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DEMONSTRATION ENERGY AUDITS

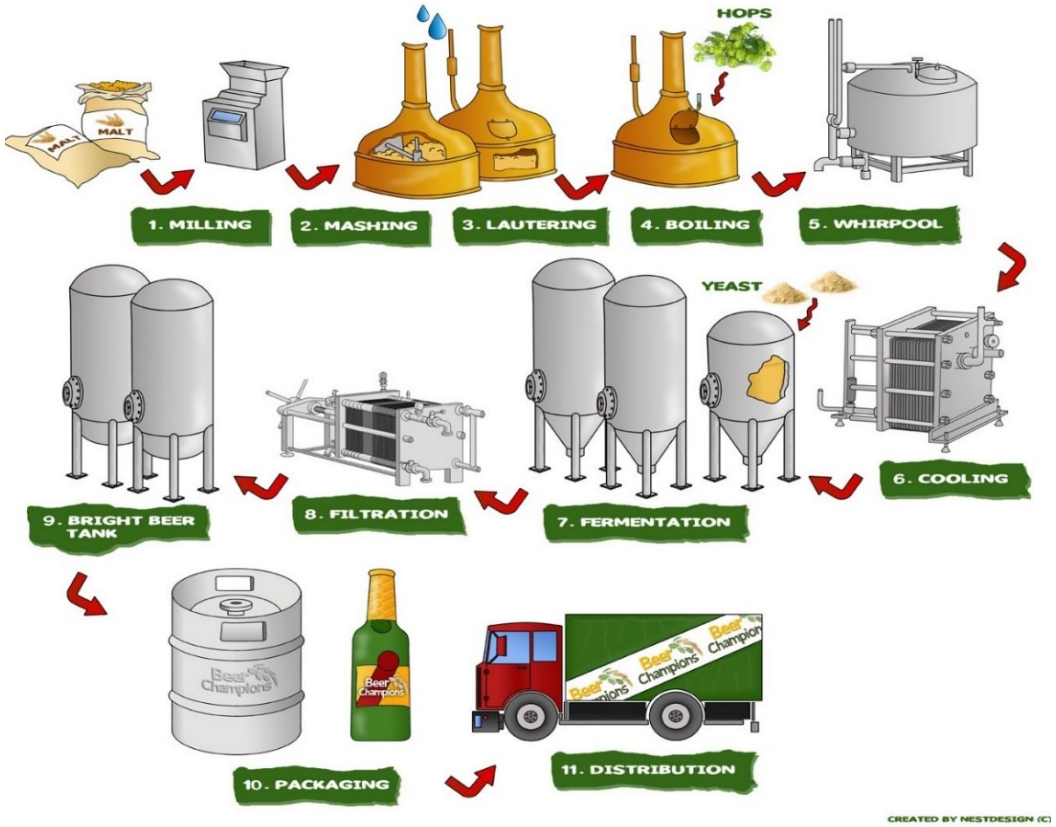
from Ideas to Mature Project

Energy Audit in the Beverage (Beer) Production Sector

22-09-2025

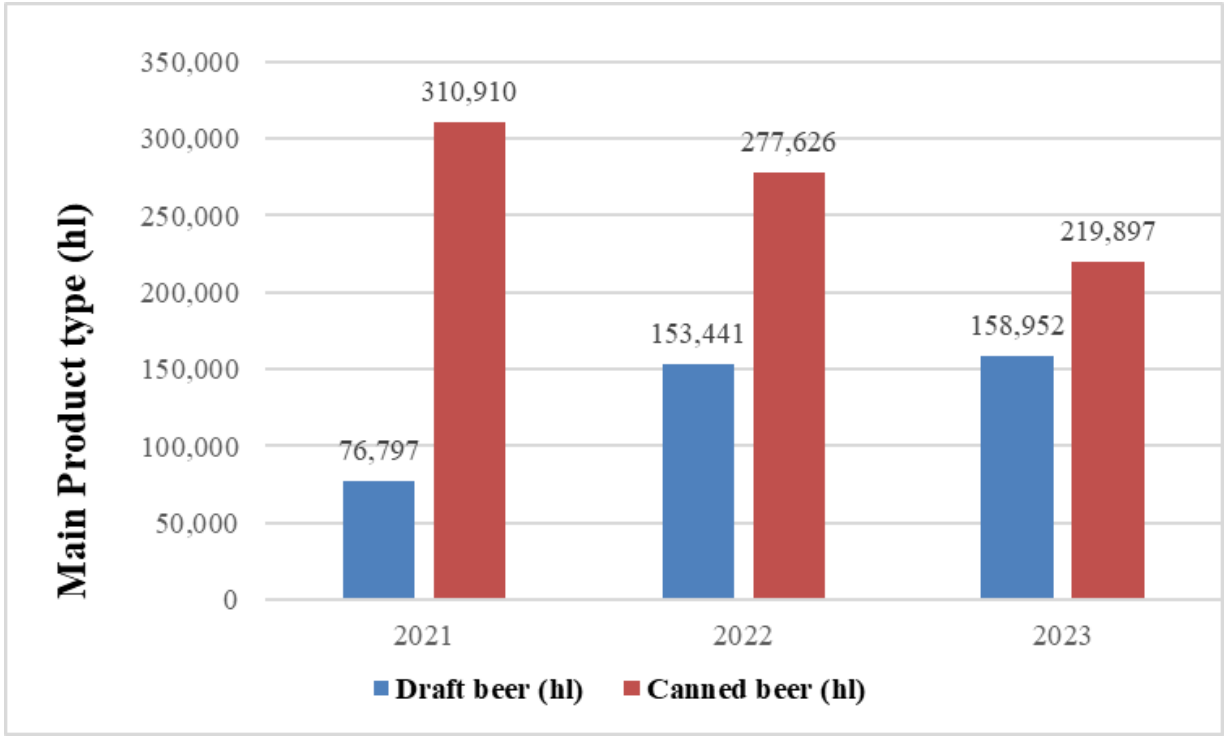
Case Overview

- Established: 12/2006
- Industry: Beverage (Beer Production)
- Capacity: 50 million litres/year



