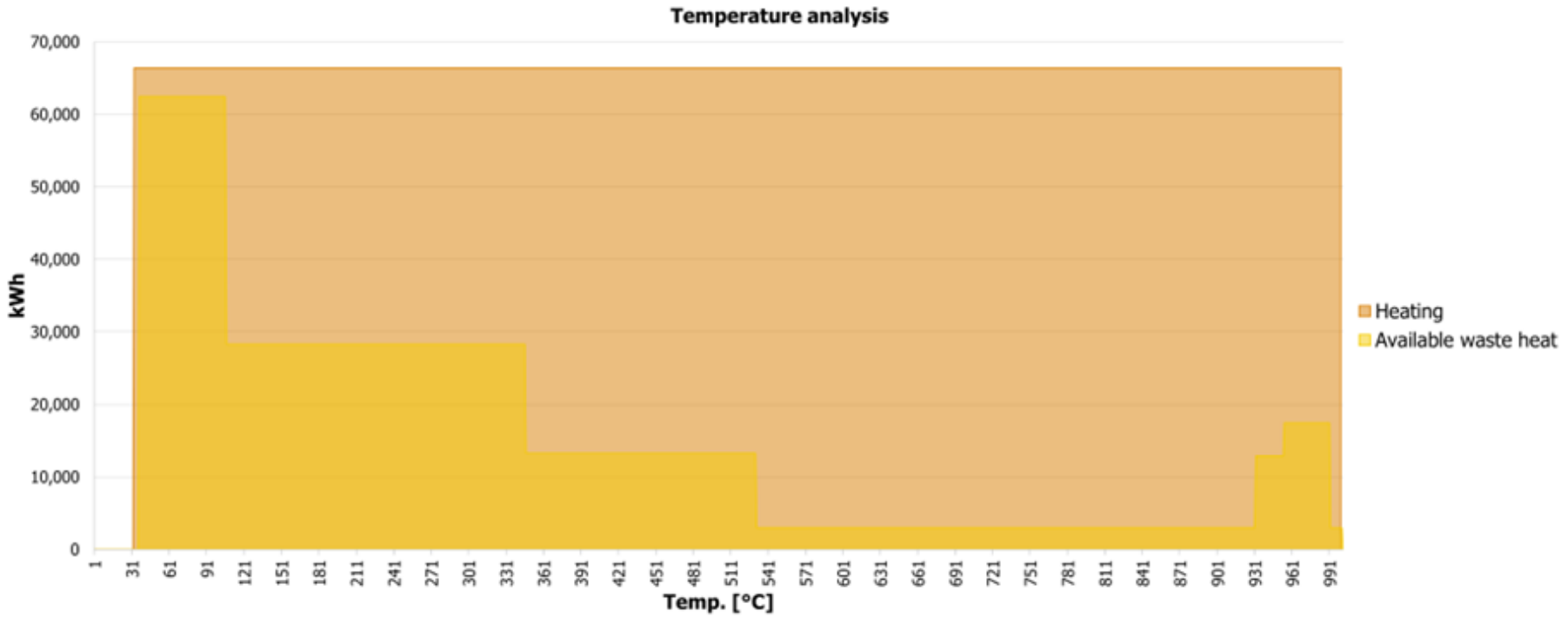
Cooling system
- Optimized flow control of pumps
- Efficiency of pumps
- Efficiency of electric motors
- Efficiency of fans

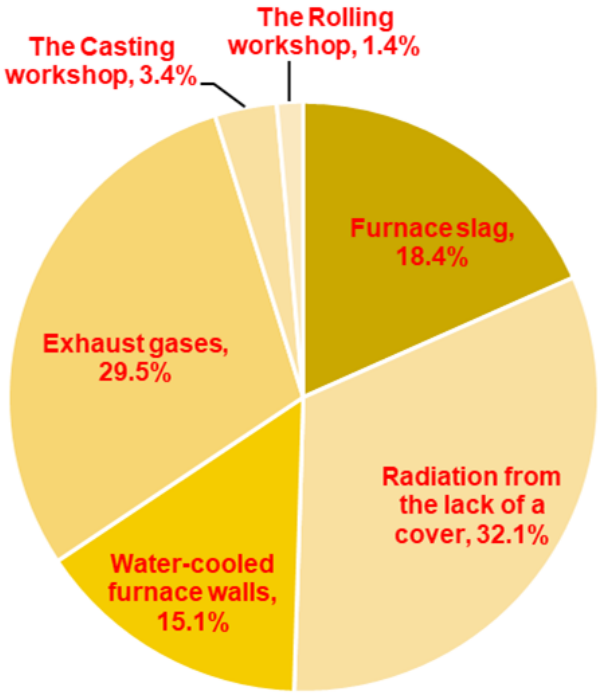
Waste heat
- ORC from heat recovery (casting and rolling section)
- Pre-heating scrap

