DEMONSTRATION ENERGY AUDITS

From Ideas to Mature project

Power industry

Date: 21/04/2026

Consulting firm:

Agenda

- Brief introduction of the plant and the scope of the energy audit
- Energy audit approach, energy mapping methodology, and SEC assessment
- Summary of identified energy-saving opportunities, highlighting three priority projects for the next phase
- Advantages and challenges
- Recommendations

Case Overview

- **Sector:** Power generation
- **Year of establishment:** 2007
- **Main fuel:** Anthracite coal (grade 5A.1)
- **Installed capacity:** 600 MW (2x300MW)
- **Main product:** Commercial electricity
  - 2021: 3,450,070,600 kWh
  - 2022: 2,738,565,990 kWh
  - 2023: 3,305,499,310 kWh



Factory image

Case Overview

MACHINERY SYSTEM AT THE FACTORY









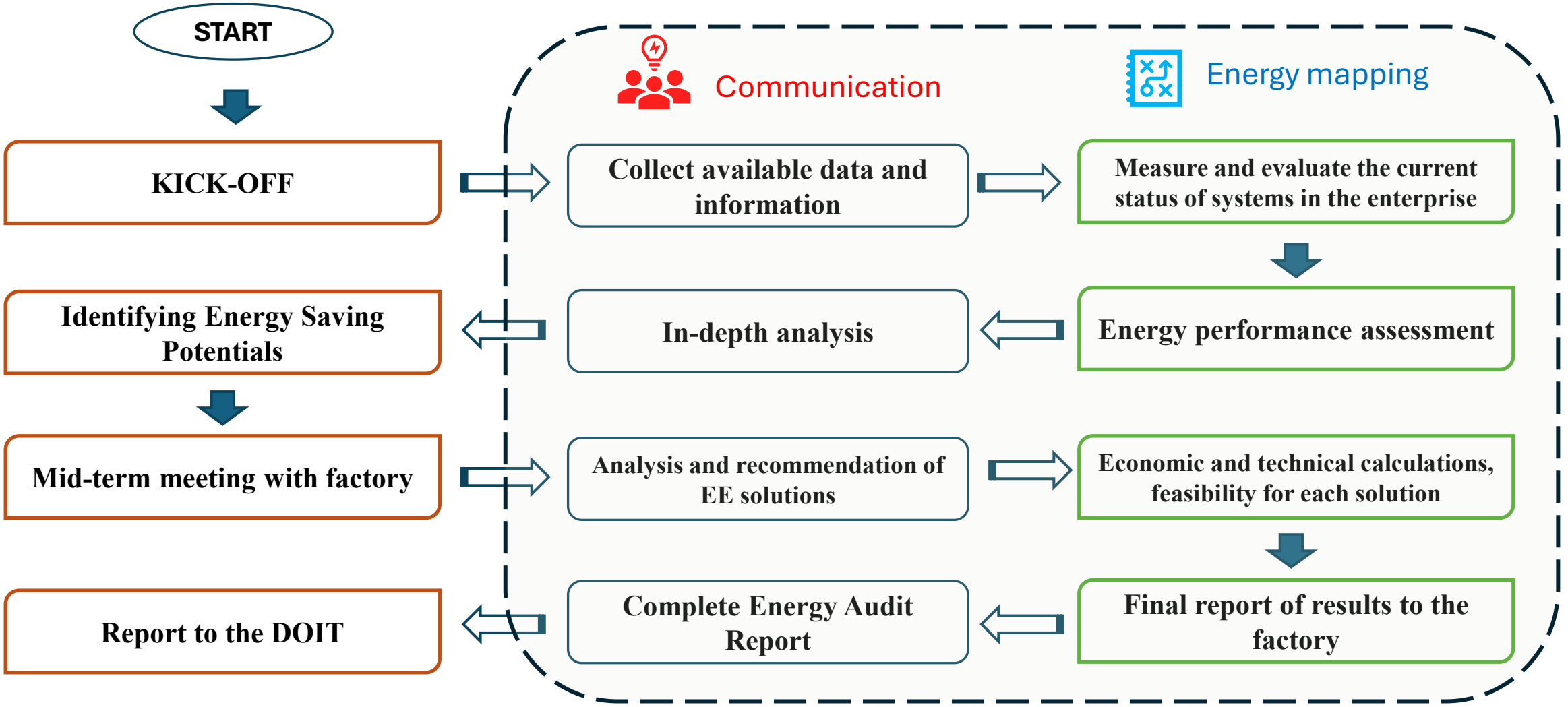


Energy methodology

a. *Data collection and analysis*
b. *System survey implementation*
c. *Preliminary assessment and determination of energy saving potential*
d. *Building an energy mapping*
e. *Energy performance assessment*
f. *Detailed analysis and evaluation*
g. *Identify energy saving opportunities and options*

The energy audit process is conducted in accordance with the guidelines in Circular 25/2020/TT-BCT dated September 29, 2020, of the Ministry of Industry and Trade and the energy audit guidelines under the Voluntary Agreement Program (VAS) of DEPP3.

Energy audit process



Energy Audit Team and Equipment

List of energy audit team

Position	Affiliation	Role/Responsibility
Team Lead	EAC	Quality assurance, oversight, and final report review
Energy Auditor(s)	EAC	Onsite data collection, interviews, walk-through; data analysis, report drafting
Technical Expert	External	Specialized technical input and solution recommendations
IC Expert(s)	DE3 Expert	Guidance, support, and report review from international perspective
Project Coordinator	EAC	Client coordination, scheduling, progress tracking, and reporting