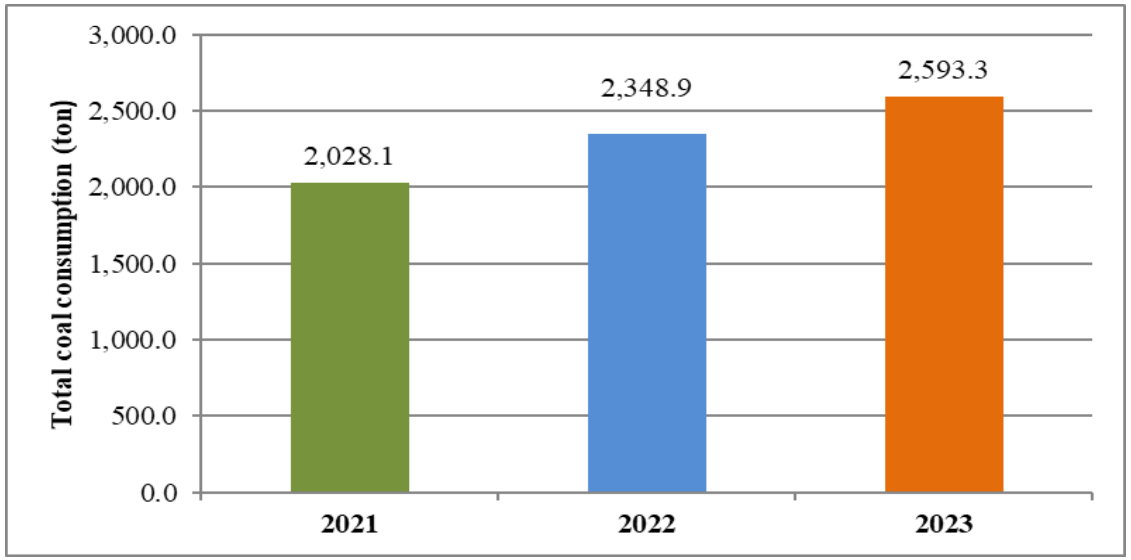
Production process

- Main products: Canned beer, draft beer
- Number of work shifts per day: 03 shifts/day
- Number of working days in a year: 335 days

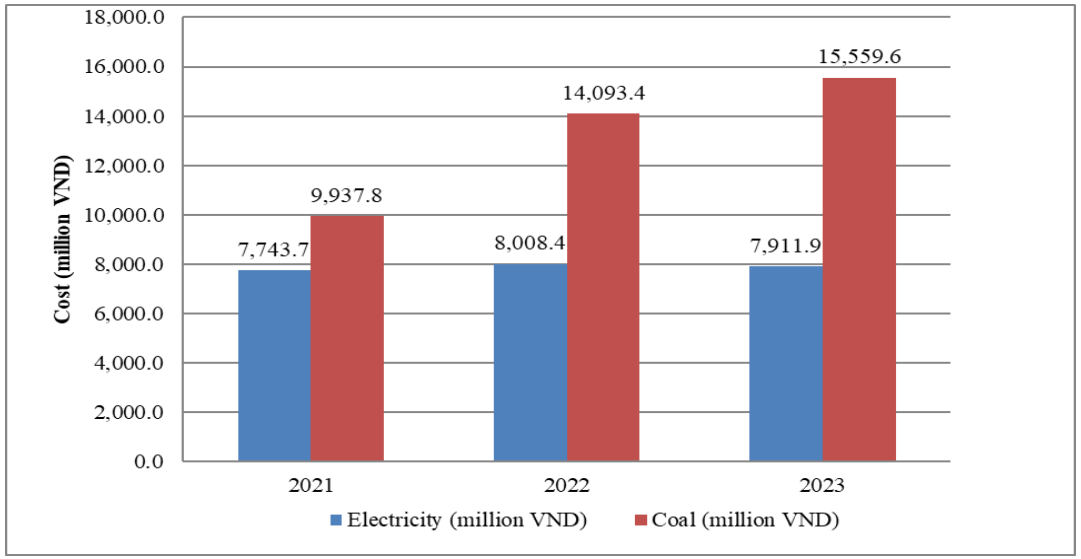


Main Product Type (2021 – 2023)

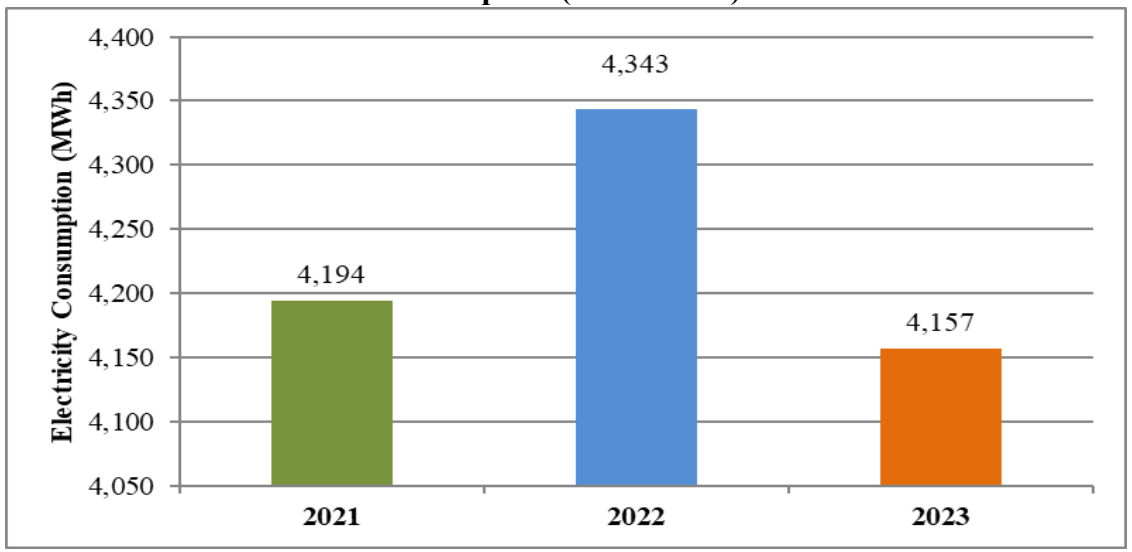
Case Overview



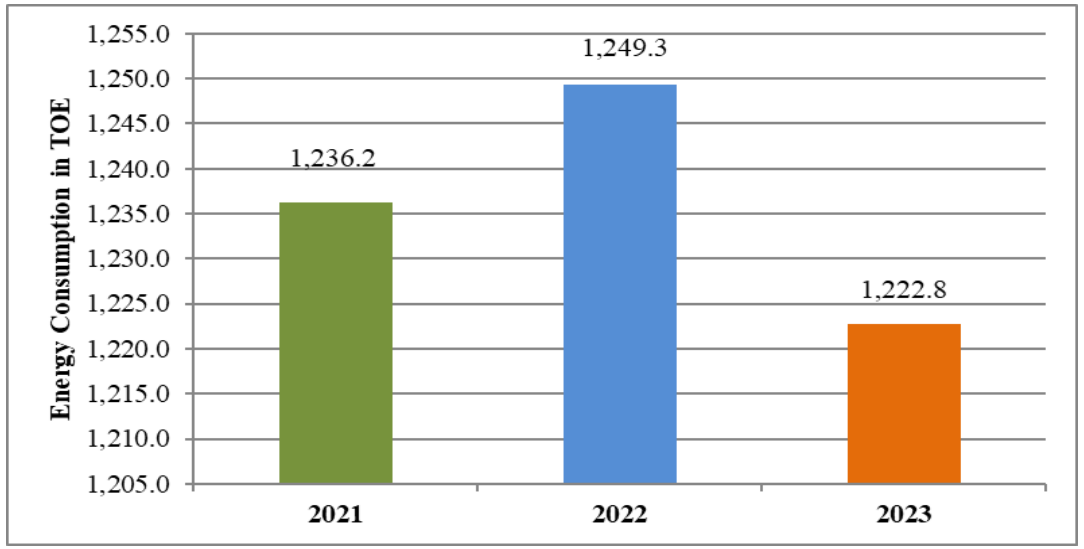
Coal Consumption (2021 – 2023)