Energy saving potential by energy mapping

ENERGY MAPPING RESULTS

TEMRERATURE ANALYSIS





The heat losses are high. These losses mostly lie in the old design and operation status of the induction furnace

ENERGY MAPPING RESULTS

No.	System	Energy saving opportunities	Recommendations from the company's leadership
1.	Melting furnace	Raw-material handling	Solution aligned with the company's improvement orientation
2.		Pre-heating	To be deferred in this stage
3.		KPIs for Melting	Solution aligned with the company's improvement orientation
4.	Transformers	Transformer loss control	To be deferred in this stage
5.		Harmonic control	
6.	Exhaust fan	Use high efficiency motor	To be deferred in this stage
7.	Cooling water systems	Efficiency of pumps	
8.		Efficiency of electric motors	
9.	Air Compressor	Replace old air compressors with low efficiency	Solution aligned with the company's improvement orientation
		Install VSD for air compressors	
10.	Others	Install solar rooftop PV system	Solution aligned with the company's improvement orientation
11.		ORC from heat recovery (casting and rolling section)	Not implemented

The energy-saving opportunities chosen for evaluation in this phase are as follows:

- Raw-material handling
- VSD for air compressors
- Optimized flow control of pumps by VSD
- Install solar rooftop PV system

DEMONSTRATION ENERGY AUDIT

Demo EA result

+ Electricity saving : 7.4 %
+ Cost saving: 11.08 billion VND/yr
+ Investment: 89 billion VND/yr
+ Simple payback: 8.1 yr
+ GHG Reduction: 6.5 %

07 projects level B

02 projects level A



Feasibility Study proposed:
Investing scrap shredding machines

+ Electricity saving: 2,666,813 kWh/yr
+ Cost saving: 4.6 billion VND/yr
+ Investment: 40 billion VND
+ Simple Payback : 8.7 yr
+ GHG reduction: 1,804 ton CO2e



- **Increased Production Efficiency**
- **Improved Furnace Lifespan:** Smaller, well-prepared scrap may reduce the wear and tear on furnaces, extending their operational life.
- **Enhanced Safety:** The improved material handling and reduction in loading times can lower the risk of accidents during furnace operation, contributing to a safer working environment.
- **Cost Savings from Reduced Maintenance**

DEMONSTRATION ENERGY AUDIT

SUMMARY OF PROJECTS AND ESTIMATED INVESMENT COSTS

No.	Projects	Electricity savings (kWh/year)	Cost savings (million VND/year)	Estimated investment[5] (million VND)	Payback period (year)	CO_2 emission reduction (ton CO_2e/year)
Group I: Projects level B						
1	Install VSD for air compressors of rolling workshop	32.636	63	112	1,8	22,1
2	Install VSD for the cooling water pump at the rolling workshop	121.950	234	77	0,3	82,5
3	Install VSD for the hydraulic pump motor of the material press	24.043	46	127	3,1	16,3
4	Use high efficiency motor	169.055	325	552	1,7	114,4
Group II: Projects level A						
5	Investing scrap shredding machines	2,666,813	4,614	40,000	8.7	1,804.4
6	Install rooftop solar photovoltaic (PV) system	3,377,582	5,843	48,045	8.2	2,285.3
Total		**3,014,497**	**11,058**	**88,913**	**8.1**	**4,324.9**
Percentage of savings[6]		**3.5%**	-	-	-	**6,5%**

Projects level B: Usually required low investment and are relatively simple to implement regarding the technical issues

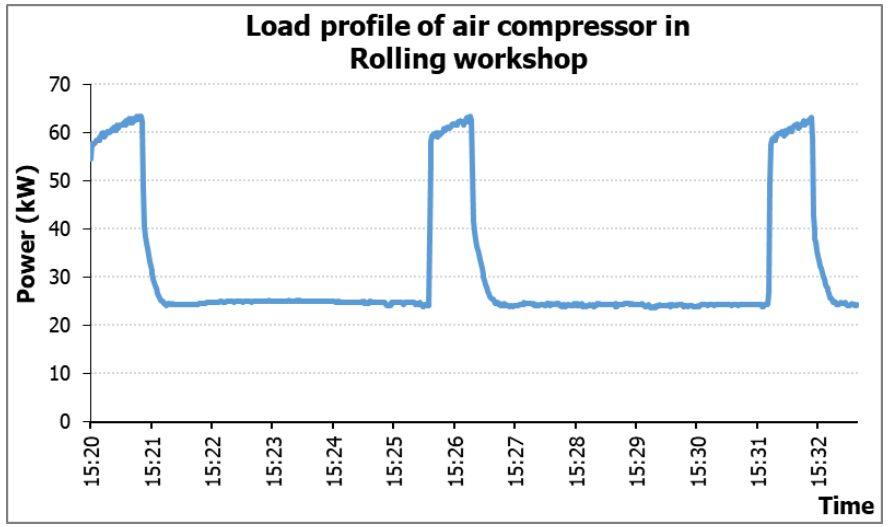
Projects level A: high investment and technical complexity (potential to implement deep dive pre-feasibility/feasibility study)

