MOIT

IGIP

EMBASSY OF DENMARK
Hanoi

Danish Energy Agency

DEMONSTRATION ENERGY AUDITS

from Ideas to Mature Project

Porcelain and Ceramic

Date 27/ 08/2025

Consulting firm:

Vets Energy and Environment

DEPP3

Case Overview

- **Sector:** Porcelain and ceramic
- **Establishment year:** 2007
- **Main raw materials:** Clay, aluminum ball, waste soil, liquid glass, talc, kaolin, feldspar, weathering soil
- **Capacity:** 145,513.49 (ton/year)
- **Main product:** Ceramic tiles
  - 2021: 5,252,539 m²
  - 2022: 4,739,436 m²
  - 2023: 3,802,232 m²



Image of the factory

Case Overview

Machinery system
at the factory



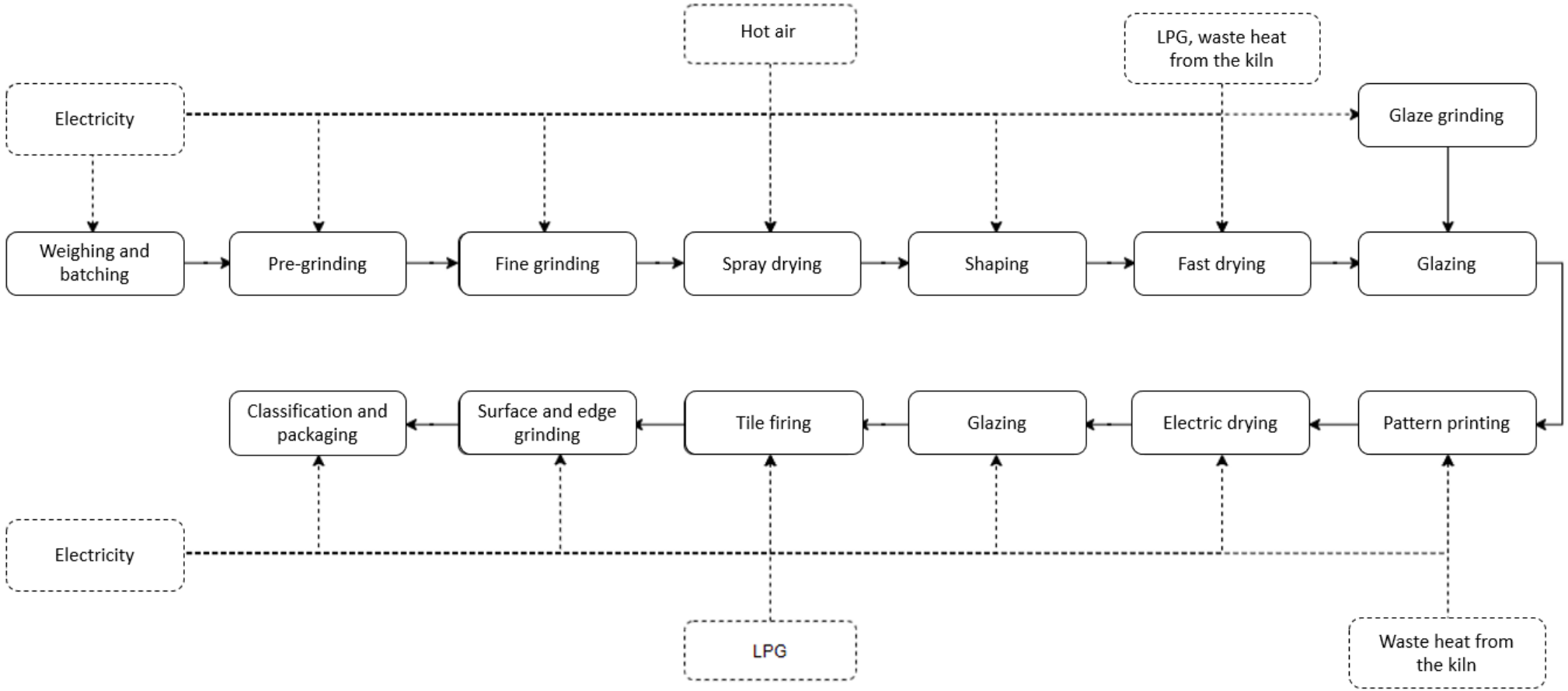








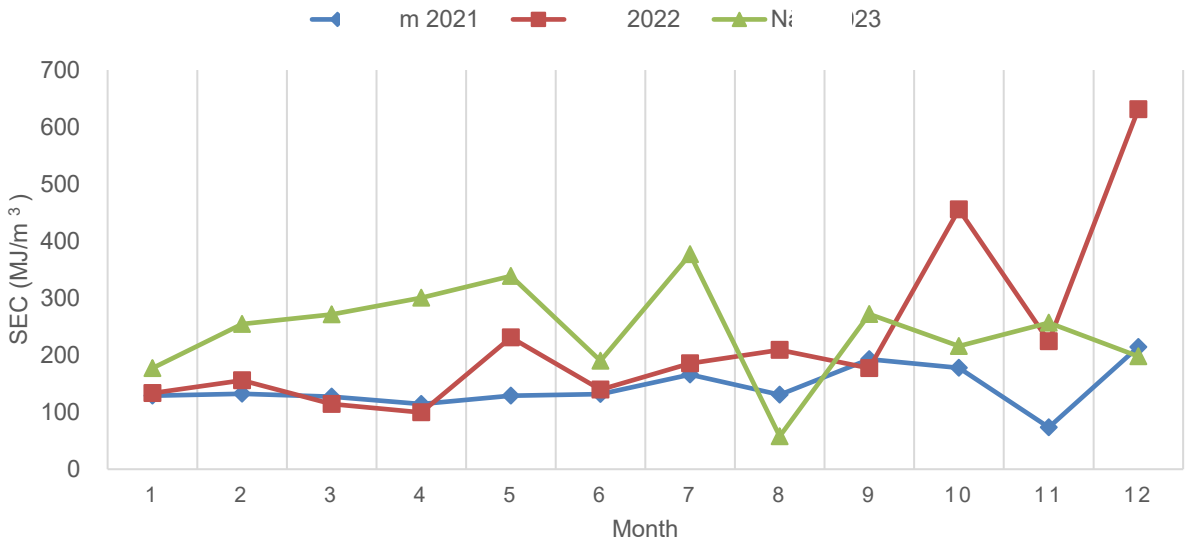
Production process

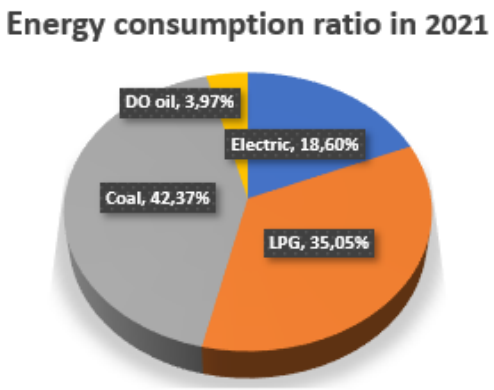


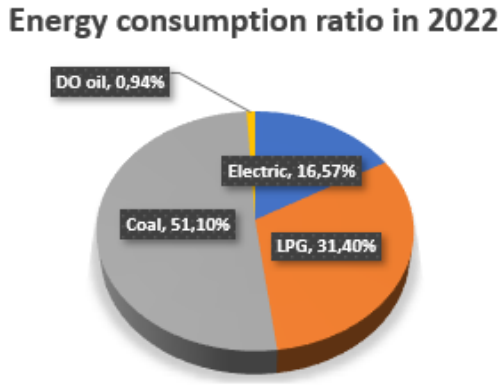
Stages in the technological process

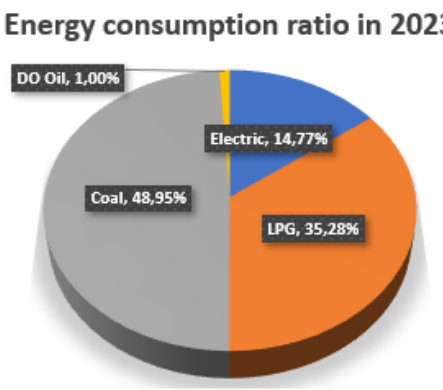
Annual energy total consumption

- **Electricity grid:** 21,748,419 (kWh), equivalent to 3,356 (TOE
- **Coal:** 18,530 (ton), equivalent to 11,118 (TOE)
- **LPG:** 7,352,977 (kg), equivalent to 8,015 (TOE)
- **Diesel:** 256,934 (lit), equivalent to 226 (TOE)
- **Water:** 12,983 (m^3)