Annual Energy Cost (2021 – 2023)



Electricity Consumption (2021 – 2023)



Energy conversion chart to TOE (2021 - 2023

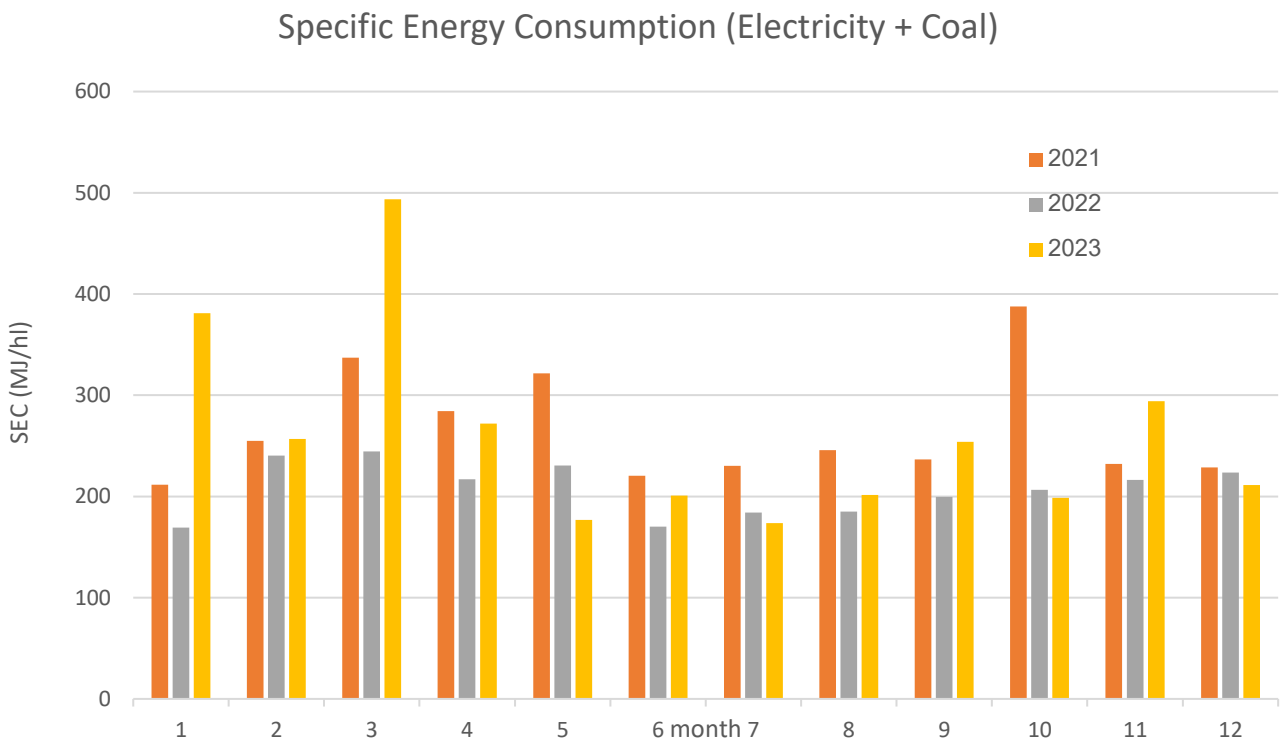
Case Overview

Monthly Specific Energy Consumption (SEC) for Beer Production (MJ/hl)

Month	2021	2022	2023
1	211.6	169.4	381.2
2	254.9	240.4	256.8
3	337.1	244.6	493.6
4	284.2	217.0	272.1
5	321.5	230.6	176.9
6	220.3	170.2	200.7
7	230.1	184.2	173.8
8	245.7	185.1	201.4
9	236.7	199.7	254.0
10	387.6	206.6	198.5
11	232.3	216.5	294.2
12	228.7	223.5	211.3
Average	**250.3**	**191.8**	**228.1**

Energy (Elec. + Coal) Consumption Standards for the Beer Industry According to Circular 19/2016/TT-BCT

No.	Industry Sector	Production Capacity (Million Liters)	Benchmark (MJ/hl)	
			Period Ending 2020	Period 2021 - 2025
1	Beer	>100	140	129
		20-100	215	196
		<20	306	286



Case Overview

- **Energy Audit procedures**

Conduct energy audit complying with the referred energy audit guideline including energy mapping. Overall the energy audit shall be in compliance with Circular 25 and include focus-areas mentioned above. A systematic energy audit will according to the best practice go through the following main activities:

+ Energy mapping;
+ Energy balances;
+ Composite curves;
+ Project identification level A (screening);
+ Project identification level B (project development);
+ Reporting on conclusions and further steps for the project development to be considered in pre-feasibility study

- **Implementation period**

The energy audit implementation period is from August 2024 to November 2024.

No.	Name of Measurement Equipment	Model	Quant.	Made in
1	Energy Test Quality Analyzer (Energytest)	2020E	01	Italia
2	Kew Power quality analyzer (Kyoritsu)	KEW-6315	01	Japan
3	Kyoritsu AC Digital Clamp Meters	2002PA	01	Japan
4	Kewtech AC Digital Clamp Meters	KT200	01	Thailand
5	Light meter	LX - 1102	01	Taiwan
6	Infrared thermometer (Extech)	42509	01	USA
7	Mini 4 in 1 Environmental Quality Meter (Anemometer + Humidity meter + Light meter + Thermometer)	LM-8000A	01	Taiwan
8	Sony camera and on-site meters	DSC-WX220	01	Vietnam

Kyoritsu Power Quality Analyzer, KEW 6315 - 8129-3



Mini 4 in 1 Environmental Quality Meter: Anemometer + Humidity meter + Light meter + Thermometer (Lutron LM-8000A)



Thermographic Camera (Flir - TG165-101134)



PCE Ultrasonic Flow Meter



List of measurement devices, energy audit tools

Case Overview

List and role of auditors

No	Name	Position	Task	Qualifications	Experience year
1	Pham Van Tan	Team leader	- Supervise activities and complete the final audit report. - Guidance for energy mapping and correction for mapping and energy saving solutions.	Master of Science in Energy Technology	25
2	Nguyen Duc Quyen	Member	- Writing energy audit reports. - Propose energy saving solutions and provide suggestions.	Master of Science in Energy Technology	24
3	Trinh Viet Thieu	Member	- Writing energy audit reports. - Propose energy saving solutions and provide suggestions.	Doctor of Philosophy in Energy engineering	14
4	Pham Van Tuyen	Member	- Performing measurement of energy consuming devices. - Prepare the energy mapping for steam, cooling system. - Develop and Calculate for energy saving solutions.	Thermal engineering engineer	9
5	Lai Tien Dat	Member	- Performing measurement of energy consuming devices. - Prepare the energy mapping for steam, cooling system. - Develop and Calculate for energy saving solutions.	Energy Technology Engineer	5
6	Tran Nguyen Phuong Thao	Member	- Economic calculation and analyse for EE sollutions.	Bachelor on Energy Economics	7