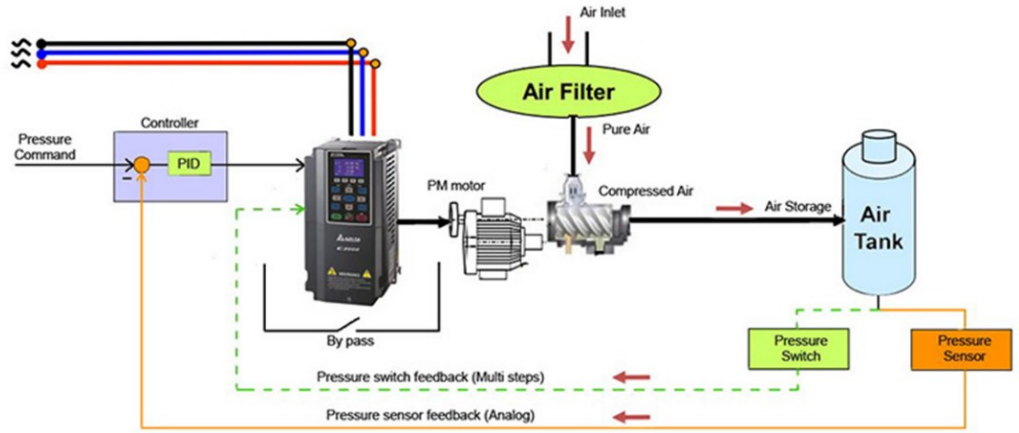
DEMONSTRATION ENERGY AUDIT

PROJECT LEVEL B: Install VSD for air compressors of rolling workshop

➢02 Air compressors with operating one compressor

in load/unload mode, and the other in standby mode





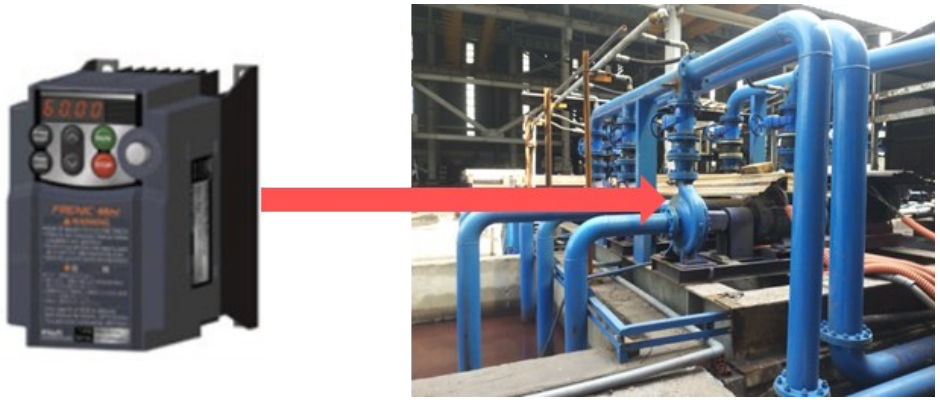
Project budget		
Element	**Quantity**	**Cost (mil. VND)**
1. VSD	**2**	112
Saving		
Electricity saving: 32,636 kWh/yr	**Financial savings:** 56 mil. VND	
GHG reduction: 22 tCO_2e/yr	**Simple payback:** 2 yr	

DEMONSTRATION ENERGY AUDIT

PROJECT LEVEL B: Install VSD for the cooling water pump at the rolling workshop

- 75kW raw water pump to provide cooling water for the roughing mill area
- A higher capacity than necessary for the cooling requirements. Used the throatting valves to control the water flowrate.