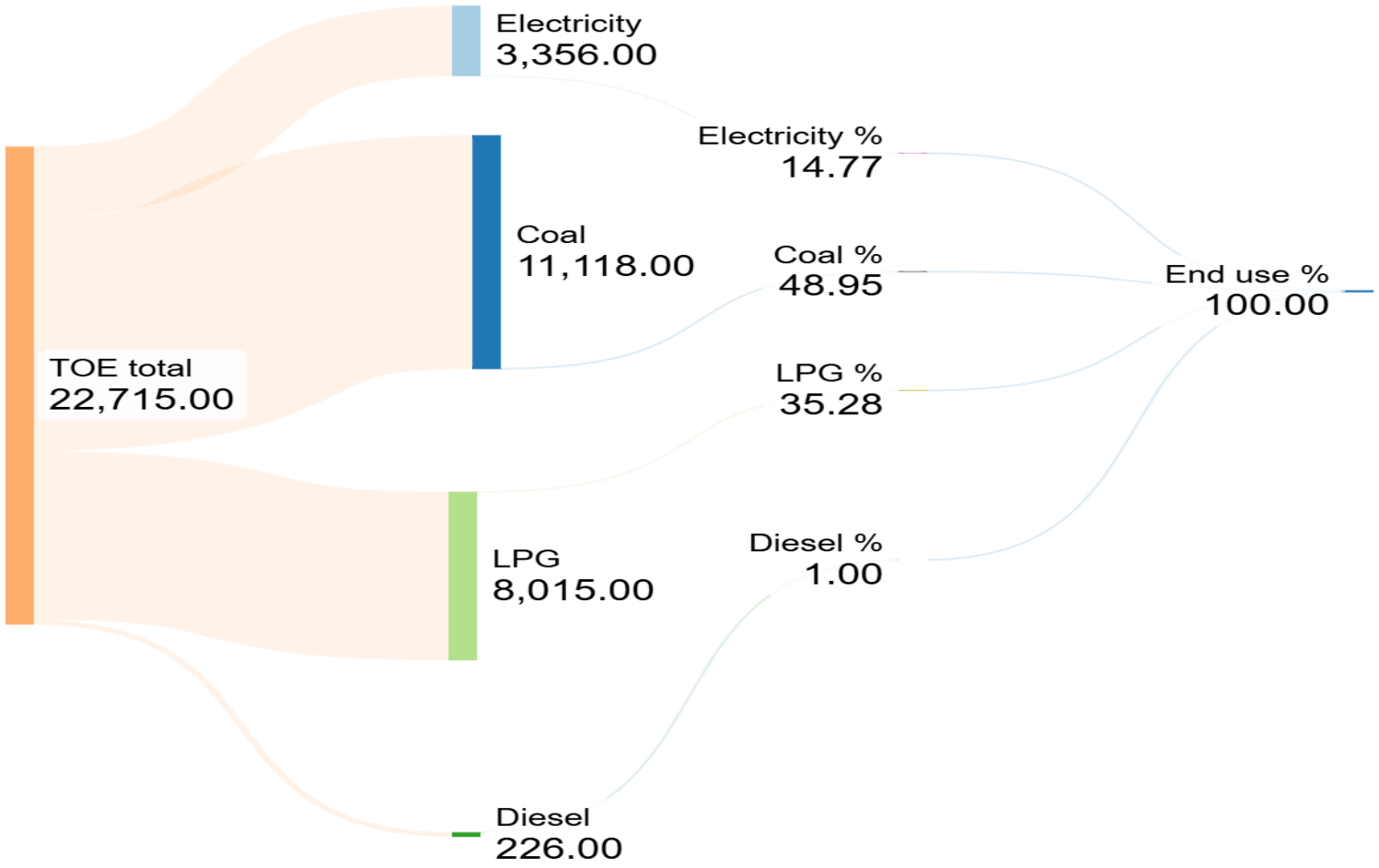








Breakdown energy flow



Energy Audit Team and Equipment

List of energy audit team

Name/Title	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

Energy audit results (Level B list)

1. There are **22** solutions have been identified.
2. Solutions span across multiple areas including:

- **Air systems**: compressors, dryers (e.g., solutions 1, 2, 14)
- **Thermal systems**: insulation, heat recovery, burner upgrades (e.g., solutions 3, 10, 11, 17)
- **Electrical systems**: motors, transformers, power factor correction (e.g., solutions 5, 8, 18, 19)
- **Process control & automation**: inverter control, time relay installation (e.g., solutions 6, 15, 16)
- **Renewables and standards**: solar installation, ISO 50001 (e.g., solutions 13, 22)

3. Energy and Cost Saving Impacts:

- Total Energy Savings ≈ **5,392,164 kWh/year**
- CO_2 Emissions Reduction ≈ **196.35 tons CO_2/year**
- Total Estimated Financial Savings ≈ **€255,000/year**
- Payback Period: Ranges from **0.15 to 6.74 years**, with many measures **under 3 years.**

No	Solution	Energy form	Investment Cost [$]	Saving			Simple Payback [Years]
				Energy [kWh]	CO2 [ton]	Financial [EUR]	
1	Re-adjust the operating mode of the air compressors	Electricity	0	16,908	-	1,119	-
2	Fix compressed air leaks	Recommended					
3	Insulation for fluidized bed furnace's doors	Coal	1,069	23,310	2.03	215	4.97
4	Improve water quality for wet dust scrubber to reuse dust and water in exhaust gas	Recommended					
5	Install a time relay to turn on/off the raw slurry tank's stirring motor	Electricity	2,139	208,915	-	13,821	0.15
6	Measures to improve operational and energy management procedures	Recommended					
7	Replace fluorescent bulbs with LED lights	Electricity	1,568	10,435	-	690	2.27
8	Increase CosPhi for Transformer Station (more efficiency)	Electricity	1,426	9,711	-	642	2.22
9	Refurbishment of pneumatic piping from branch circuit pattern to closed-loop circuit pattern	Electricity	17,822	129,462	-	5,995	2.97
10	Utilize residual heat to raise the temperature of the slurry before entering the spray drying tower	Coal	42,773	1,045,520	91.02	9,647	4.43
11	Utilizing residual heat to pre-heat the air supply to the fluidized bed furnace	Coal	28,515	1,186,640	103.30	10,949	2.60
12	Install harmonic filters for transformers	Recommended					
13	Rooftop solar panel installation	Electricity	463,376	1,071,000	-	68,714	6.74
14	Replace old air dryer with high efficiency air dryer	Electricity	15,206	41,796	-	2,765	5.50
15	Install inverter to control fan system in fast Horizontal dryer of 2nd line	Electricity	21,387	109,105	-	7,218	2.96
16	Replace non-electric LPG vaporizer	Electricity	142,577	684,288	-	45,270	3.15
17	Utilize waste heat to generate hot water	Electricity	53,466	1,710,600	-	113,166	0.47
18	Replace tile grinder motor with IE4 motor of Production line No.1	Electricity	34,931	137,892	-	9,122	3.83
19	Replace tile grinder motor with IE4 motor of Production line No.2	Electricity	44,555	153,140	-	10,131	4.40
20	Replace existing batch ball mill with continuous vertical mill	Recommended					
21	Replacement of 1st line's spray drying tower	Recommended					
22	Apply Energy Management System according to ISO 50001 standard	Electricity	89,111	115,591	-	37,857	2.35