Case Overview

List of energy saving solutions

No	Energy Saving Solutions	Location	Energy Saving Potentials			CO_2 Reduction (ton/year)	Invest (10^6 VND)	Saved Cost (10^6 VND/year)	Simple Payback (Year)
			Electricity (kWh/year)	Coal (ton/year)	Total saved energy (TOE/year)				
1	Activities to enhance internal management and regular maintenance and minor repairs of equipment	Total Company	41,570	31.1	28.2	114.6	300.0	265.8	1.1
2	Install a water heater (ecomiser) that utilizes waste heat from boiler flue gas	Boiler system	-	21.0	9.4	38.3	357.5	125.8	2.8
3	Conversion of coal-fired boiler to biomass boiler		-	535.8	241.1	980.5	15,000.0	3,214.8	4.7
4	Removing Scale and Enhancing Heat Exchange Efficiency for the Cooling Tower Using EWater Scale Treatment Equipment	Cooling tower system	83,409	-	12.9	56.4	364.6	158.7	2.3
5	Utilizing the waste cold released during the evaporation of CO_2 to cool NH_3 after the condenser	Refrigeration and CO2 recovery system	22,829	-	3.5	15.4	120.0	43.4	2.8
6	Using Solar Energy Lights for the Company's Campus Lighting System	Lighting system	19,710	-	3.0	13.3	96.0	37.5	2.6
7	Install a variable frequency drive (VFD) and control system to reduce the unload time of compressor number 2	Compressed air system	82,571	-	12.7	55.9	301.3	157.1	1.9
Total			**250,090**	**587.9**	**310.9**	**1,274.5**	**16,539.4**	**4,003.2**	
% of Total Energy Use (compared to 2023)					**25.4%**	**20.5%**		**17.1%**	

Case Overview

Energy Saving Solution: "Installation of a water heater utilizing waste heat from boiler flue gas"

No.	Parameter	Unit	Value
1	Total investment	million VND	358
2	Energy (coal) saved annually	kg/year	20,962
3	Energy (coal) price	VND/kg	6,000
4	Total annual energy cost savings after implementing the energy-saving solution	million VND/year	126
5	Annual repair and maintenance costs	million VND/year	3.6
6	Estimated lifespan of the investment project (rounded to years)	year	8
7	Discount rate	%	10
8	Simple payback period	years	2.8
9	Discounted payback period	years	3.4
10	Internal rate of return (IRR)	%	34.3
11	Net present value (NPV)	million VND	398
12	Benefit-cost ratio (B/C)		2.0

Case Overview

Energy Saving Solution: "Conversion of coal-fired boiler to biomass boiler"

No.	Specifications	Unit	Value
1	Total Investment	Million VND	15,000
2	Total annual energy cost savings after implementing the energy efficiency solution	Million VND/year	3,214.8
3	Annual repair and maintenance costs	Million VND/year	300.0
4	Calculated lifetime of the investment project (rounded to the nearest year)	years	10.0
5	Discount rate	%	12.0
6	Simple payback period	years	4.7
7	Discounted payback period	years	7.1
8	Internal rate of return (IRR)	%	18.2
9	Net present value (NPV)	Million VND	4,366.3
10	Benefit-cost ratio (B/C)		1.2

Detail EA methodology and energy mapping

1) Methodology / approach & Why Use Energy Mapping?

- **Key Points:**
  - **Approach:** The audit complied with Vietnamese regulations (**Circular 25**) and followed a systematic methodology guided by the Danish Energy Agency, IC experts.
  - **Why Energy Mapping? (Advantages over conventional methods):**
    - It moves beyond analyzing total bills to provide a granular, "big picture" view of how energy flows through the entire plant.
    - Identifies the largest energy-consuming processes and equipment, allowing for data-driven prioritization.
    - Uncovers "hidden" system losses in distribution and conversion (e.g., heat loss, electrical losses) that are often missed.
    - Enables system-level optimization instead of just component-level replacement, leading to better-targeted solutions.

Detail EA methodology and energy mapping

2) Mapping Development & Data Collection

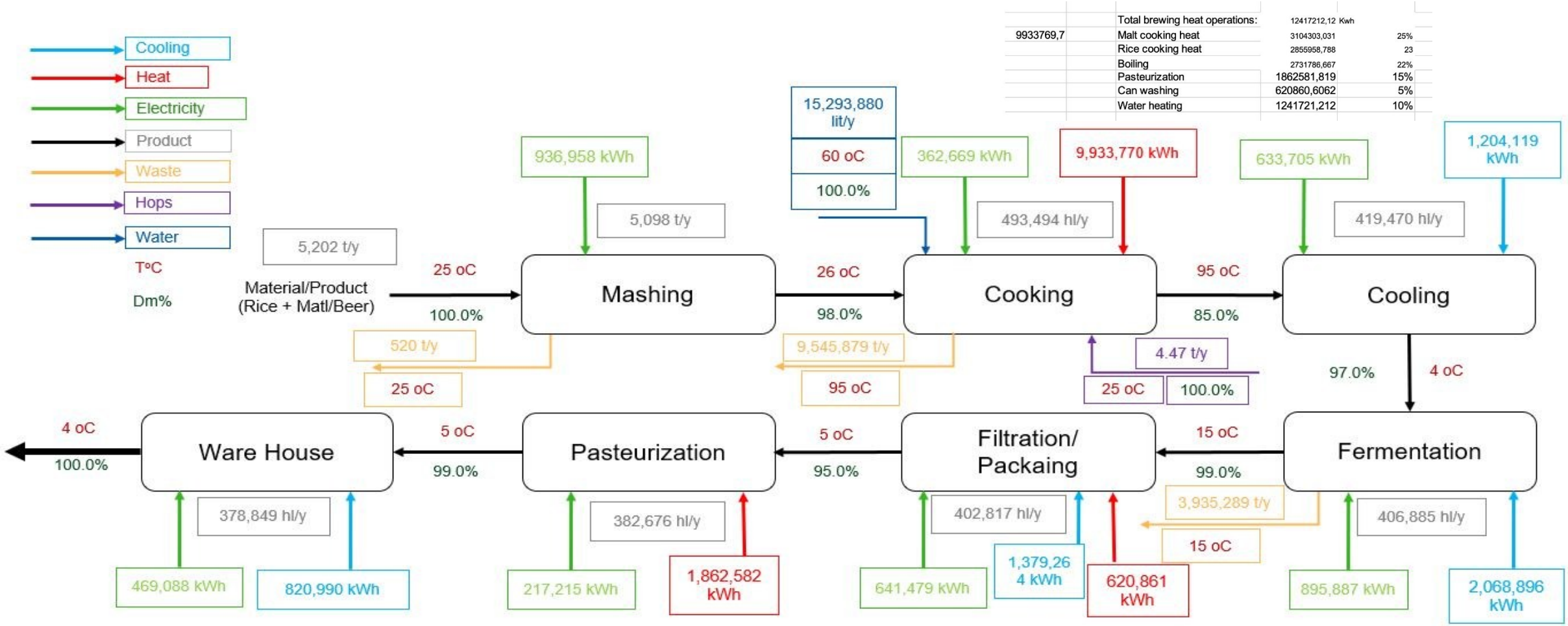
- **Key Points:**
  - **Development Process:**
    - A visual **process flow diagram** was created to map all material and energy streams.
    - A **quantitative breakdown** was developed to detail the specific consumption of heat, cooling, and electricity for each production stage.
  - **Data Collected:**
    - Historical data (2021-2023) from energy bills, receipts, and operational logs.
    - On-site measurements for temperature, pressure, and flow rates.
    - Specific measurements like power quality assessments and ultrasonic leak detection for compressed air systems.
  - **Data Validation:** The process was validated by creating **energy balances** to ensure inputs matched the sum of consumption and identified losses

Detail EA methodology and energy mapping

3) Energy Mapping Results

Heat Consumption Hotspot: The **Cooking** process dominates heat energy use, consuming **9,933,770 kWh** annually.