List of equipment





Power quality analyzer



Electric power meter



Thermal camera



Liquid flow meter



HIOKI Lux Meter



Air pressure equipment

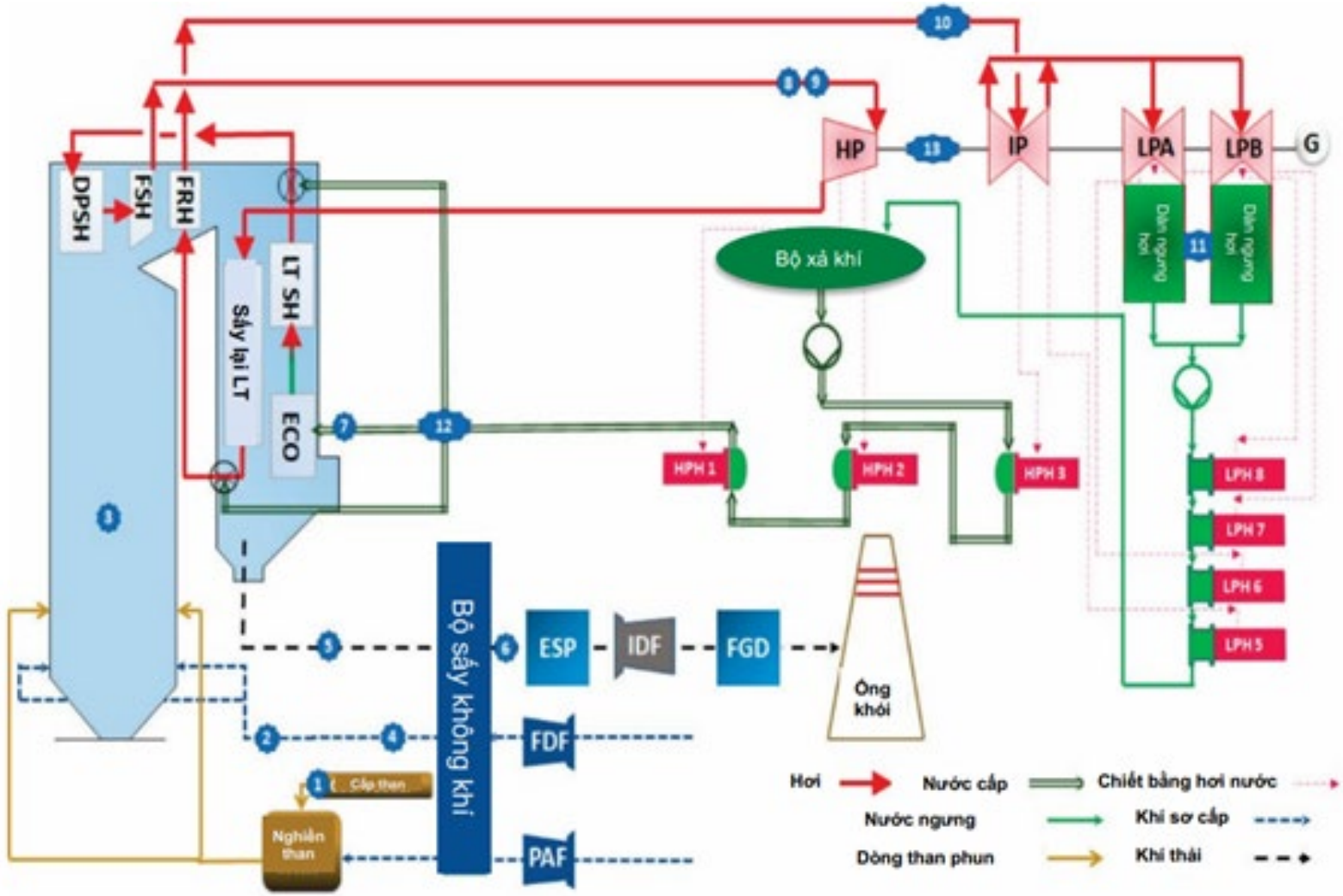


Emission analysis equipment



Wind speed measuring equipment

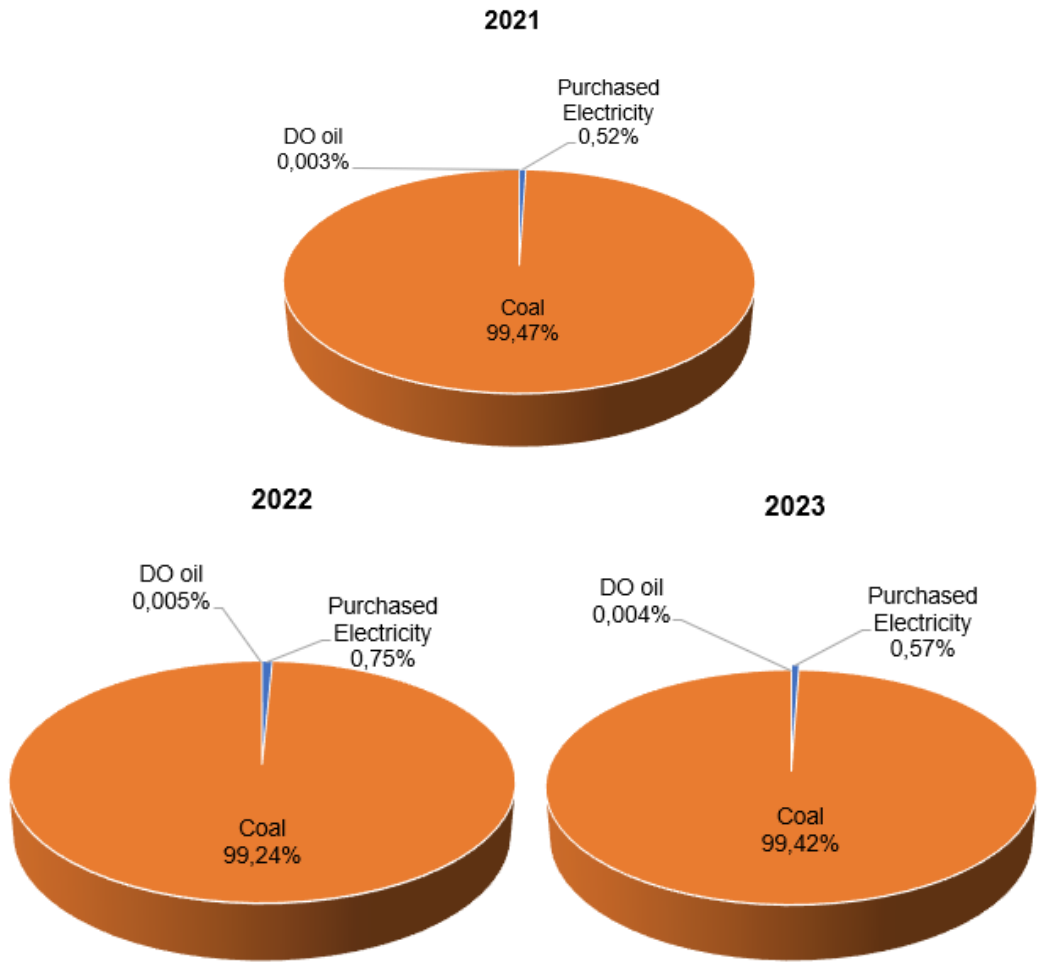
Production process



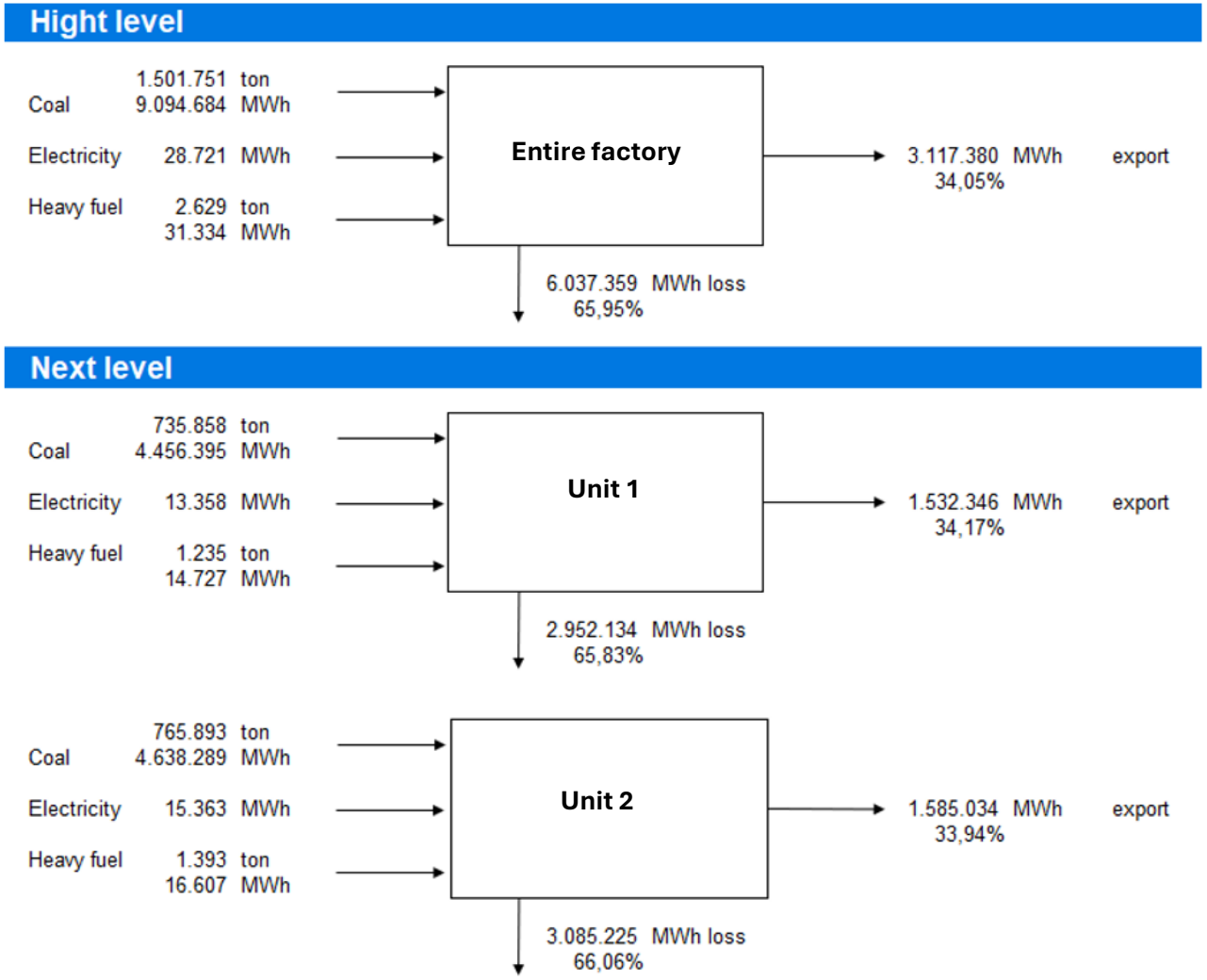
Technological process (2)

Annual energy total consumption

No.	Energy Type	Unit	Energy Consumption	Conversion (TOE)	Ratio (%)
2021					
1	Purchased auxiliary electricity	kWh	29,841,990	4,605	0.52
2	Coal	tons	1,653,607	873,672	99.47
3	DO Oil	tons	24	23	0.003
Total				**878,299**	**100**
2022					
1	Purchased auxiliary electricity	kWh	34,767,048	5,365	0.75
2	Coal	tons	1,340,967	708,491	99.24
3	DO Oil	tons	40	38	0.005
Total				**713,893**	**100**
2023					
1	Purchased auxiliary electricity	kWh	31,412,134	4,847	0.57
2	Coal	tons	1,596,589	843,547	99.42
3	DO Oil	tons	40	38	0.004
Total				**848,431**	**100**