Energy audit results (Level A list)

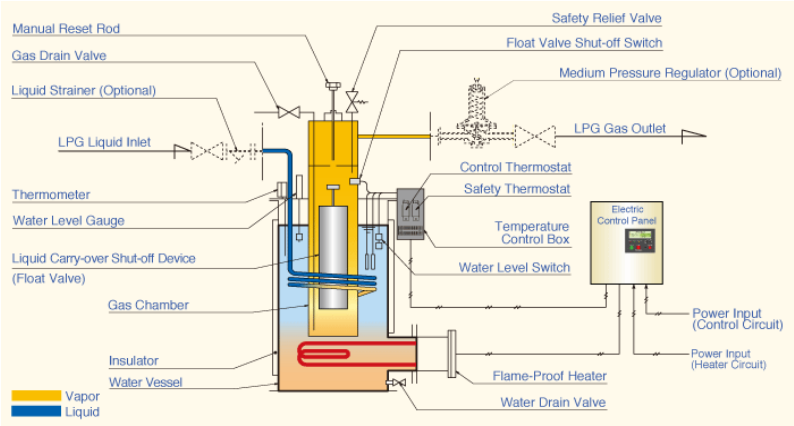
No	Project description	Location	Equipment	Type of saving	Potential Energy Saving (kwh)	Estimated Cost Savings (EUR)	Investment cost (EUR)	Payback time (year)
1	Install inverter to control fan system faster. Rapid drying of 2nd line.	Rapid drying	Inverter	Electricity savings	109,105	7,218	21,387	2.96
2	Utilizing residual heat to pre-heat the air supply to the fluidized bed furnace	Fluidized bed furnace	Heat exchanger	Heat savings	1,538,401	10,949	28,515	2.60
3	Replace non-electric LPG vaporizer	Kiln	Vaporizer	Electricity savings	684,288	45,270	142,577	3.15
4	Replacement of 1st line's spray drying tower	Spray drying tower	Spray drying tower	Heat savings	N/A	N/A	N/A	N/A
5	Apply Energy Management System according to ISO 50001 standard	Energy Management		EnMS Improvement	2,043,663	37,857	89,111	2.35
	Total				4,375,457	101,293	281,590	

Project selected for next steps

Utilize residual heat to create hot water to vaporize LPG;

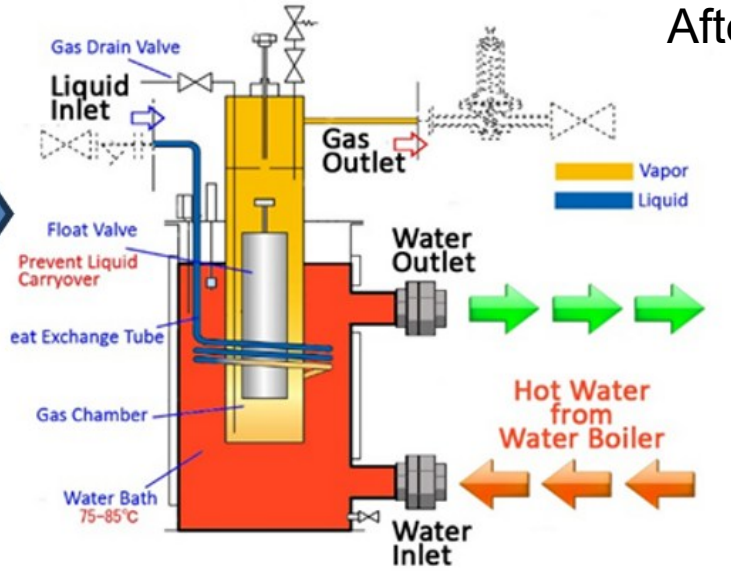
Currently, 4 electric LPG vaporizers are installed in parallel, usually running 3 sets at the same time. The electrical capacity of 1 machine is 60kW;