Cooling Energy Demand: The **Fermentation** and **Cooling** stages are the most significant consumers of cooling energy.

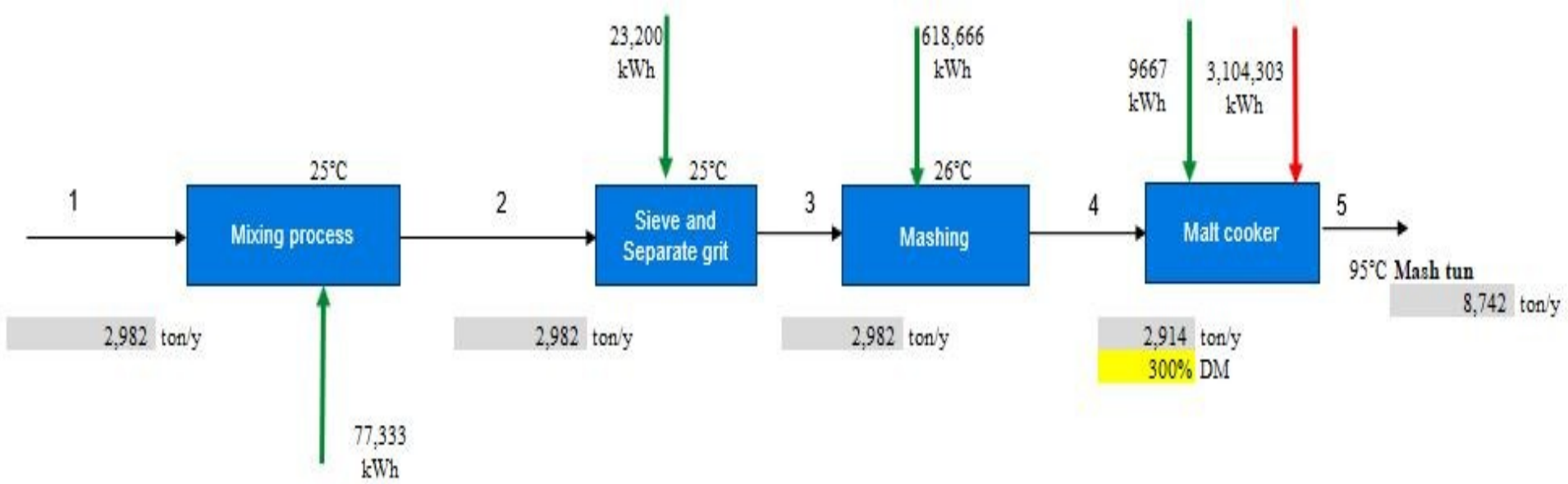


Simple process flow diagram

Detail EA methodology and energy mapping

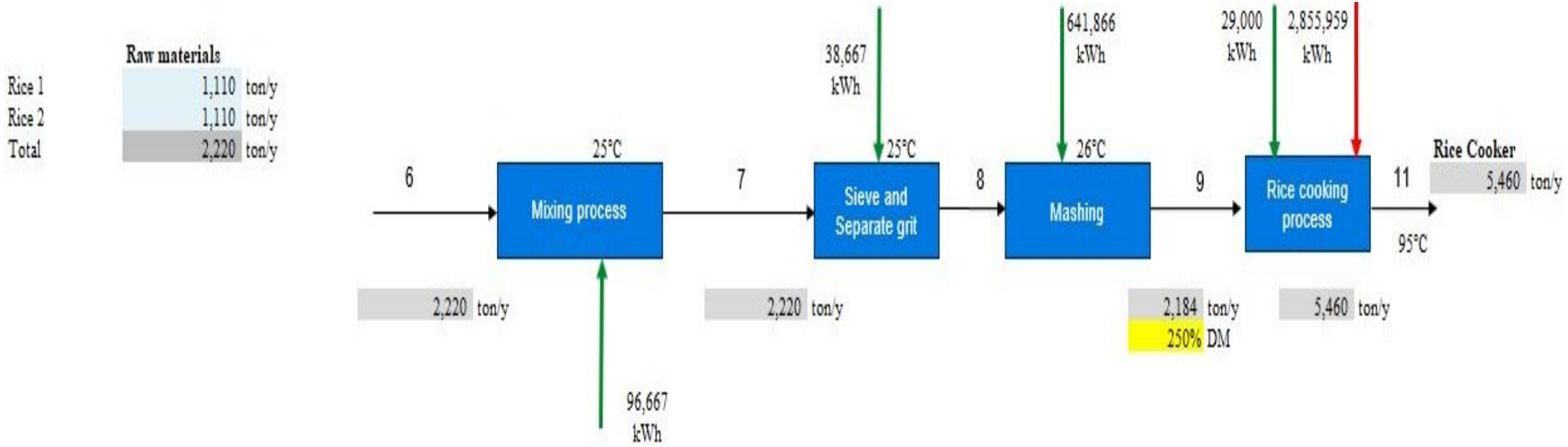
Flowchart of Malt Preparation and Cooking Process

Raw materials		
Malt 1	994	ton/y
Malt 2	994	ton/y
Malt 3	994	ton/y
Total	2,982	ton/y