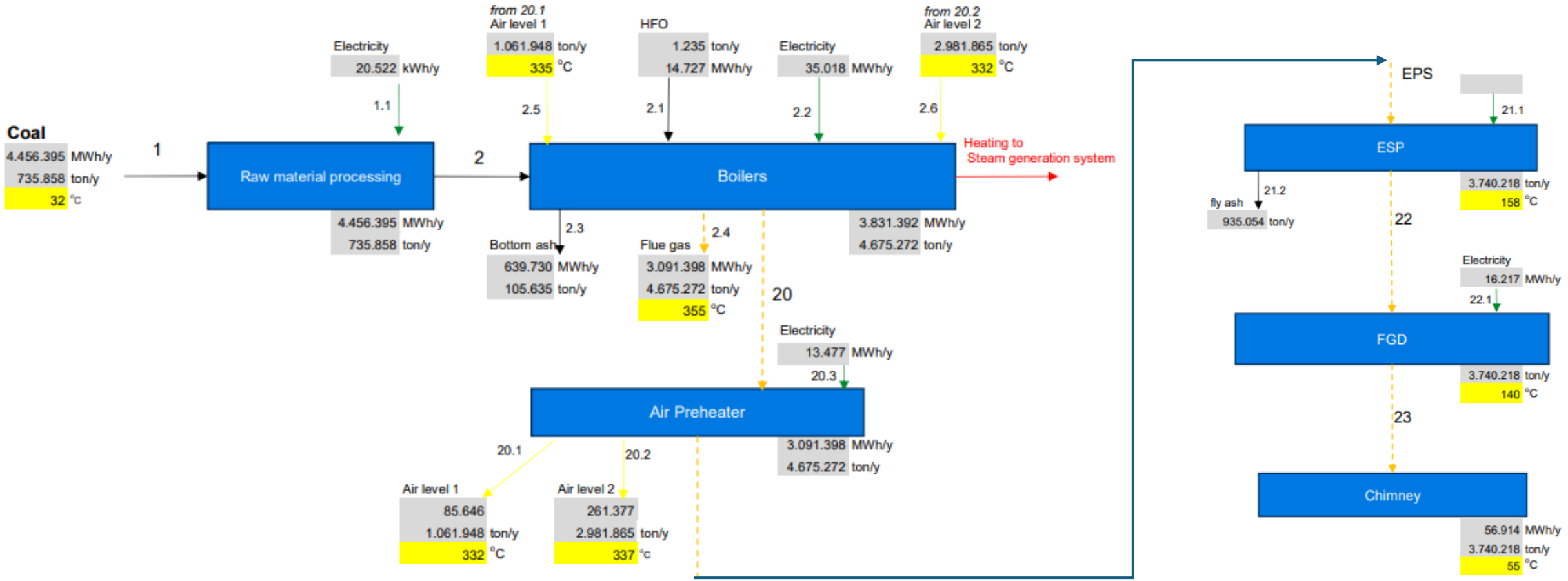


Actual efficiency of the plant



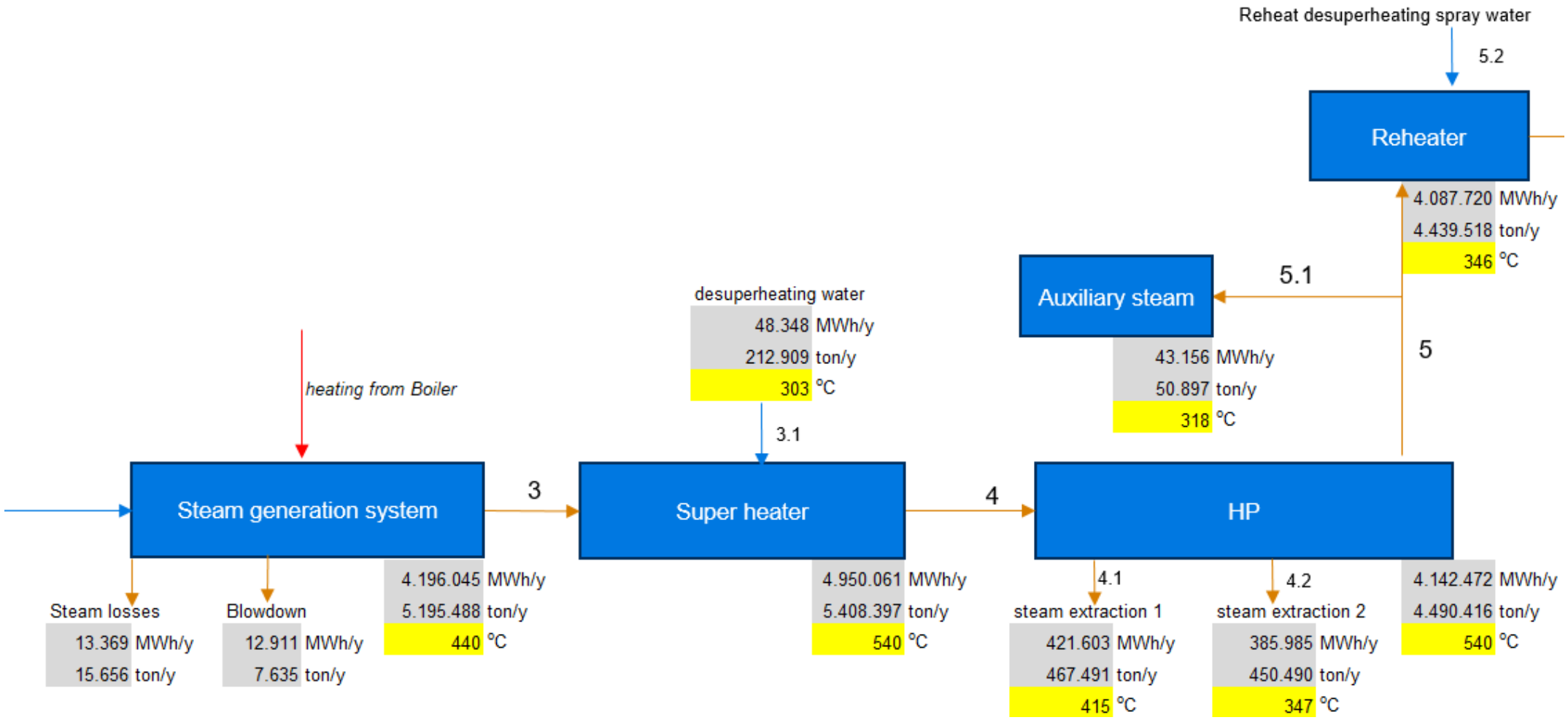
The plant's actual power generation efficiency is higher than the average of non-OECD countries, but still lower than the OECD average and significantly below the advanced level of Denmark.

Energy mapping



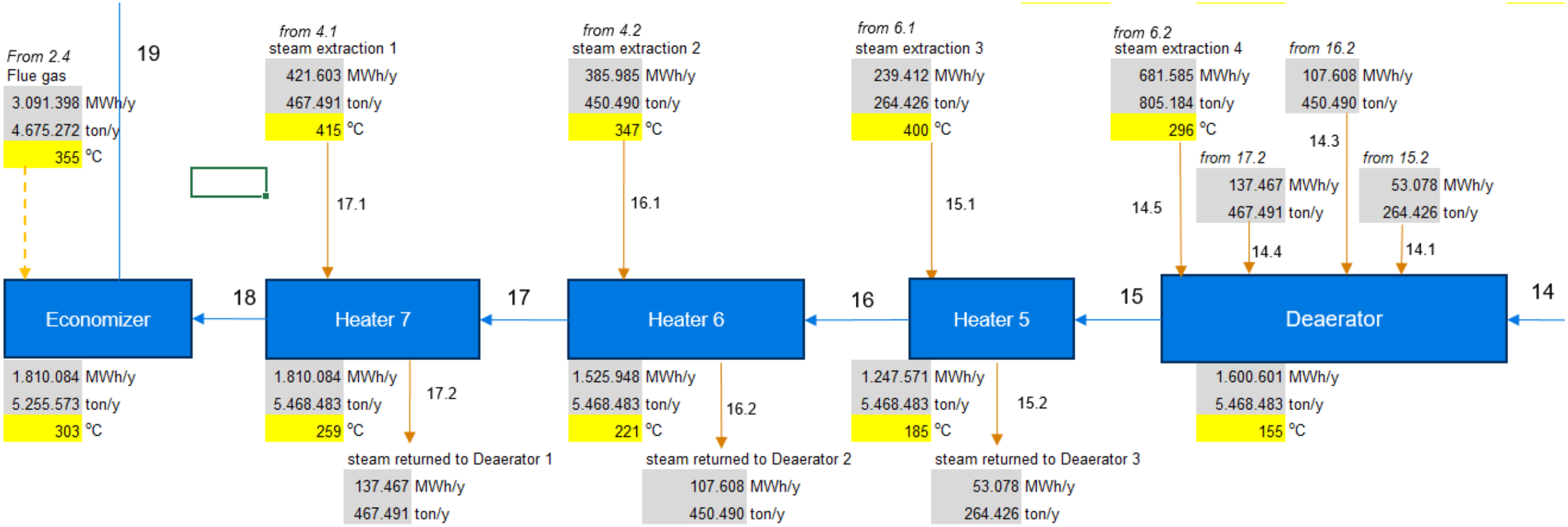
Energy mapping of Boiler and auxiliary system

Energy mapping



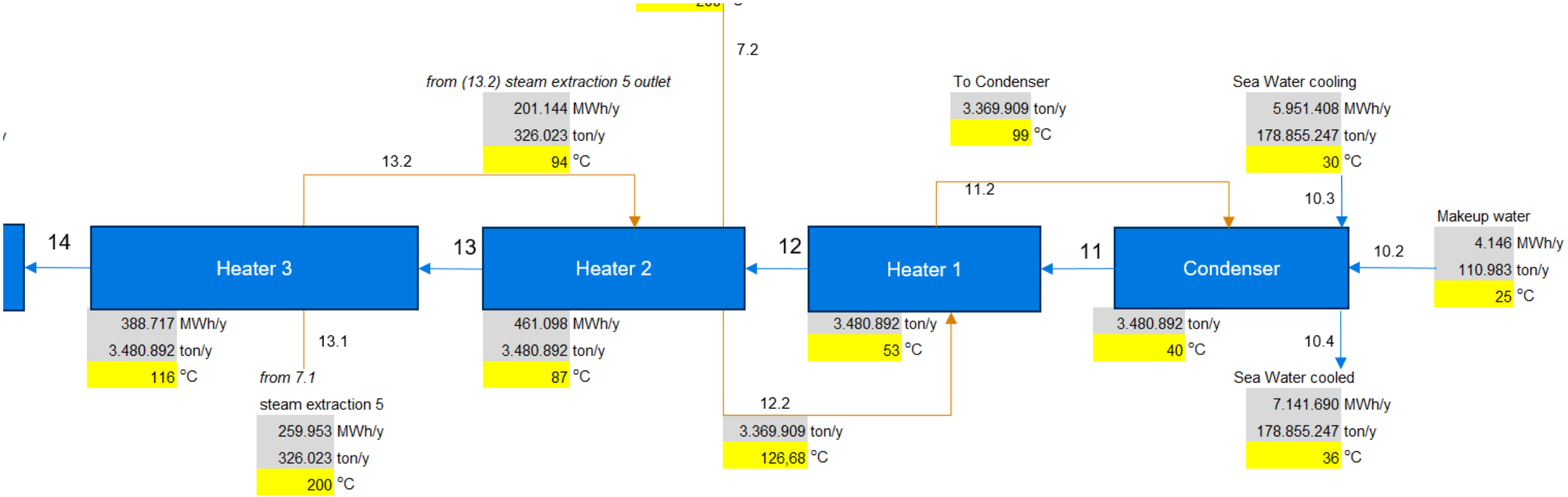
Energy mapping of the boiler's steam generation system

Energy mapping



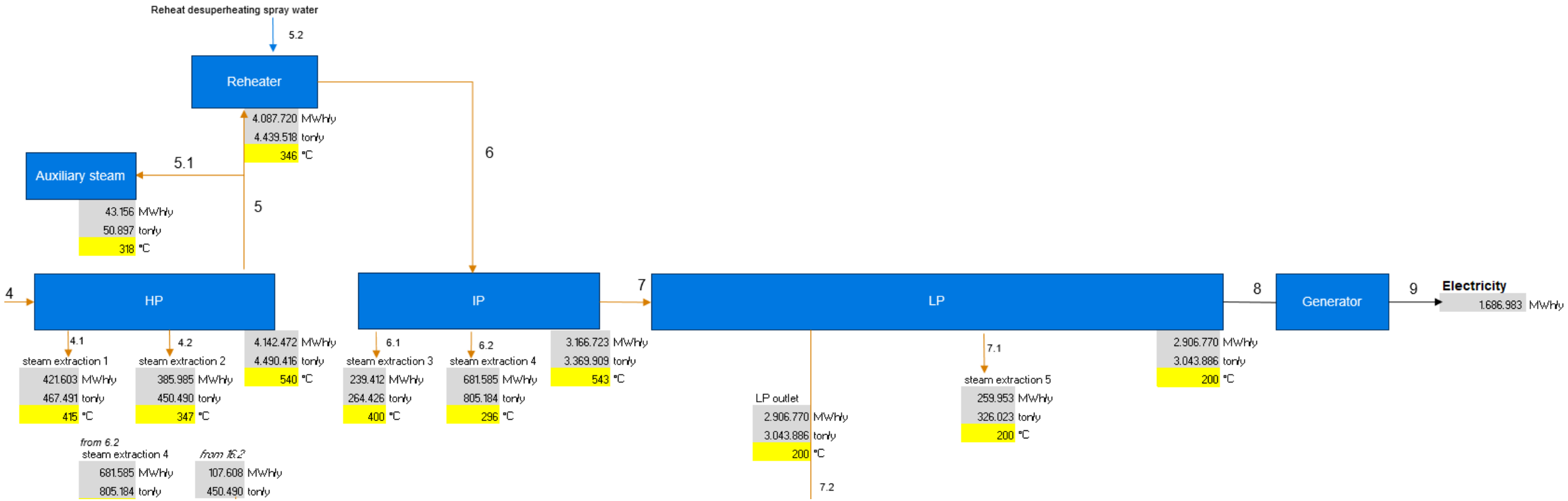
Energy mapping of boiler water supply system