Before

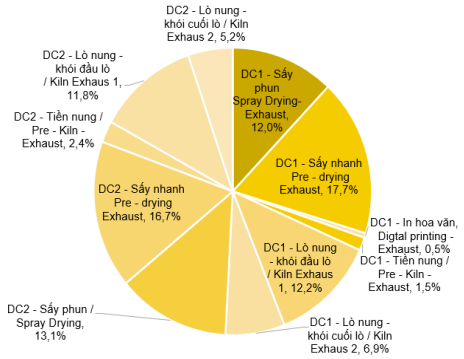


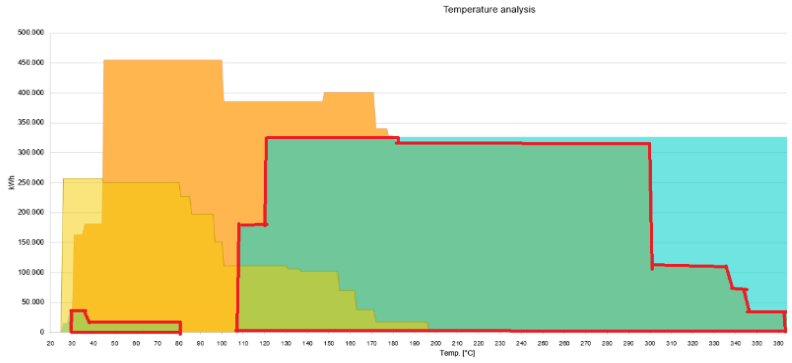


After



Distribution of waste heat potential



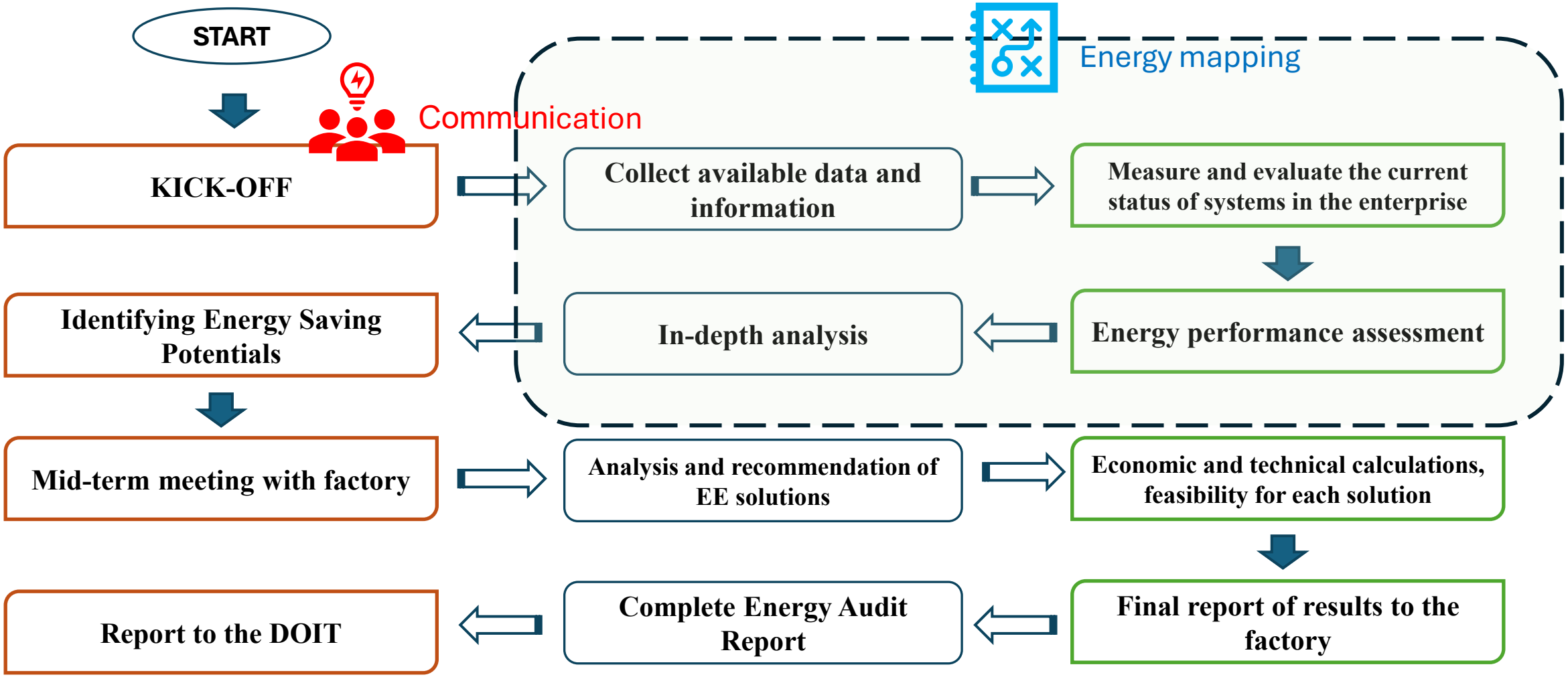


Energy methodology

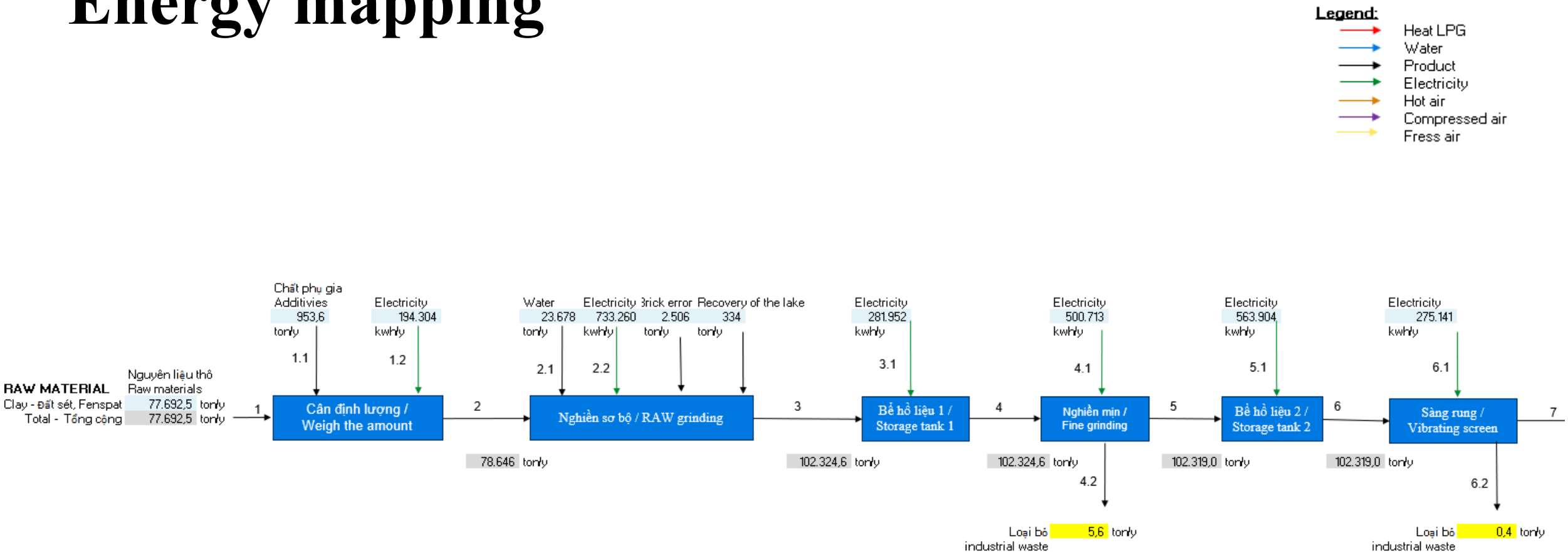
a. *Data collection and analysis*
b. *System survey implementation*
c. *Preliminary assessment and determination of energy saving potential*
d. *Building an energy mapping*
e. *Energy performance assessment*
f. *Detailed analysis and evaluation*
g. *Identify energy saving opportunities and options*

- The energy audit process follows the instructions of Circular 25/2020/TT-BCT dated September 29, 2020.