Project budget		
Element	**Quantity**	**Cost (mil. VND)**
1. VSD	**1**	77
Saving		
Electricity saving: 121,950 kWh/yr	**Financial savings:** 221 mil. VND	
GHG reduction: 82.5 tCO_2e/yr	**Simple payback:** 0.4 yr	

DEMONSTRATION ENERGY AUDIT

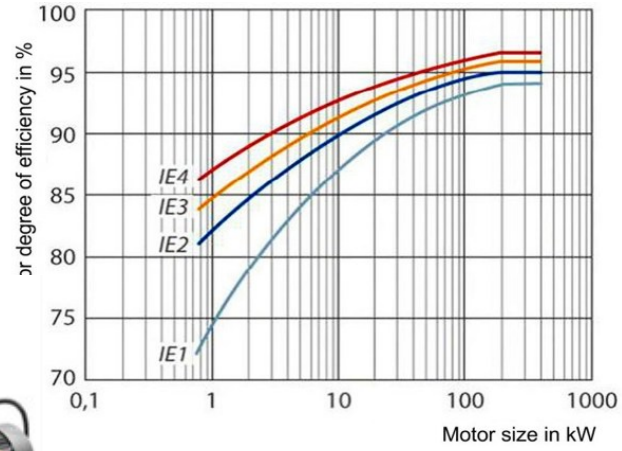
PROJECT LEVEL B: Use high efficiency motor

- Most motors used in the facility are the old IE1 efficiency class
- To rewind rather than replacing them and switching to higher efficiency motors









Project budget	
Element	**Cost (mil. VND)**
1. Install using IE3 motors replacing a mount of selected EI1 old motors	551.8
Saving	
Electricity saving: 169,055 kWh/yr	Financial savings: 292.5 mil. VND
GHG reduction: 114.4 tCO_2e/yr	Simple payback: 1.9 yr

DEMONSTRATION ENERGY AUDIT

PROJECT LEVEL A: INVESTING SCRAP SHREDDING MACHINES

- The company uses scrap steel as the input material for induction furnaces.
- Scrap steel is shredded and compacted into rectangular blocks of 0.5m x 0.5m x 1m.
- The material preparation process includes input treatment, but the efficiency remains low.
- Large block sizes make furnace loading difficult, extend melting time, and increase energy consumption per batch.







Reduce the size of the materials fed into the furnaces.

Project budget		
Element	**Quantity**	**Cost (mil. VND)**
1. Scarp shredding machines	1	40,000
Total	**40,000 mil. VND**	
Saving		
Electricity saving: 2,666,813 kWh/yr	**Financial savings:** 5,120 mil. VND	
GHG reduction: 1,804 tCO_2e/yr	**Simple payback:** 7,8 yr	

KEY HIGHLIGHTS

- Guidance and support from the Danish Energy Agency (DEA) and international consultants (VM) were appropriate and helpful, particularly in sharing in-depth knowledge and practical experience in on-site assessments.
- The mapping tools and guidelines were highly useful for conducting energy audits and identifying energy efficiency potentials.
- The selected companies expected to receive high-quality energy audit results with valuable energy efficiency improvements and greenhouse gas reductions.

CHALLENGES & LESSON LEARNT

Lessons Learned

- Traditional auditing in Vietnam is often based on generic checklists; an industrial process approach is often limited.

→ The energy mapping approach enables process-based energy auditing, integrating the production process with the energy balance right from the start of the assessment.

  - ✓ Clearly define scope and more quickly identify significant energy usage units (SEUs)
  - ✓ Prioritizing systems early prevents wasting resources on low-impact areas.
- Energy Mapping speeds up the transition from findings to actionable projects.
- Visualizing flows and losses improves understanding and consensus in energy audits
- Successful Energy Mapping depends on strong collaboration between plant teams and auditors.

CHALLENGES & LESSON LEARNT

Challenges

- Incomplete or Inaccurate Data
  - ✓ Historical energy and production data are missing or inconsistent.
  - ✓ Operational data lacks detail by shift, by line or by utility system

→ Conduct a **pre-audit data review** to identify gaps early; Use short-term measurements and engineering estimates

- Inadequate measuring system at the factory
  - ✓ Lack of measuring meters (temperature, pressure, electricity…) at main consumption points.

→ Recommend phased investment in metering systems starting from Significant Energy Users (SEUs).

It takes a long time to build an energy map.

CHALLENGES & LESSON LEARNT

Challenges

- Limited Data Sharing from Enterprises

✓ Reluctance to share detailed data due to fear of revealing production or commercial secrets.

✓ Poor coordination between departments (production, maintenance, energy accounting).

- Limited internal human resources of the enterprise make it difficult to fully support the survey and mapping process.

SUGGESTIONS

- Introducing energy mapping tools for businesses to implement
- Standardize the Energy Mapping methodology in Vietnam:
  - Develop a national guideline for energy mapping based on DEPP3.
  - Create **standardized Excel templates** that are user-friendly for industrial enterprises in Vietnam
- Integrate Energy Mapping into energy audit requirements (add-in the Circular and EA guideline)
- Establish **Energy Mapping training programs for auditors**

THANK YOU

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