Energy mapping



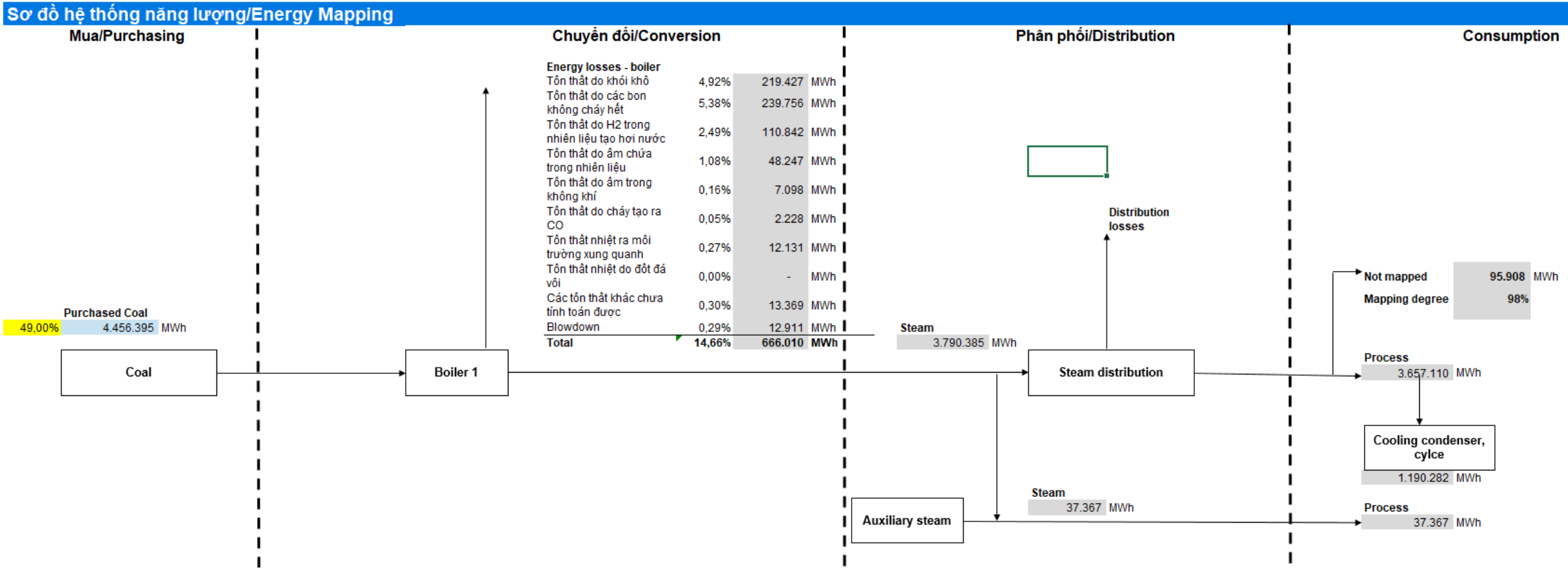
Energy mapping of the plant's condensate water system

Energy mapping



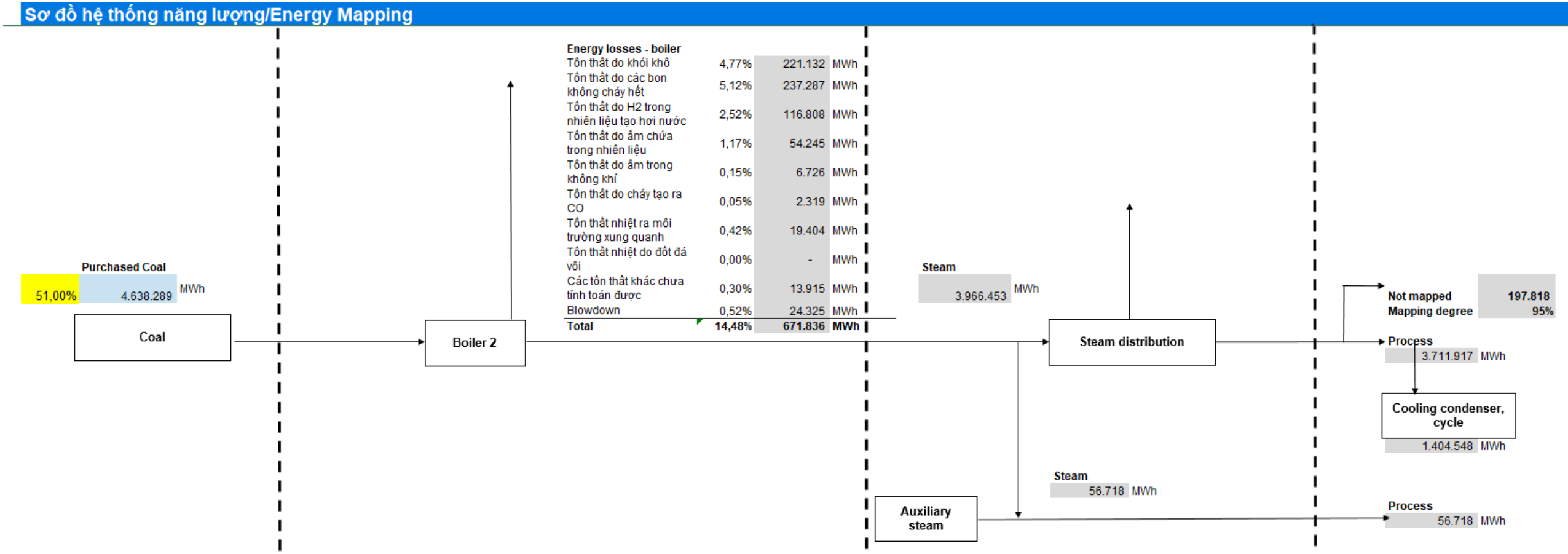
Energy mapping of the turbine-generator system