Energy audit process



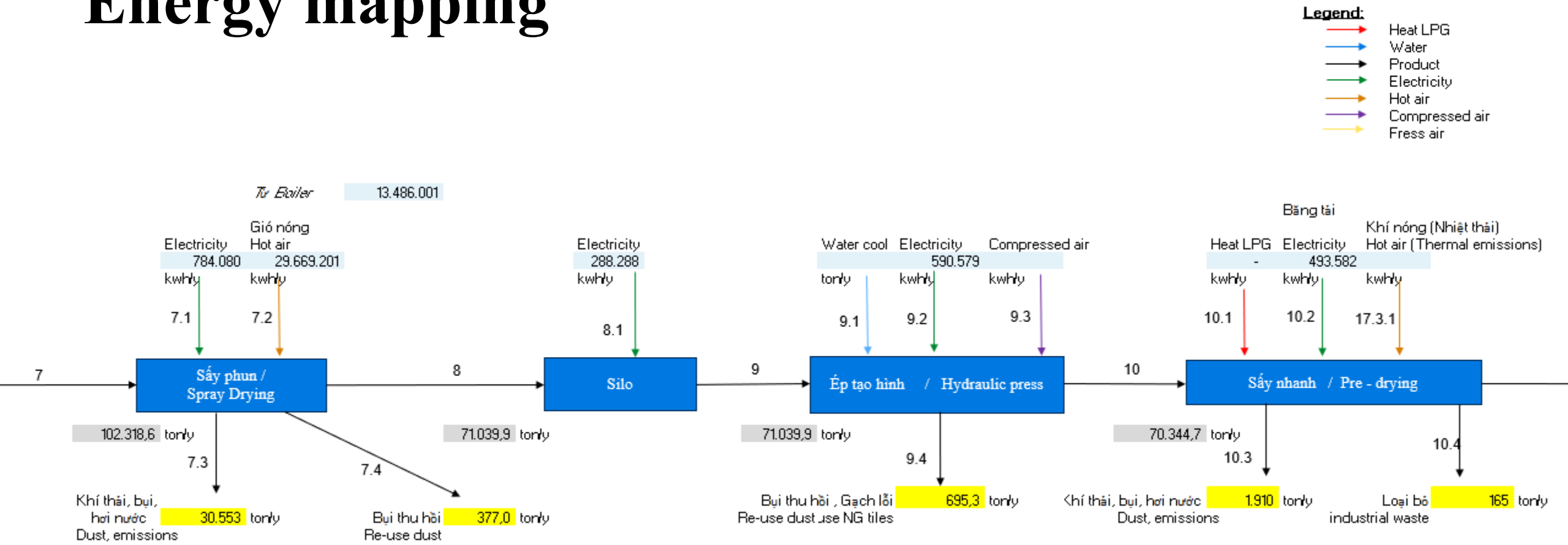
Energy mapping



Material preparation stage

Flow chart of the production process of two lines

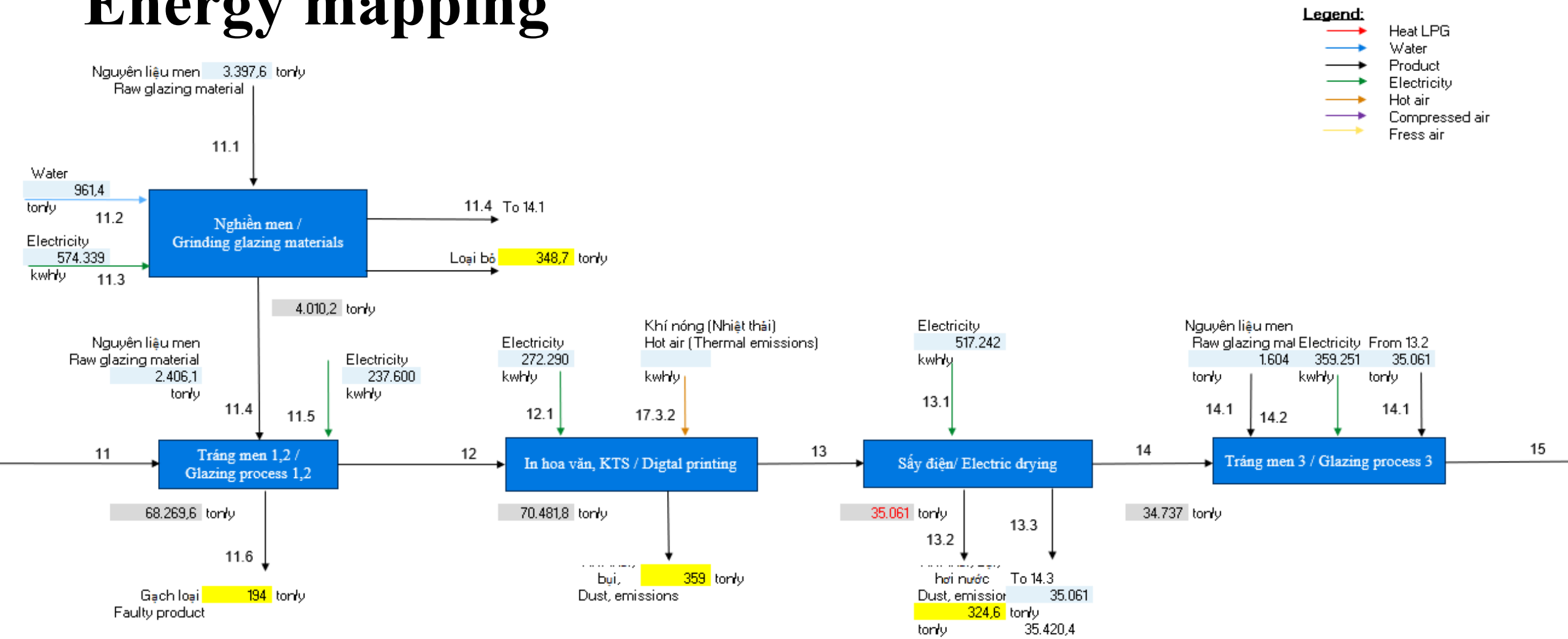
Energy mapping



Tile forming stage

Flow chart of the production process of two lines

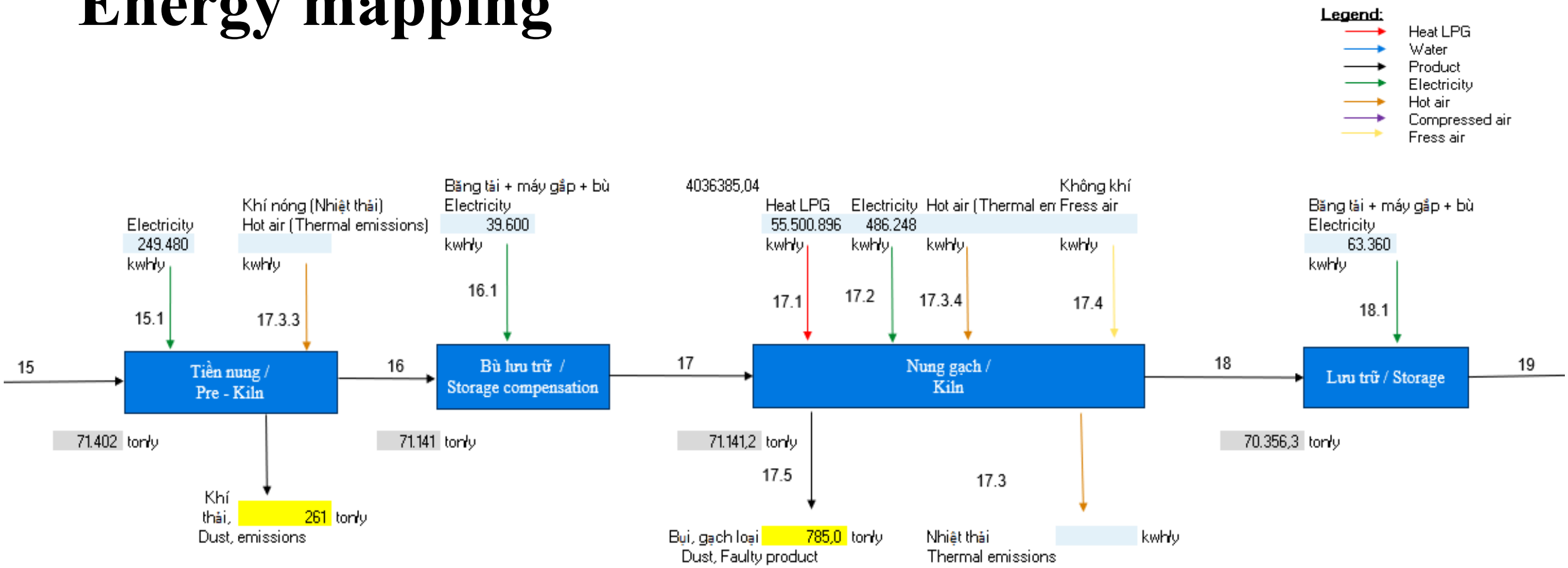
Energy mapping



Glazing & Pattern printing

Flow chart of the production process of two lines