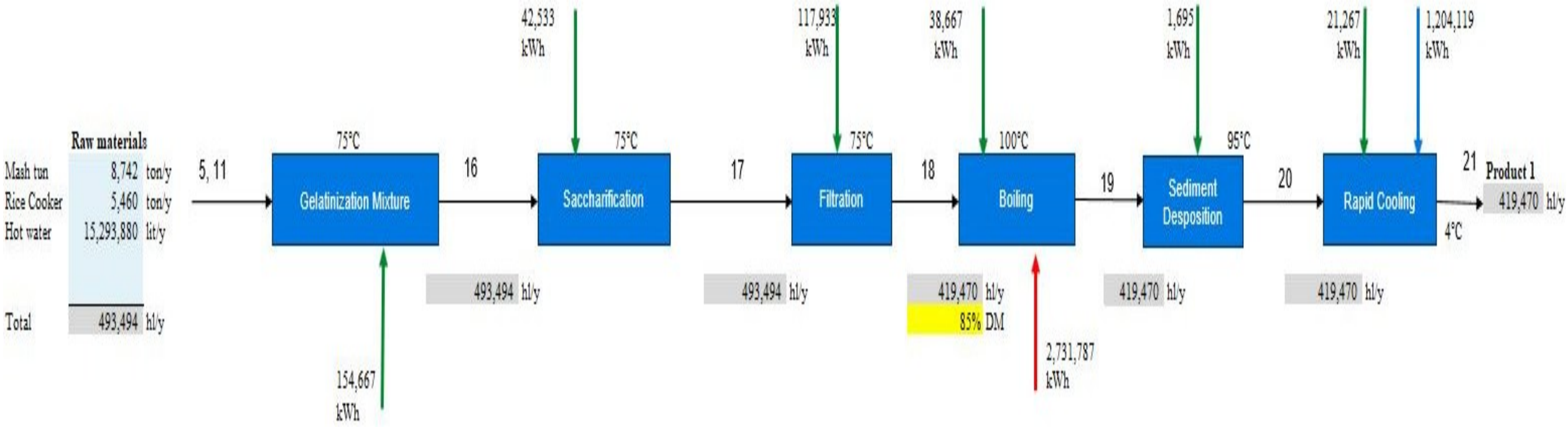
Detail EA methodology and energy mapping

Flowchart of Rice Preparation and Cooking Process



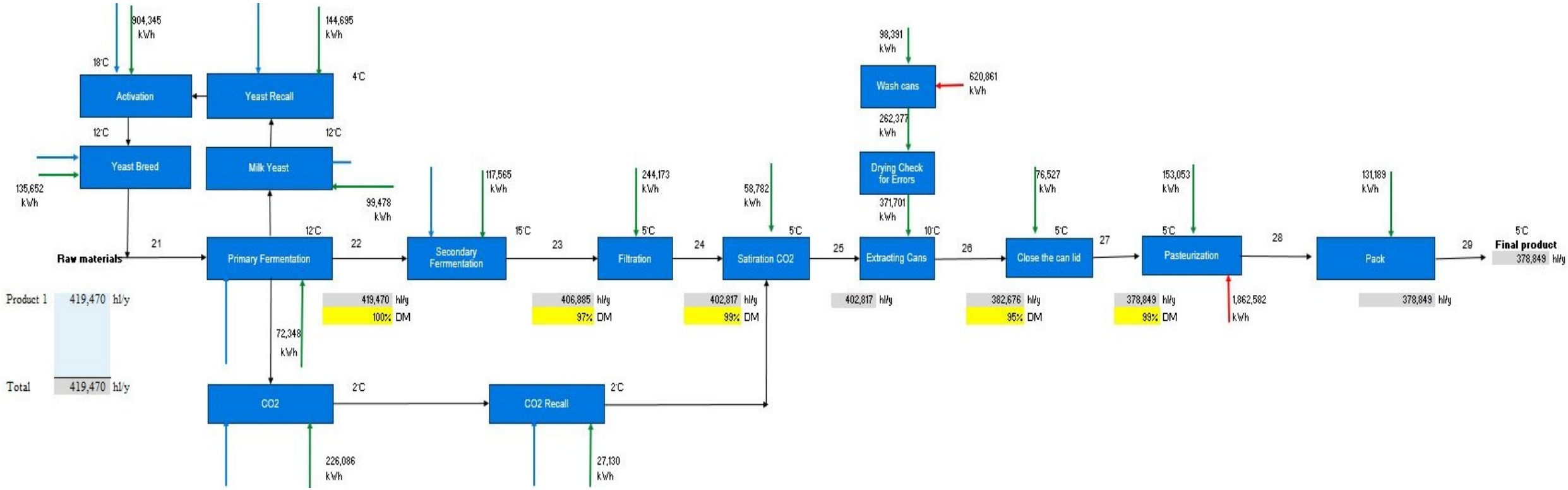
Detail EA methodology and energy mapping

Mixing, Pressing, and Boiling Process after Cooking Rice and Malt

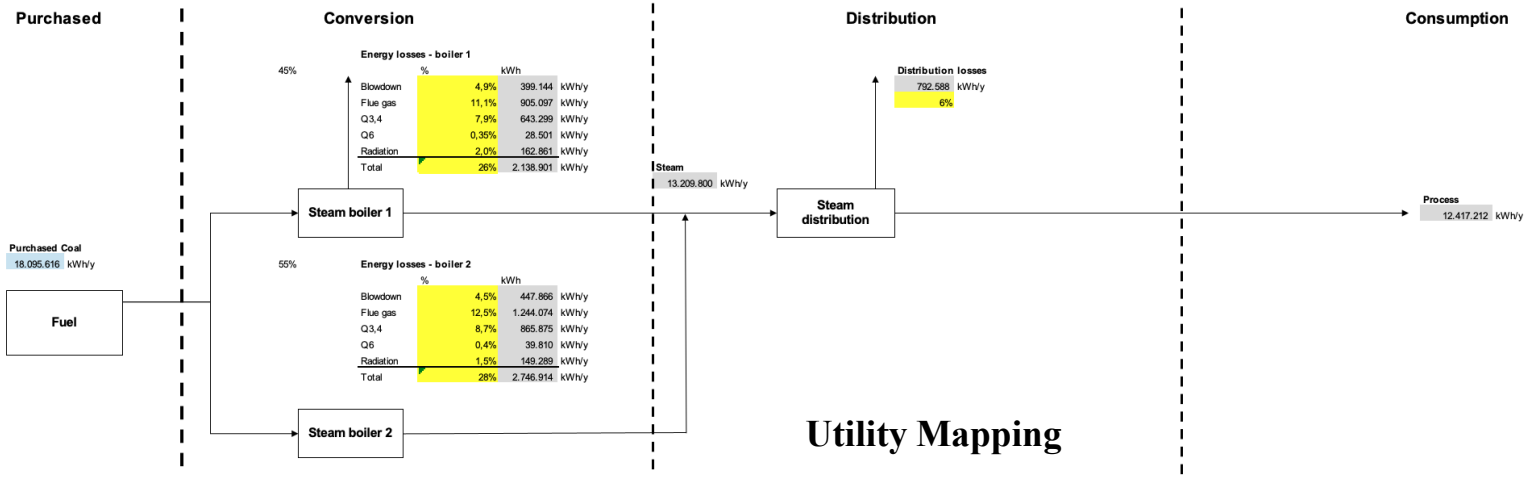


Detail EA methodology and energy mapping

Fermentation and Canning Process



Detail EA methodology and energy mapping





The company's old coal-fired boiler system

Case Study - Identifying Boiler Inefficiencies

- **Key Points:**
  - **Project Identified:** The boiler system was found to be operating at only **~73% efficiency**, with significant heat loss from high-temperature flue gas (180-200°C).
  - **Proposed Solution:** This finding directly led to the proposal of **Project #2: "Install a water heater (economizer) utilizing waste heat from boiler flue gas"**.
  - **How Energy Mapping Helped:**
    - The **Utility Map** visually represented the "Steam boiler" as a central energy conversion unit **(accounted for around 60% of total energy used)**
    - Crucially, the map quantified the total fuel energy input versus the useful steam output, allowing for the calculation of the low 73% efficiency.
    - The map explicitly showed an "Energy losses" path for "Flue gas," pinpointing it as a major source of waste and a clear target for a heat recovery project.