Energy mapping



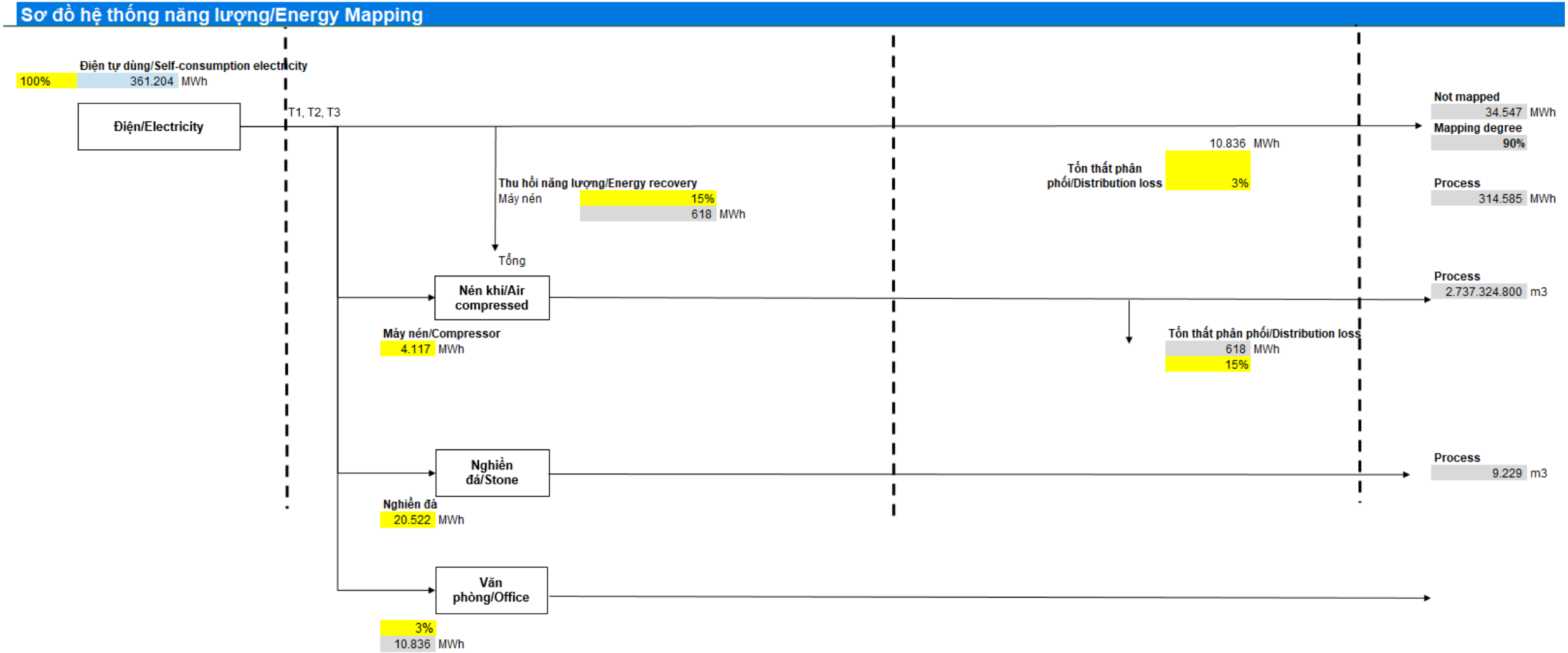
Energy mapping of Unit 1

Energy mapping



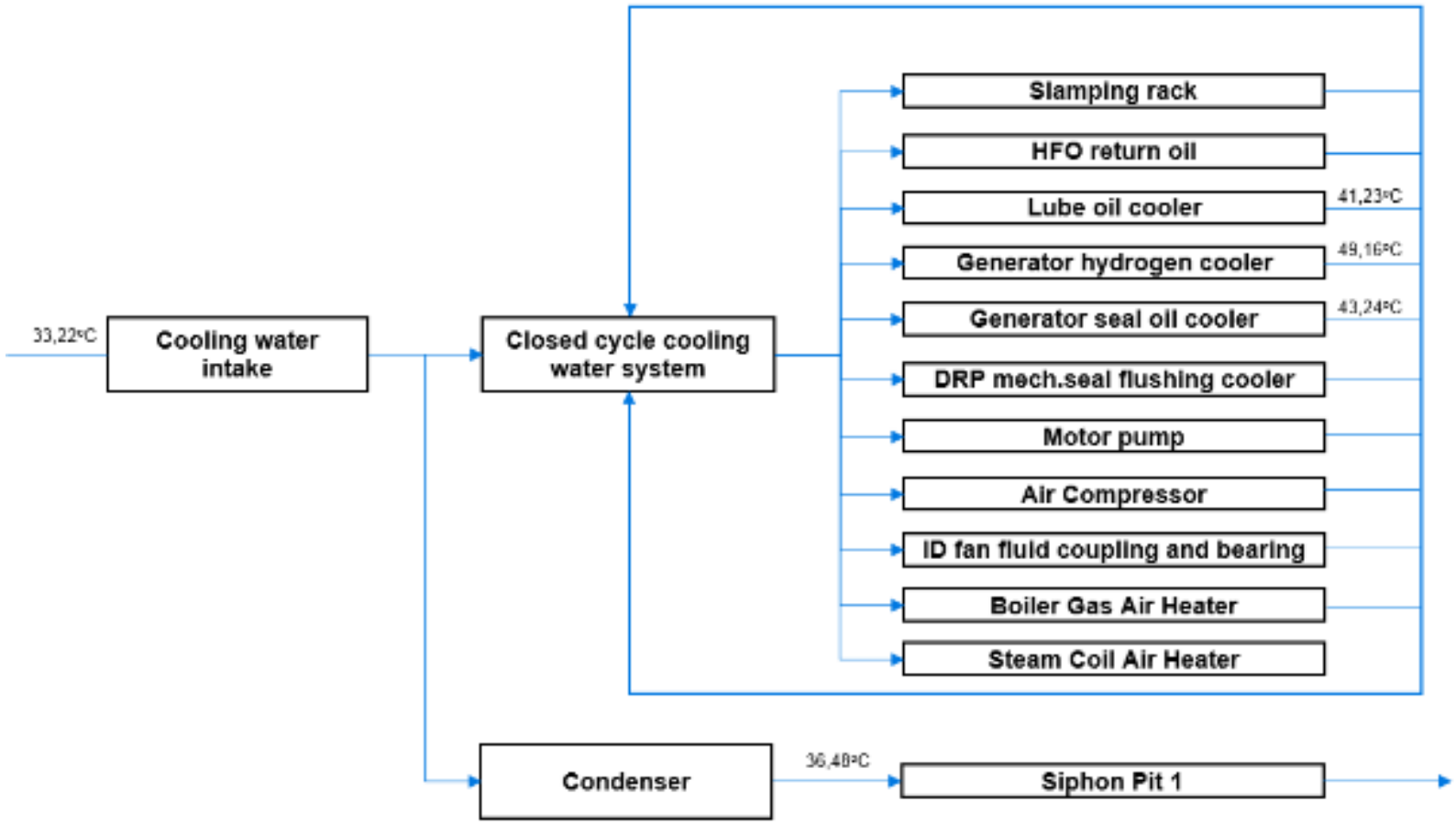
Energy mapping of Unit 2

Energy mapping



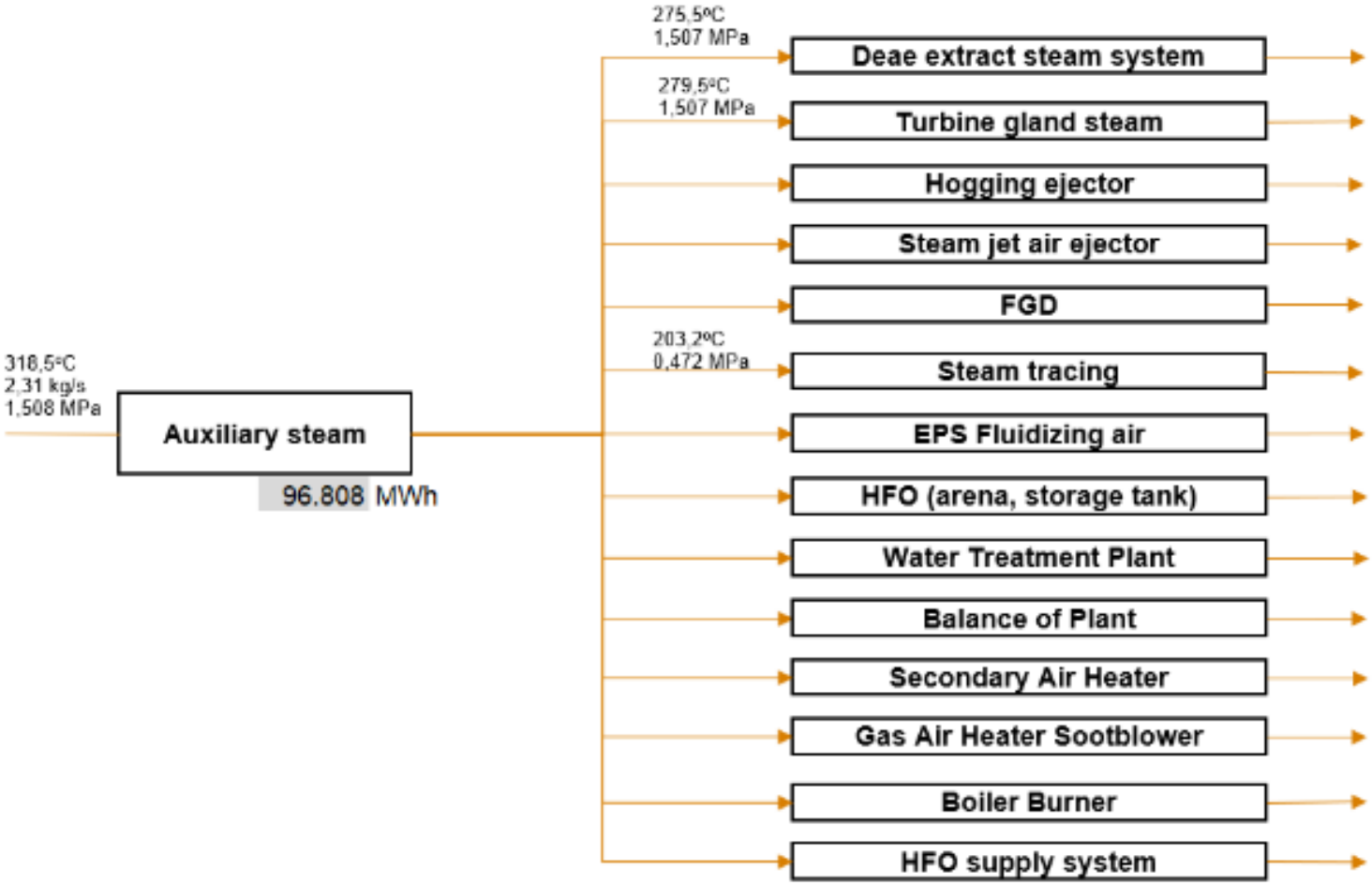
Energy mapping of self-consumption electrical

Energy mapping



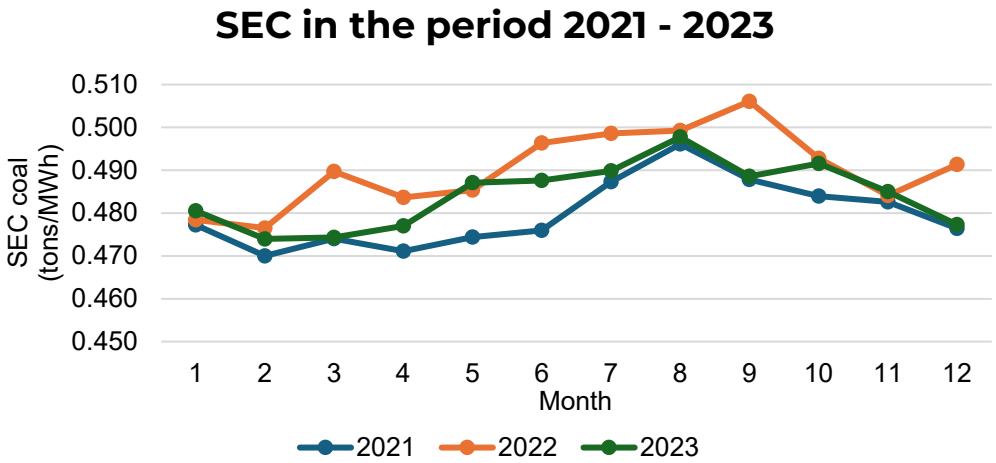
Energy mapping of Cooling water system

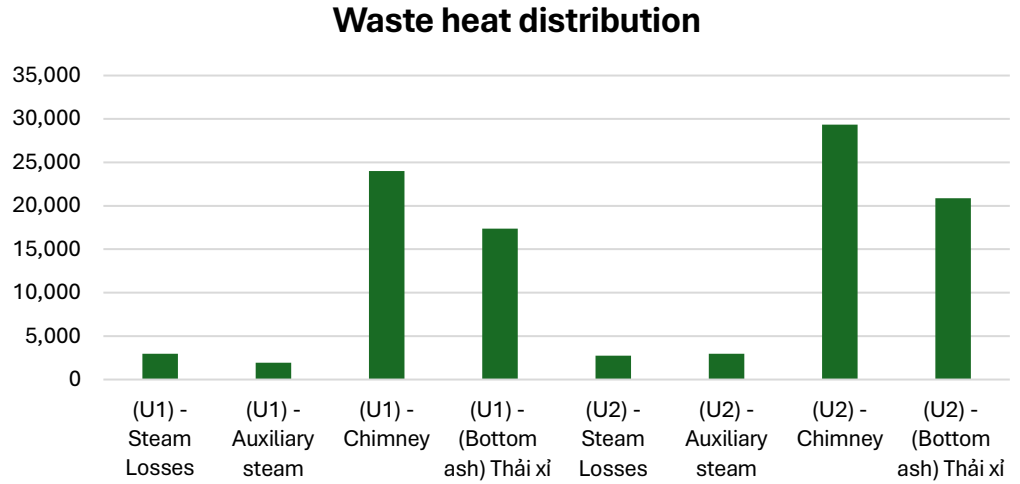
Energy mapping



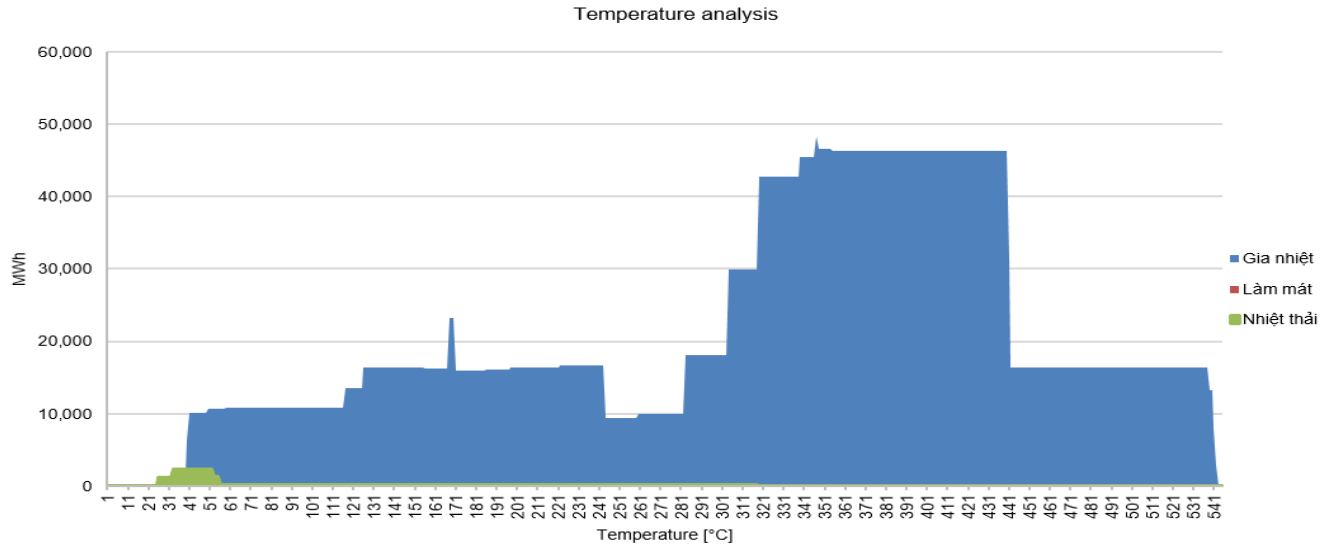
Energy mapping of the auxiliary steam system