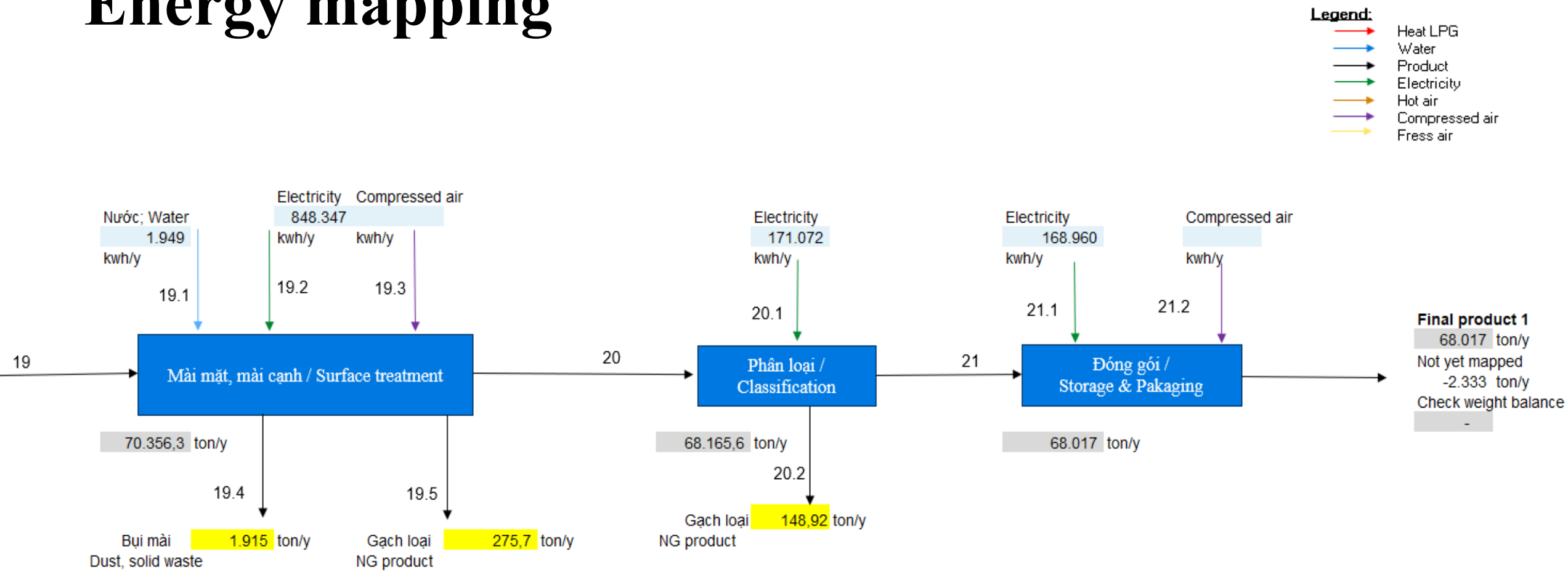
Energy mapping



Tile firing

Flow chart of the production process of two lines

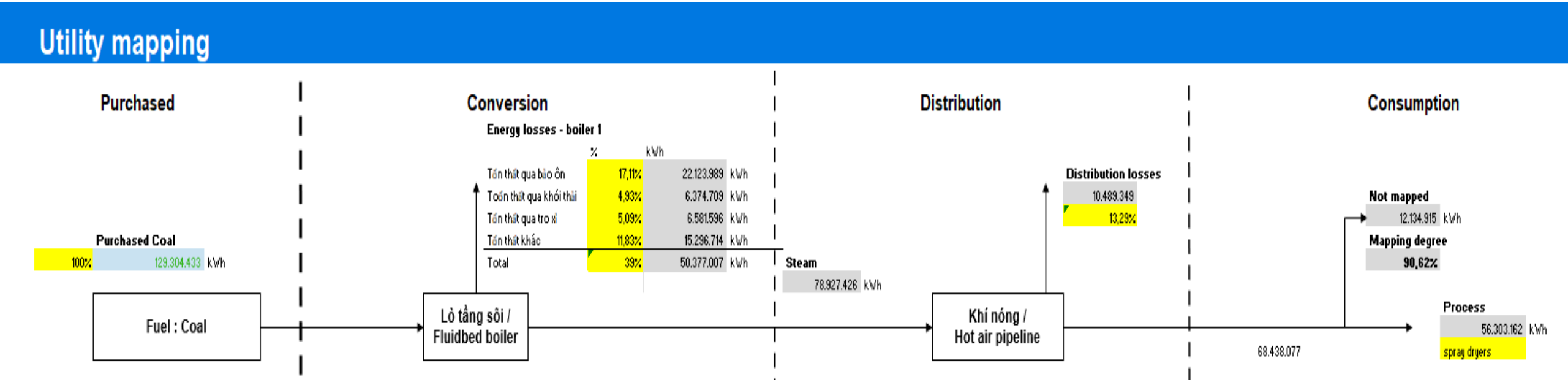
Energy mapping



Finishing & Packaging

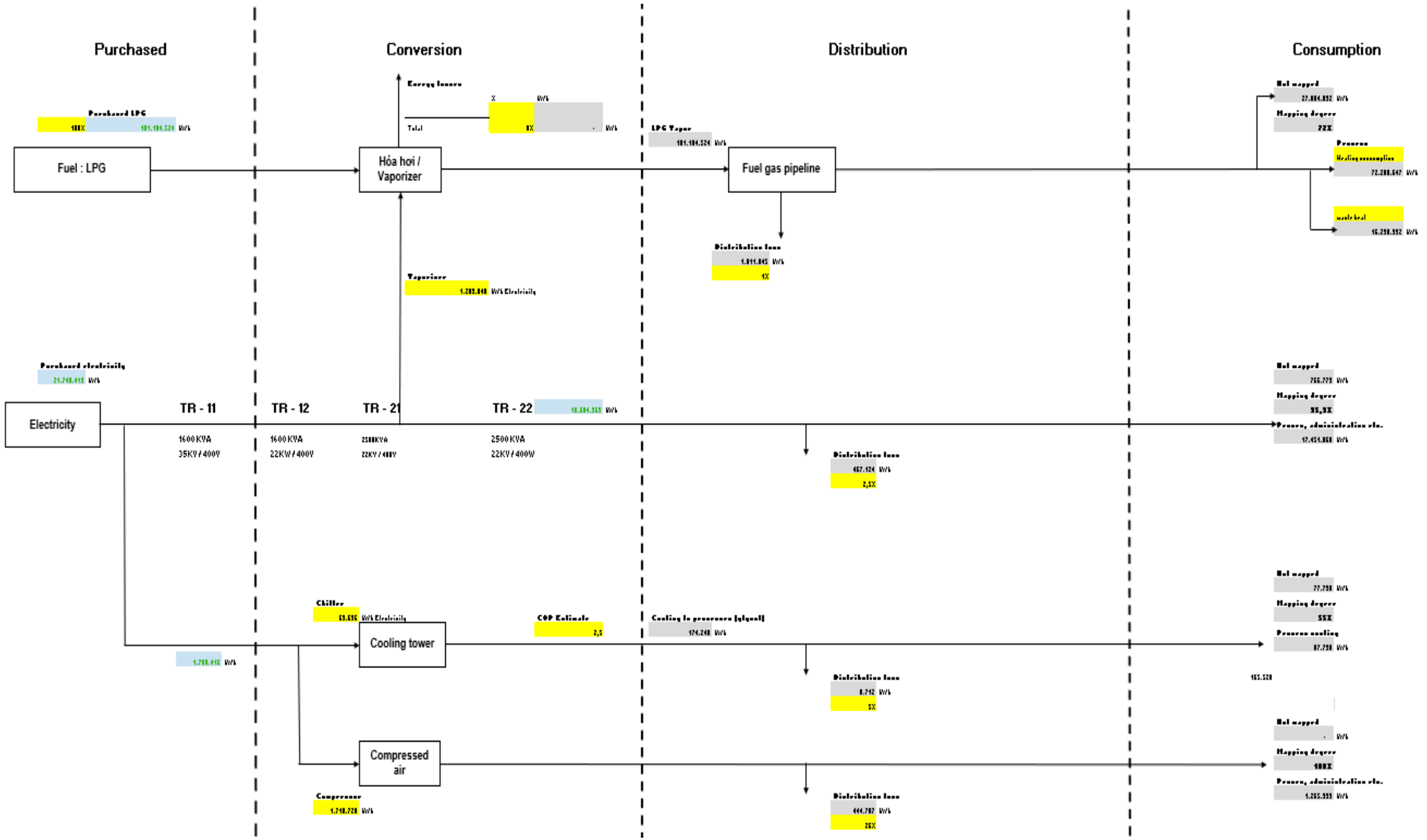
Flow chart of the production process of two lines

Energy mapping



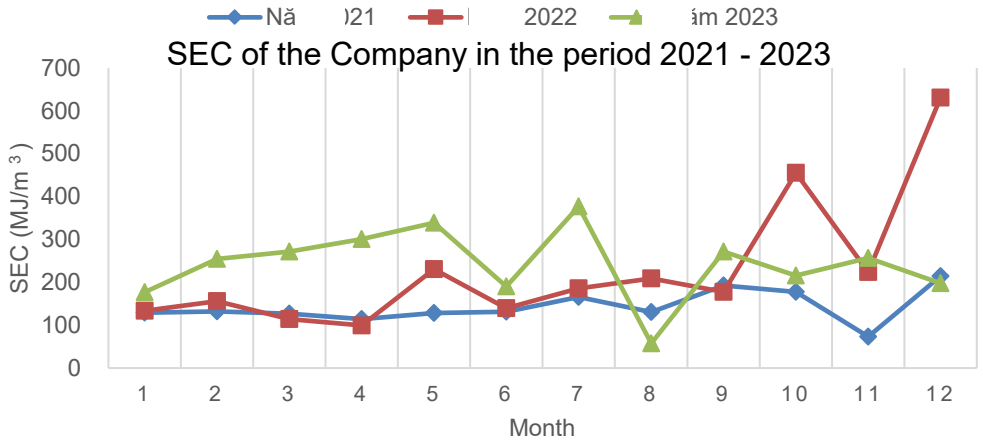
Flow chart of the electricity supply & utility system