Detail EA methodology and energy mapping

Case Study - Identifying Cooling System Issues

- **Project Identified:** The central cooling system's performance was found to be reduced by **10-30%** due to scale buildup in the cooling tower, which lowered the chiller's overall efficiency (COP).
- **Proposed Solution:** This led to the proposal of **Project #4: "Removing scale and enhancing heat exchange efficiency for cooling tower"** using an EWater system.



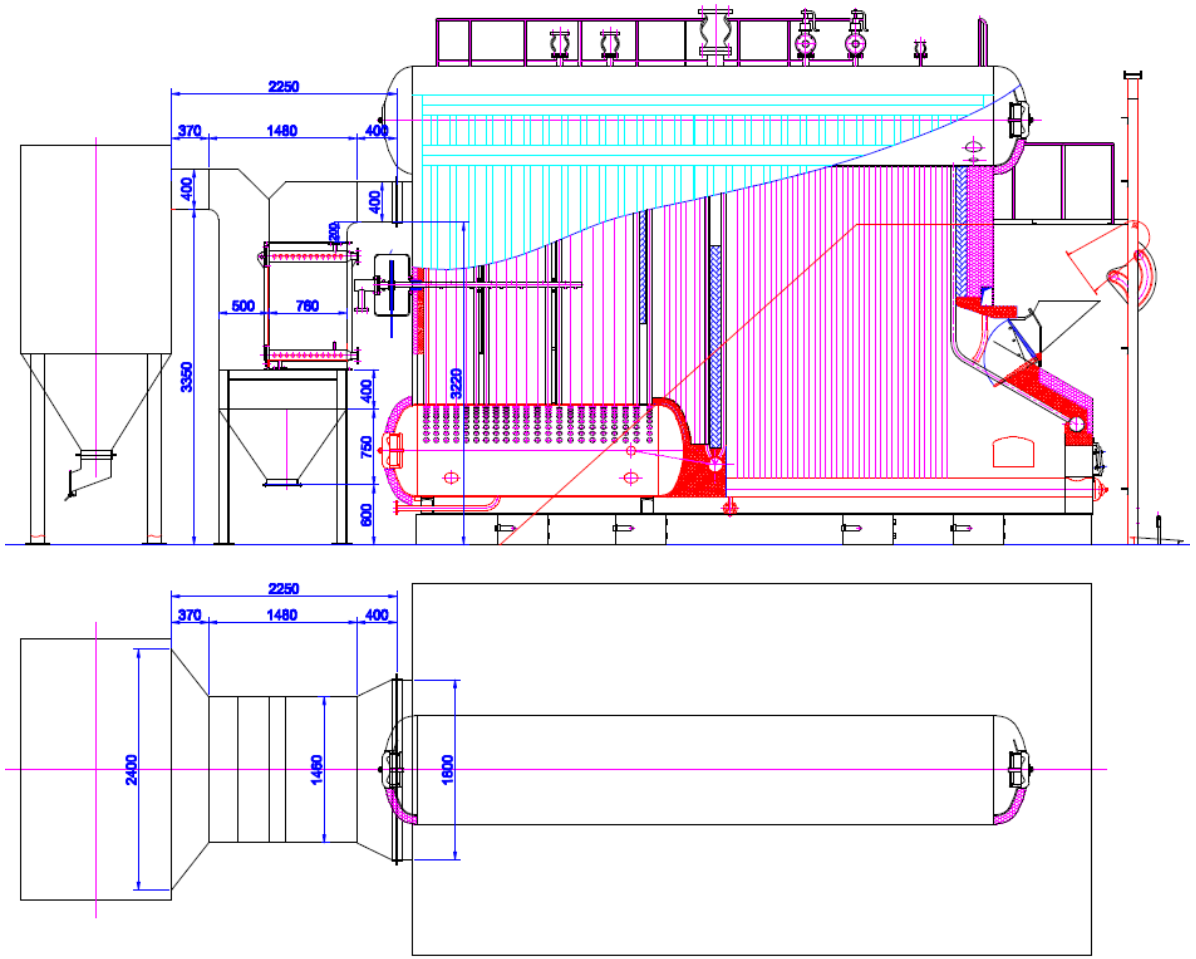
Scale deposits and algae on the surface of the heat exchange plates

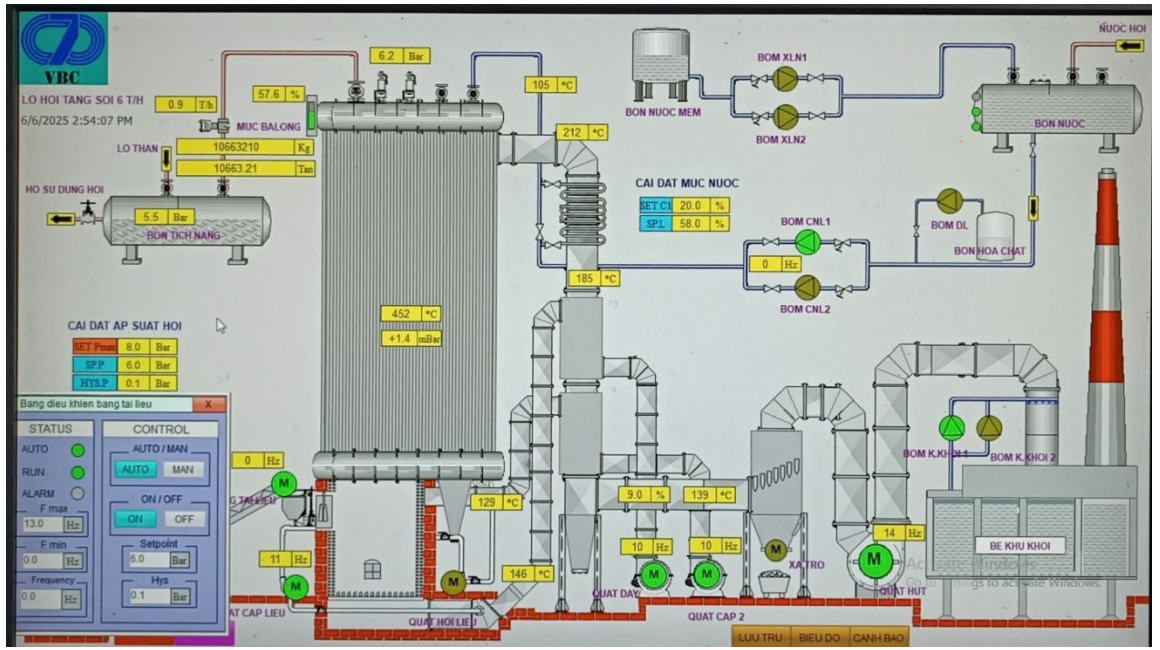
How Energy Mapping Helped:

- The **Process Map** showed a massive demand for cooling energy across multiple stages (Cooling, Fermentation, Filtration), totaling over 5.4 million kWh.
- The **Utility Map** showed the "Refrigeration system" as a major electricity consumer.
- The sheer scale of the cooling demand, as visualized by the maps, prioritized the entire cooling system for a detailed efficiency investigation. This investigation then uncovered the physical problem of scale buildup.