Energy mapping





Identifying energy saving potential from energy mapping



Identifying the potential for waste heat recovery and optimizing inter-process heat utilization

Energy audit results

1. **A total of 15 solutions have been identified.**
2. **These solutions focus on:**

- *Boiler system: Reducing heat losses, recovering waste heat, and applying variable frequency drives (VFDs);*
- *Fuel supply system: Equipment replacement;*
- *Cooling water system: Pipeline upgrades and installation of VFDs;*
- *Compressed air system: Leakage reduction, equipment replacement, and VFD application;*
- *Flue Gas Desulfurization (FGD) system: Motor replacement.*

The key solutions focus on installing variable frequency drives (VFDs) for pumps and fans, upgrading the seawater circulation piping system, and replacing equipment with high-efficiency alternatives.

3. **Energy and cost-saving impacts:**

- Total electricity savings: **≈ 36,918,098 kWh/year**
- Total coal savings: **≈ 1,408.23 tons/year**
- CO_2 emission reduction: **≈ 28,968 tons CO_2/year**
- Total financial savings: **≈ 58,282 million VND/year**
- Total investment cost: **≈ 195,394 million VND**
- Payback period: Ranges from **0.36 to 6.82 years**, with most solutions achieving payback **within 3 years.**

When implementing the proposed solutions, the plant's efficiency can be improved by 1%. -> New, modern power generation technologies worldwide can increase power generation efficiency by up to 45% (under suitable operating conditions).

Level B List– Classified By Impact Level and Innovation

➢ Group 1 : Main solutions (High-impact / Strategic)

No	System	Solutions		Estimated Savings		Cost Savings (VND/year)	Investment Cost (million VND)	Payback (years)	CO_2 reduction (tons/ year)	Assessment
		Eliminate losses (maintain optimal operation)	Improve efficiency	Quantity	Unit					
1	Boiler		Install inverter for seawater booster pump	852,938	kWh/ year	1,279.41	2,000	1.56	379.67	Feasible
2			Researching options for using blended coal with higher calorific value and volatile matter content than the designed coal.	Recommendation						
3		Utilize waste heat from auxiliary steam to preheat supplementary feedwater.		1.137	Ton of coal/year	2,259.82	4,000	1.77	2,809.56	Feasible
4		Utilize waste heat from flash steam and blowdown water for other necessary processes		139	Ton of coal/year	383.41	1,000	2.61	476.68	Feasible
5		Recover waste heat from the boiler after it has been used to preheat the combustion air or to heat the condensate for the condenser		Recommendation						
6	Circulation Pump		Install a variable frequency drive to control the auxiliary fan in the boiler area	12.638.683	kWh/ year	18,958.02	2,000	2.11	9,126.39	Feasible
7			Upgrade the common pipeline connection of the seawater circulation pumping system with 2 units	3.744.000	kWh/ year	5,616.00	4,000	0.36	2,533.19	Reseach
8			Install a variable frequency drive (VFD) for the seawater circulation pump system	7.371.817	kWh/ year	11,057.73	2,000	1.81	4,987.77	Feasible
9	Pulverized coal		Replace the current ball mill with a vertical mill	12,214,944	kWh/ year	18,322.42	125,000	6.82	8,264.63	Research
Total				**24,607,438**	**kWh/year**	**57,876.80**	**194,000**		**28,101**	
				1,260.00	**Ton of coal/year**					

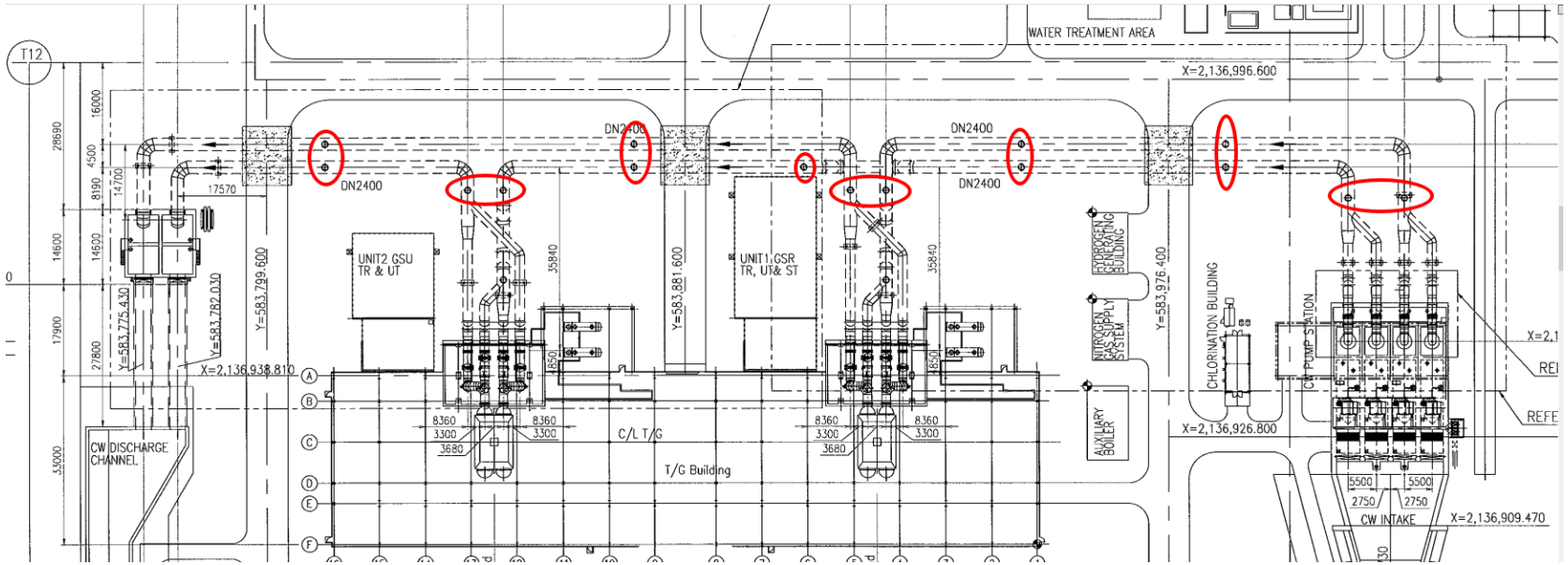
Level B List– Classified By Impact Level and Innovation

➢ Group 2 : Support solutions(Conventional / Best Practice)

No	System	Solutions		Estimated Savings		Cost Savings (VND/year)	Investment Cost (VND)	Payback (years)	CO_2 reduction (tons/ year)	Assessment
		Eliminate losses (maintain optimal operation)	Improve efficiency	Quantity	Unit					
1	Air compressor	Repair air leakage points		Recommendation						
2			Install compressed air piping from branch to loop	Recommendation						
3			Replace old air dryer with high-efficiency model	Recommendation						
4			Install inverter for Air compressor A	37,189	kWh/ Year	55.78	200	3.59	25.16	Feasible
5	Insulation	Repair and insulate heat loss points (insulate heat loss points)		95.99	tons coal/year	190.71	100	0.52	237.11	Feasible
		Repair and insulate heat loss points (Insulate steam valves)		35.76	tons coal/year	71.04	200	2.82	88.33	Feasible
6	FGD		Replace inefficient slurry stirrer motor with IE4 motor	102,301	kWh/Year	153.45	640	4.17	69.22	Feasible
Total				**139,490**	**kWh/year**	**470.99**	**1,140**		**419.82**	
				1,407.75	**Tons coal/year**					

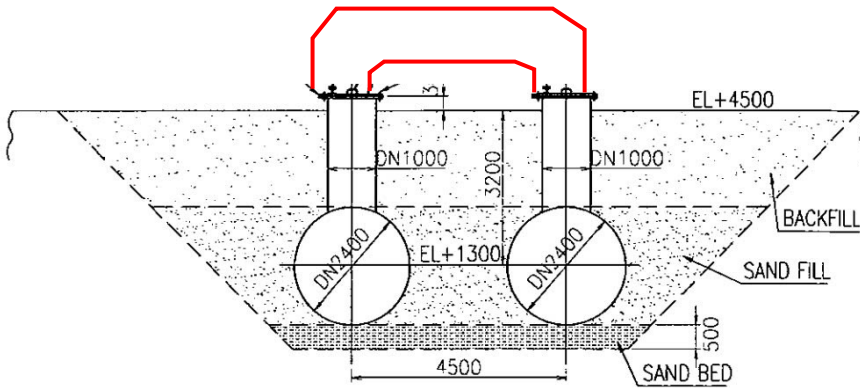
Project selected for next steps

Renovate the common pipeline connection of the seawater circulation pumping system with 2 units