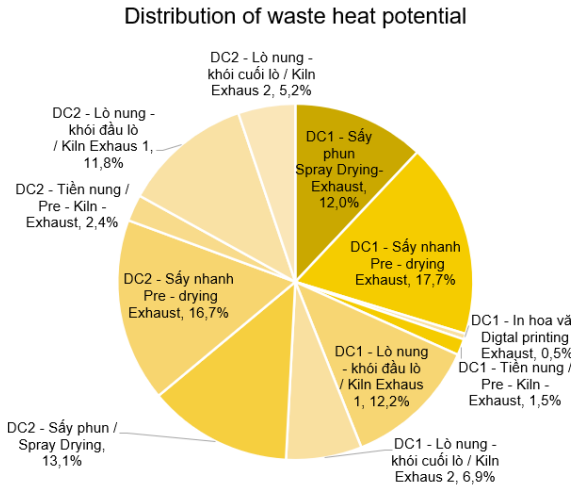
Energy mapping

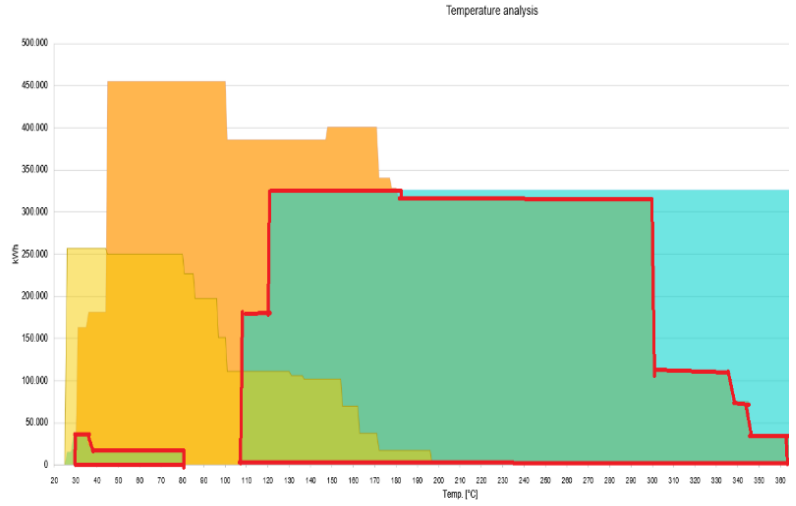


Flow chart of the electricity supply & utility system

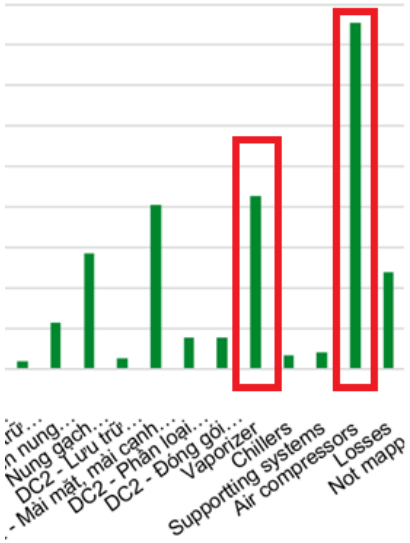
Energy mapping

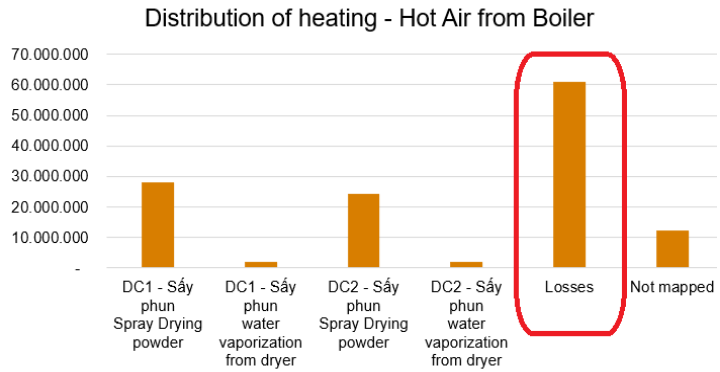




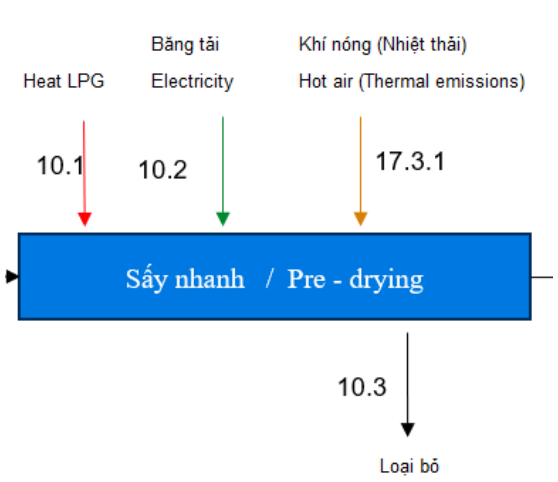


Identifying waste heat recovery potential and inter-process thermal optimization (red-circled areas)