Detail EA methodology and energy mapping

Implemented Investment a New Biomass Boiler - Replacing the Old coal-fired boiler



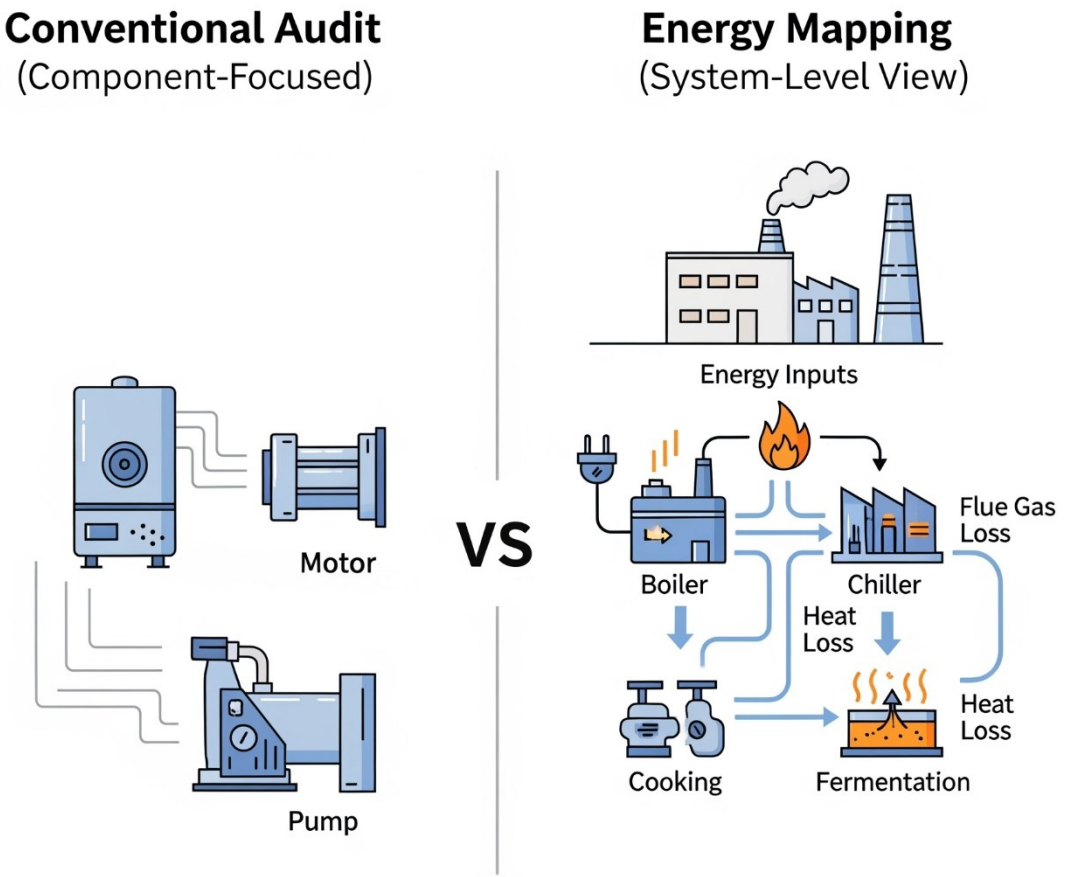




Lesson learnt and reflections

Audit Procedure & Energy Mapping

- **Challenge:** Conventional audits are component-focused, often missing system-wide interactions and losses.
- **Solution (Good Practice):** Energy Mapping provides a holistic, system-level view of all energy flows, from source to end-use.
- **Lesson Learned:** This approach effectively pinpoints the true energy hotspots (e.g., the Cooking process) and hidden losses (e.g., boiler inefficiency), guiding where to focus efforts for maximum impact.



Lesson learnt and reflections



Super leak detector

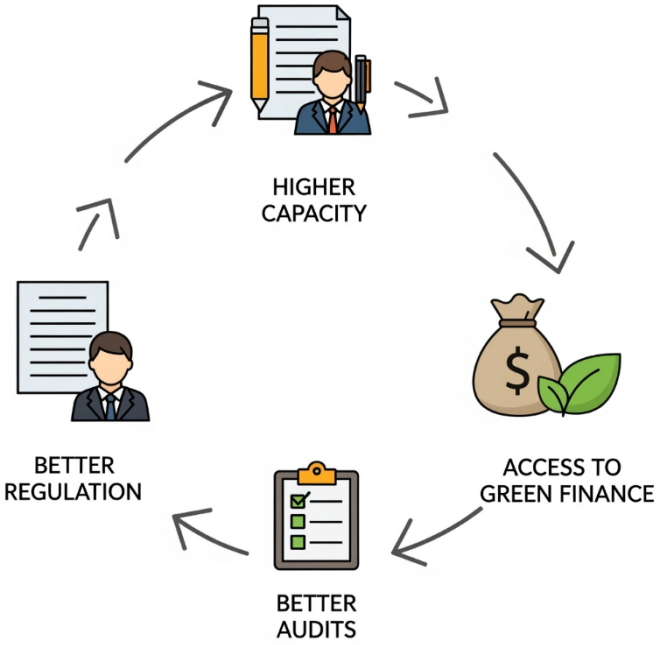
Enhancing Quality: Tools, People & Reports

- **Tools & Methodology:**
  - **Gap:** Relying only on nameplate data is often inaccurate.
  - **Solution:** Use modern tools (Power Analyzers, Ultrasonic Leak Detectors) to get *actual* data, which reveals issues like significant compressor unload time.
- **People & Engagement:**
  - **Gap:** Audits seen as a compliance task with low factory engagement.
  - **Solution:** Form a **joint audit team** (External Experts + Internal Staff) to ensure collaboration, data access, and ownership of results.
- **Report Quality:**
  - **Gap:** Reports can be too long or unclear for management to make decisions.
  - **Solution:** Provide a clear summary table linking problems to solutions with key financial metrics (investment, savings, payback).

Lesson learnt and reflections

Recommendations for Scaling Up in Vietnam

- **Recommendation 1: Strengthen Regulation**
  - **Action:** Update **Circular 25/2020/TT-BCT** to make **Energy Mapping** a standard requirement for official energy audits. This ensures a consistent, high-quality, system-level approach.
- **Recommendation 2: Build Capacity**
  - **Action:** Train auditors (EACs) and factory energy managers on advanced mapping techniques and the use of modern measurement tools.
- **Recommendation 3: Create Incentives**
  - **Action:** Start with pilot implementation by sector/industry, then expand nationwide through technical and financial support programs. Link high-quality, map-based energy audits to preferential **Green Finance** programs and other financial incentives. This motivates companies to invest in comprehensive audits that lead to bankable projects.
- **Acknowledgement:**
  - Gained the useful management, guidelines from Danish Energy Partnership Program (DEPP3), and got the special technical supports from the International Experts (from **Viegand Maagøe A/S).**



THANK YOU FOR LISTENING