Vets Energy and Environment

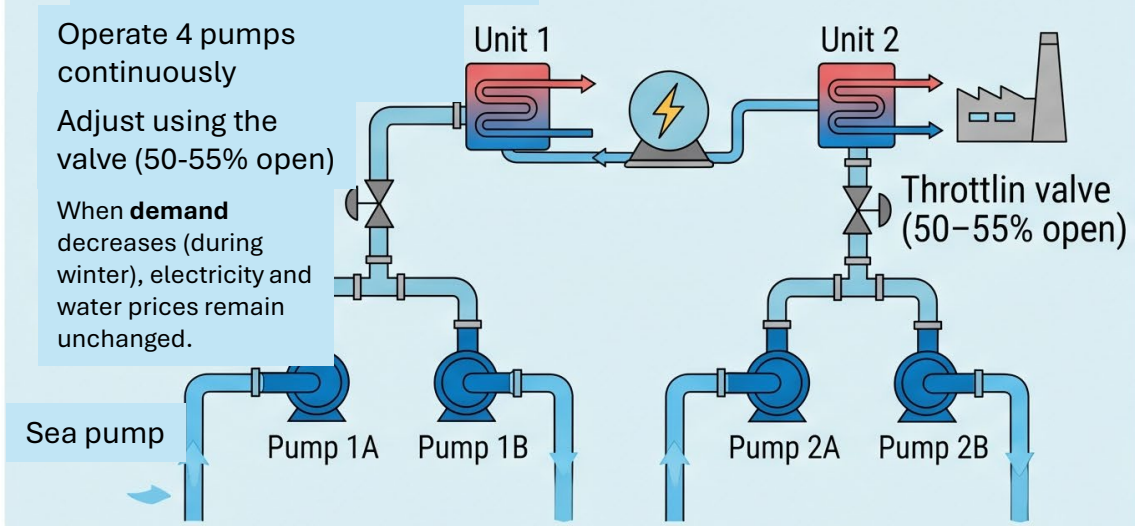
SOLUTION DESCRIPTION: RENOVATION OF THE COMMON PIPELINE SYSTEM FOR SEAWATER CIRCULATION

1. Current status:

Operate 4 pumps continuously

Adjust using the valve (50-55% open)

When **demand** decreases (during winter), electricity and water prices remain unchanged.

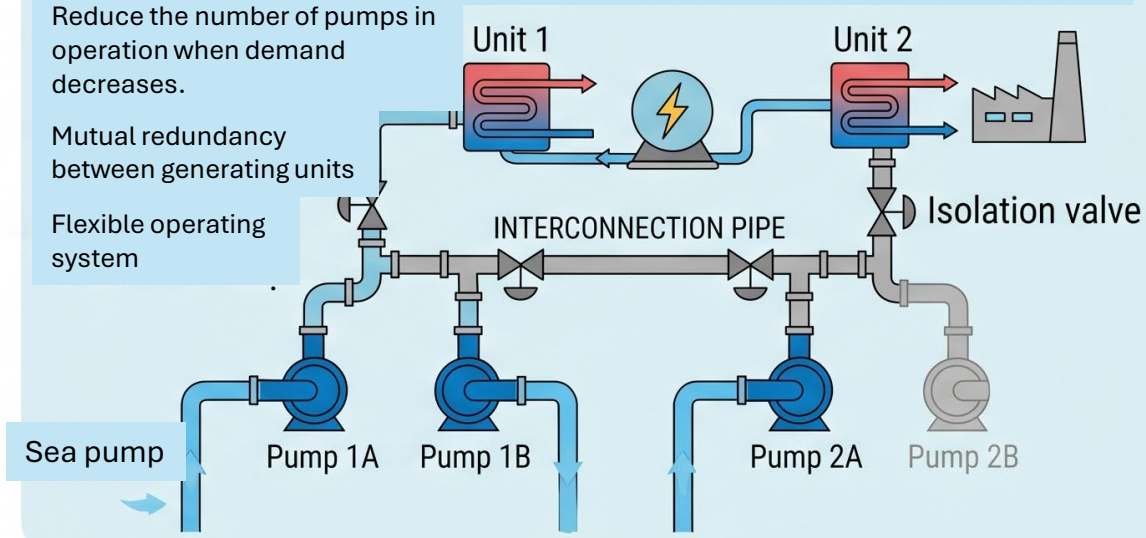


2. Proposed solution: Connect the pipelines together.

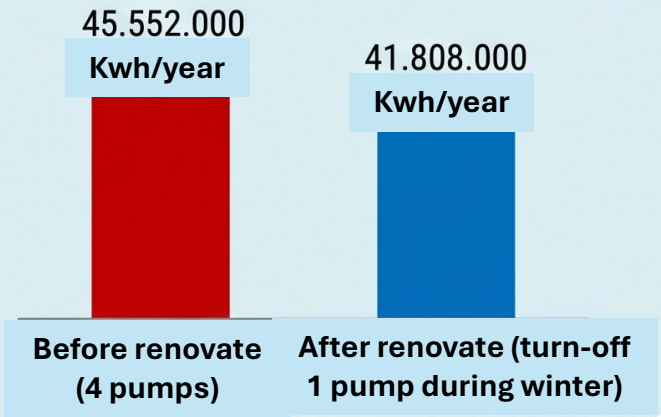
Reduce the number of pumps in operation when demand decreases.

Mutual redundancy between generating units

Flexible operating system



3. Electricity consumption before and after



4. Expected savings

Electricity saving
3.744.000 Kwh/year

Money saving
5.616 Million VND/year

Reduce CO2 emissions
2.533,19 Ton/year

Convert
577,70 TOE/year

5. Investment costs & financial performance

Investment cost **2,000 million VND**

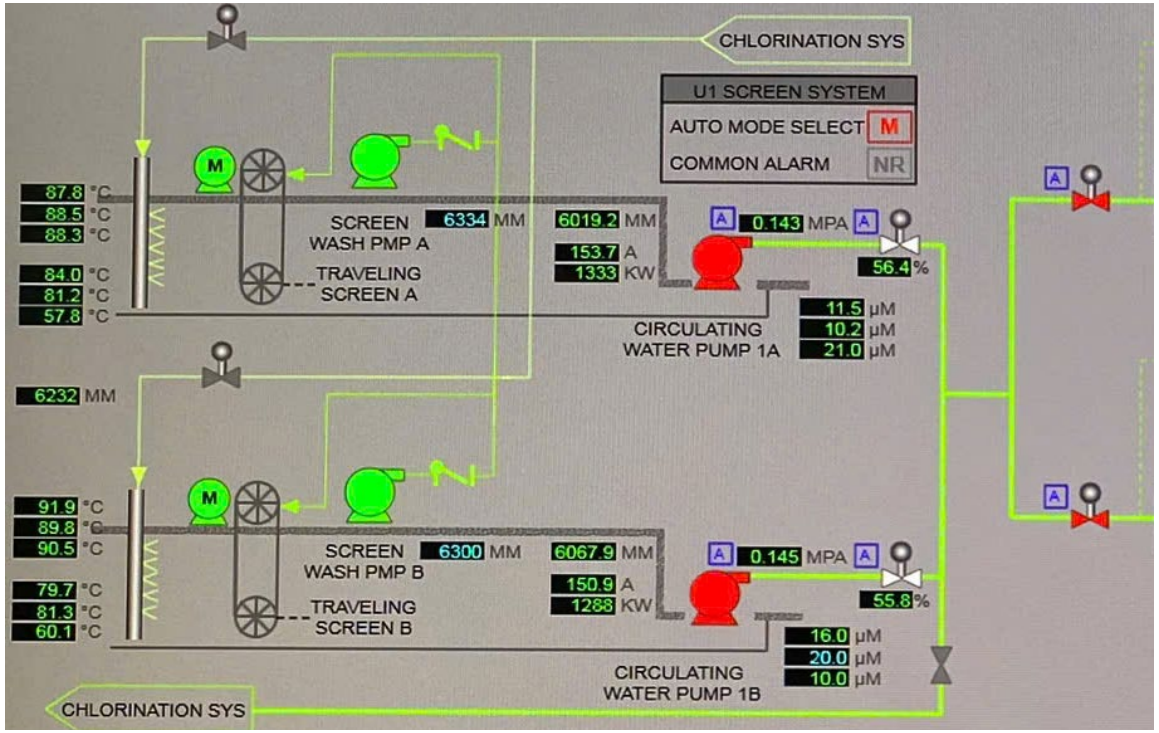
Simple payback period **0.36 years**

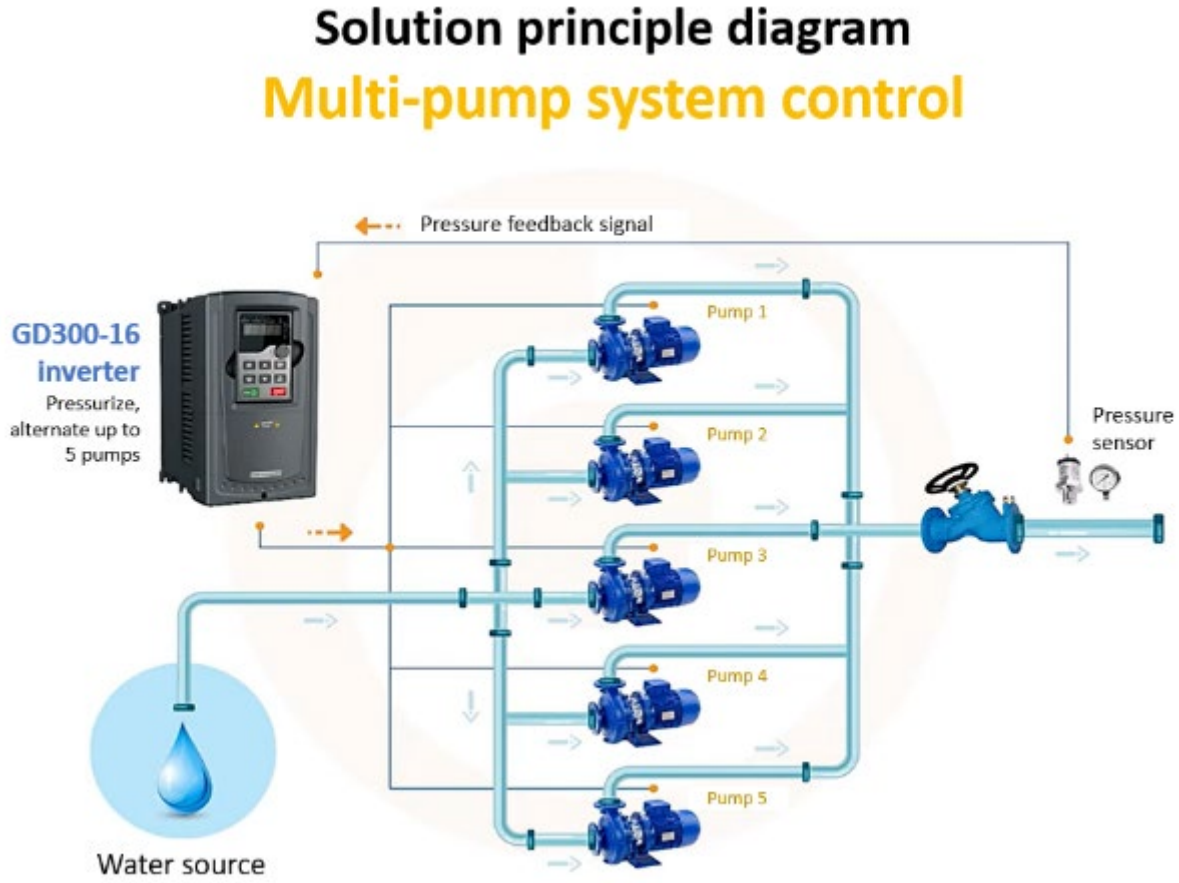
NPV after 5 years (12% discount per year) **18,244.4 million VND**

IRR **12.2%**

Project selected for next steps

Install a variable frequency drive (VFD) for the pump in the seawater circulation system.