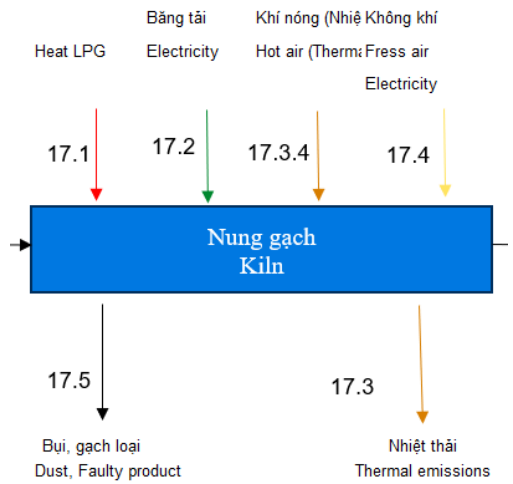




Identifying energy saving potential from mapping

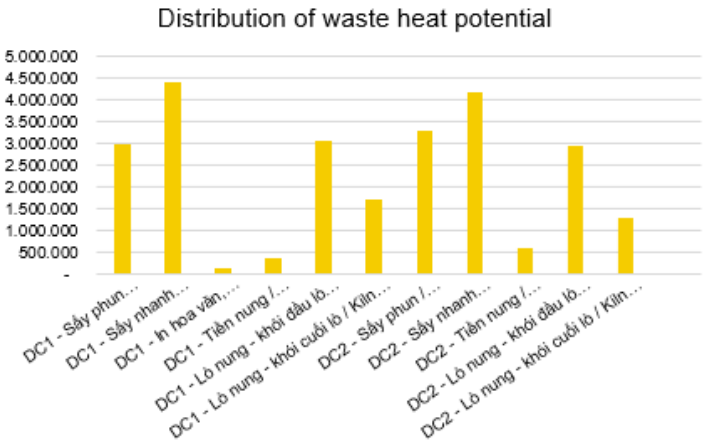


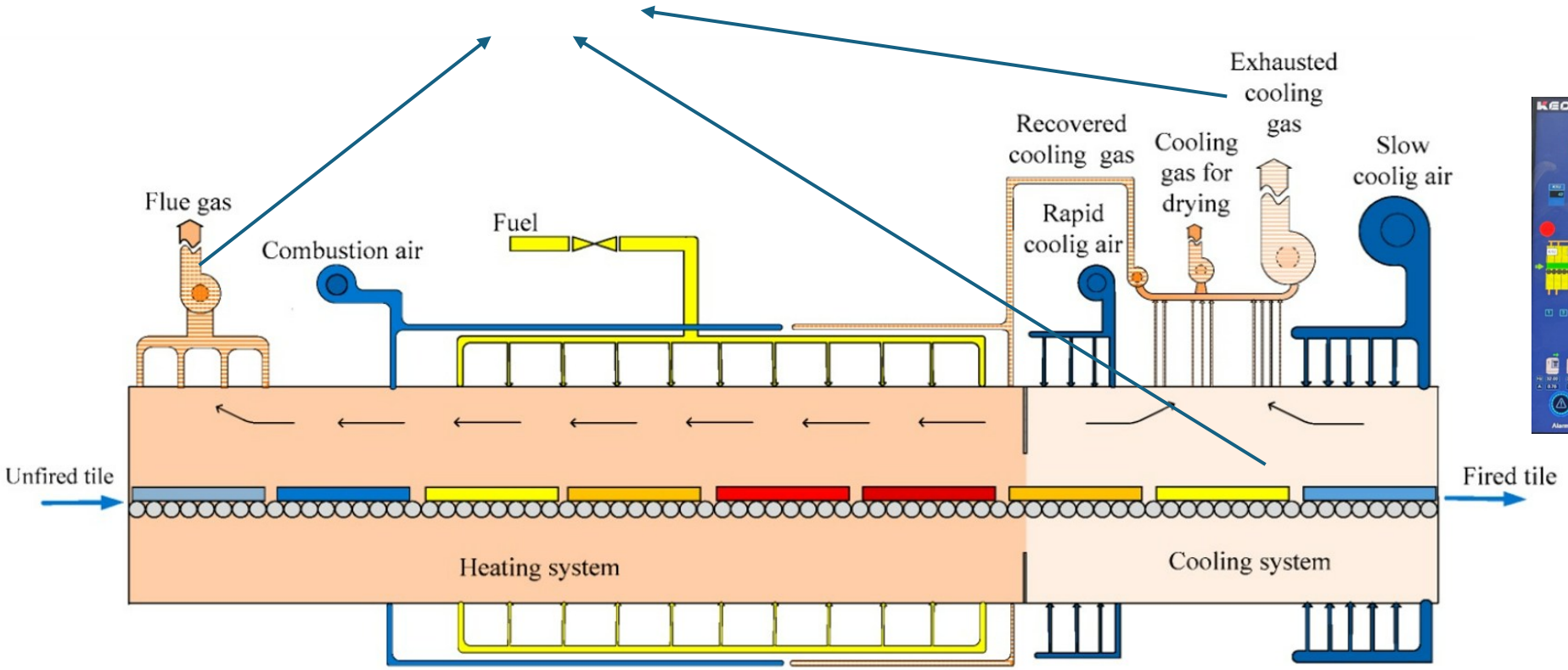
Rapid drying process using LPG

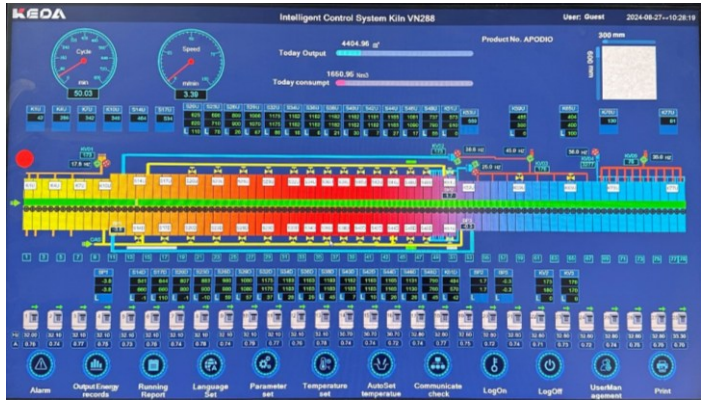


Tile firing process using LPG

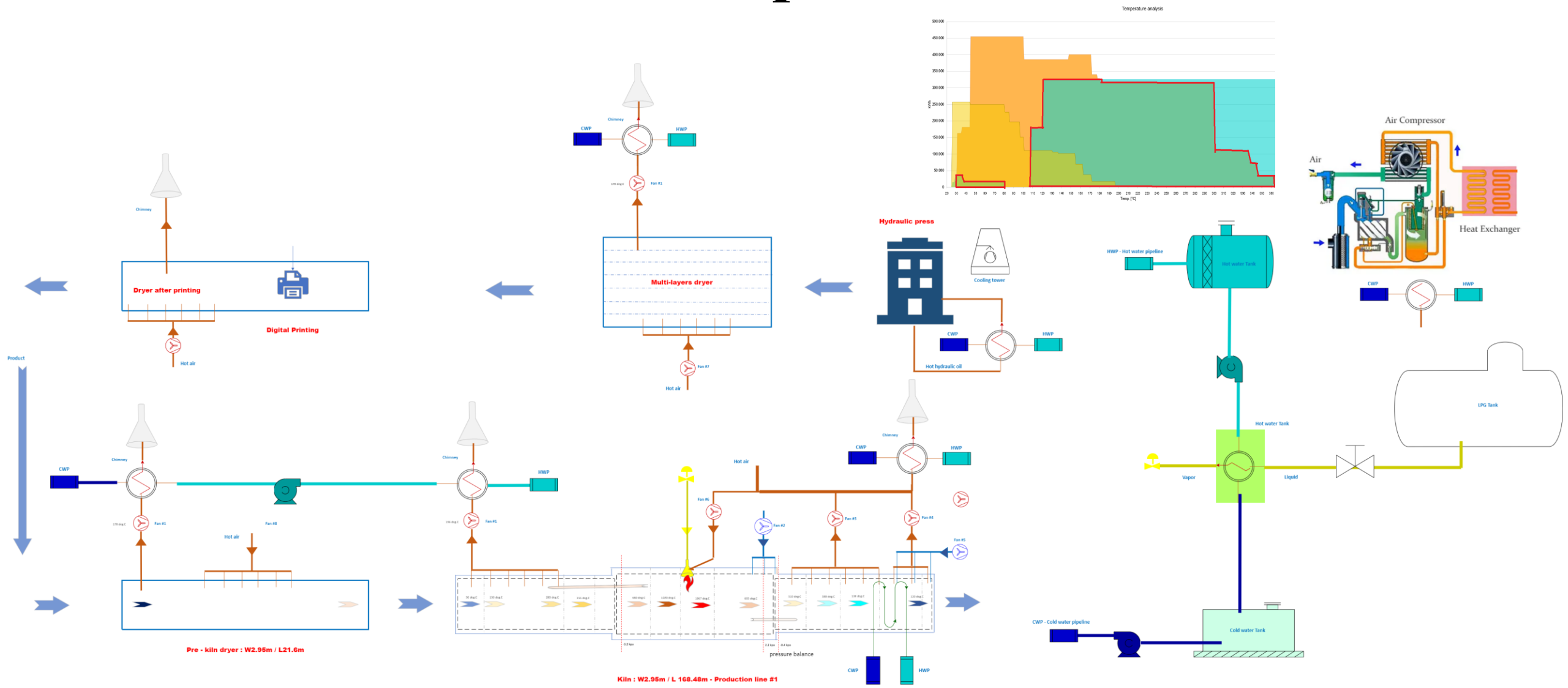
Heat recovery







Recover waste heat to vaporize LPG



Advantages

❑Support from the Factory :

- ❖ Provide information on raw materials, fuel consumption, water, electricity, finished products, and losses at each step of the process so that we can:
- ❖ Develop a mass balance
- ❖ Create a detailed energy map
- ❖ Equipment list: Name, location, and design capacity
- ❖ Support VETS and international experts in conducting on-site measurements at the factory
- ❖ Show interest in implementing the project's proposed solutions and be willing to invest if they are feasible







❑Support from international consultants:

- ❖ Guidelines for mapping
- ❖ Development of solution ideas
- ❖ Guidelines for solution calculations

Challenges

- Lack of data, especially data required for mapping and for calculating project efficiency
- Complexity of the factory's production technology, particularly in mechanical workshops with thousands of product codes
- Diverse and complex material flows within the production lines
- Difficulty in data standardization due to varying units of measurement

Lesson learnt and reflections

❑ Lessons Learned:

- ❖ Develop data collection templates tailored to different industries and adjust the templates to suit each factory after conducting a preliminary survey → clearly communicate data requirements with the factory for the energy audit process.
- ❖ Estimate certain intermediate data points for energy mapping based on the collected data, and discuss with the factory's technical staff to assess the appropriateness of the estimated data. The international consulting expert reviews the calculation results to ensure the accuracy and reliability of the developed energy map.

❑ Recommendations:

- ❖ Further develop requirements and guidelines for energy data collection and monitoring, and standardize data for common, energy-intensive industries.
- ❖ Accelerate the review and approval process for proposed energy efficiency solutions from consultants to better meet the needs of enterprises



THANK YOU FOR LISTENING!

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