ENERGY SAVING SOLUTION: INSTALLING VARIABLE FREQUENCY DRIVES FOR SEAWATER RECIRCULATION PUMPING SYSTEMS IN COAL-FIRED POWER PLANTS.

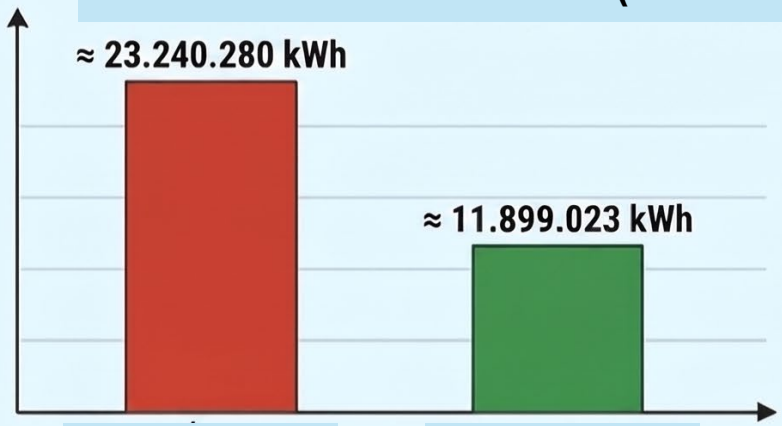
CURRENT STATUS

- Direct-drive pump
- Flow rate adjustment via manual valve
- Low valve opening angle (55-56%)
- Increased resistance, wasted energy

PROPOSED SOLUTION

- **Install a VFD to control the pump speed**
- **Valve fully open**
- **Reduce energy loss**

ENERGY CONSUMPTION (ANNUAL)

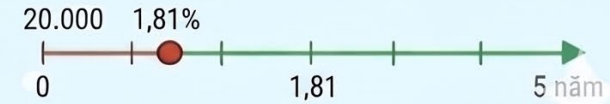


EXPECTED SAVING (ANNUAL)

Electricity saving:	Money saving:	Reduce CO2 emission:	Convert:
~7.371.817 kWh	~11.057.725.224 VND	~4.988 tăn	~1.137 TOE

INVESTMENT COSTS AND FINANCIAL EFFICIENCY

Investment cost: **20,000 million VND**
Simple payback period: **1.81 years**
IRR: 12.2%
NPV after 5 years (discounted at 12%/year):



~19.860.624.740 đồng

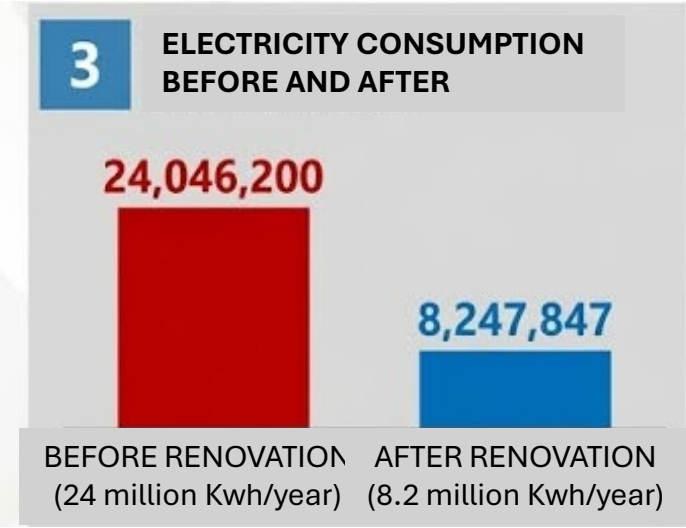
Install a variable frequency drive for the boiler auxiliary fan

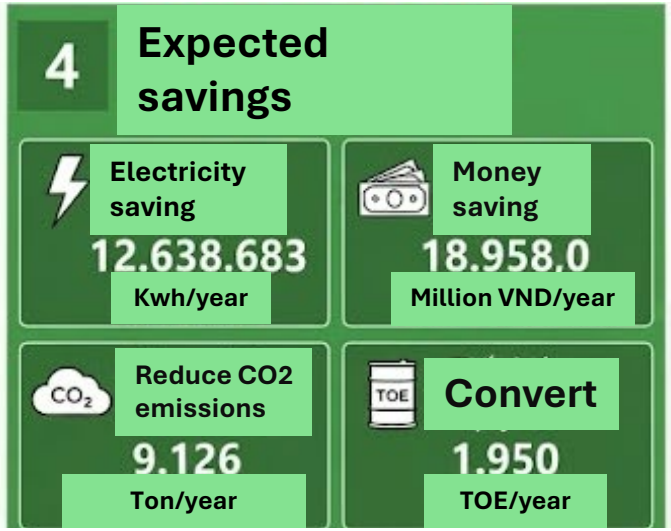
1. CURRENT STATUS:

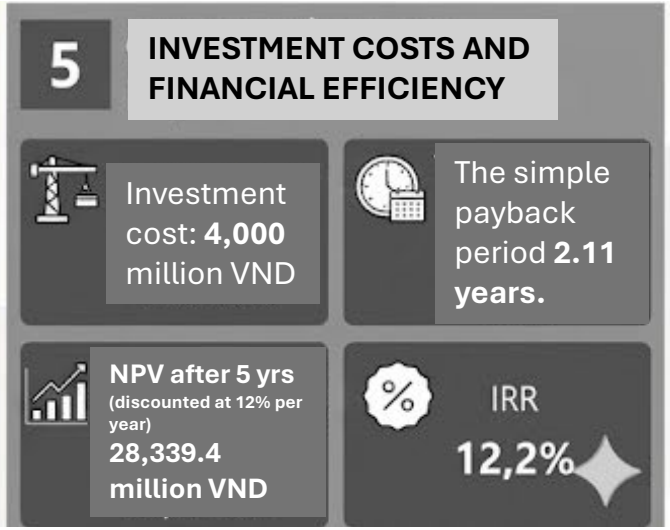
The auxiliary fans are operating at loads ranging from 24–90% of rated capacity, as airflow is currently regulated by adjusting damper positions (approximately 34–54% open).

2. PROPOSED SOLUTION:

- Install variable frequency drives (VFDs) to control fan speed;
- Fully open the fan dampers to reduce energy losses.







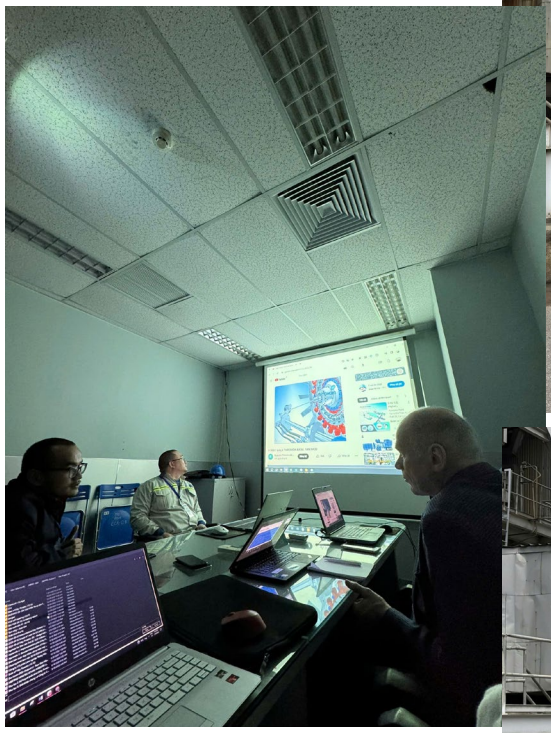
Advantages

❑ Support from the factory:

- ❖ Provide input data on energy sources (coal), fuel, water, and electricity consumption; as well as outputs and losses at each process stage
- ❖ Provide data for developing mass and energy balances
- ❖ Support the development of detailed energy mapping
- ❖ Provide equipment list: name, location, and design capacity
- ❖ Facilitate VETS and international experts in conducting on-site measurements
- ❖ Engage in discussions and align on proposed energy efficiency (EE) solutions
- ❖ Demonstrate interest in implementing proposed solutions and readiness to invest if feasible

❑ Support from International Consultant:

- ❖ Provide guidance on developing energy mapping
- ❖ Support in developing solution concepts
- ❖ Provide guidance on solution calculations
- ❖ Review and provide comments on reports







Challenges

- Due to the nature of thermal power generation, material flows and energy flows are not clearly separable
- Lack of data, especially the data required for energy mapping and project performance calculations
- Diverse and complex energy flows within the production system

Lesson learned

- ❑ Develop structured data collection templates by system and process, and adjust them to fit actual plant conditions after preliminary surveys → clearly communicate data requirements to the plant for the energy audit process.
- ❑ Estimate intermediate data points for energy mapping based on collected data, and validate these assumptions through discussions with the plant's technical staff. International consultants should review the calculations to ensure the accuracy and reliability of the developed energy map.

Recommendations for the plant

- **Short-term actions:**
  - Implement highly feasible solutions with short payback periods;
  - Standardize data collection templates by system/process;
  - Enhance measurement and monitoring of major electrical loads.
- **Medium- and long-term actions:**
  - Conduct Pre-FS/FS for large-scale projects or those with data uncertainties;
  - Improve the data management system to support energy mapping and process-level KPIs;
  - Integrate process KPI monitoring into the plant's energy management system.

Recommendations for DEPP3 project

- Further develop requirements and guidelines for energy data collection, monitoring, and standardization for power generation industries;
- Develop sector-specific energy audit guidelines for thermal power plants, particularly guidance on building energy flow diagrams for the sector;
- Accelerate the review and approval process for proposed energy-saving solutions from consultants to better meet the needs of enterprises.



Thank you for listening!

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