Viegand Maagøe

Lessons Learned from Energy Audits

Workshop

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Agenda

1. Value added?
   - What additional elements have we been introducing
2. New projects ideas
   - What “new” project ideas have emerged
3. Lessons Learned
   - What have we learned from the process
4. Questions

Value added

New elements added to the long tradition of energy auditing in industry in Vietnam

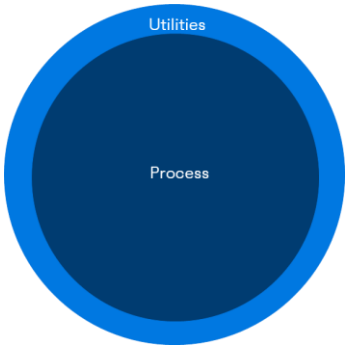
In Vietnam there is a long tradition of conducting energy audits in the industry. The new way of thinking and methods adds valuable new knowledge, creating a better baseline, understanding o the energy needs, and points out long lasting improvements.

Traditional

- Focus on utility
- Focus on energy supply
- Focus on electrical system
- There is a tendency that audit has special focus areas, which is linked to the specific auditors

New

- Mapping (establishing a baseline)
- Insight into the production
- “Upgrading” the thermal analysis
- Overview of utility systems
- Securing that we are covering all energy users
- Forecasting
- Continuous improvements

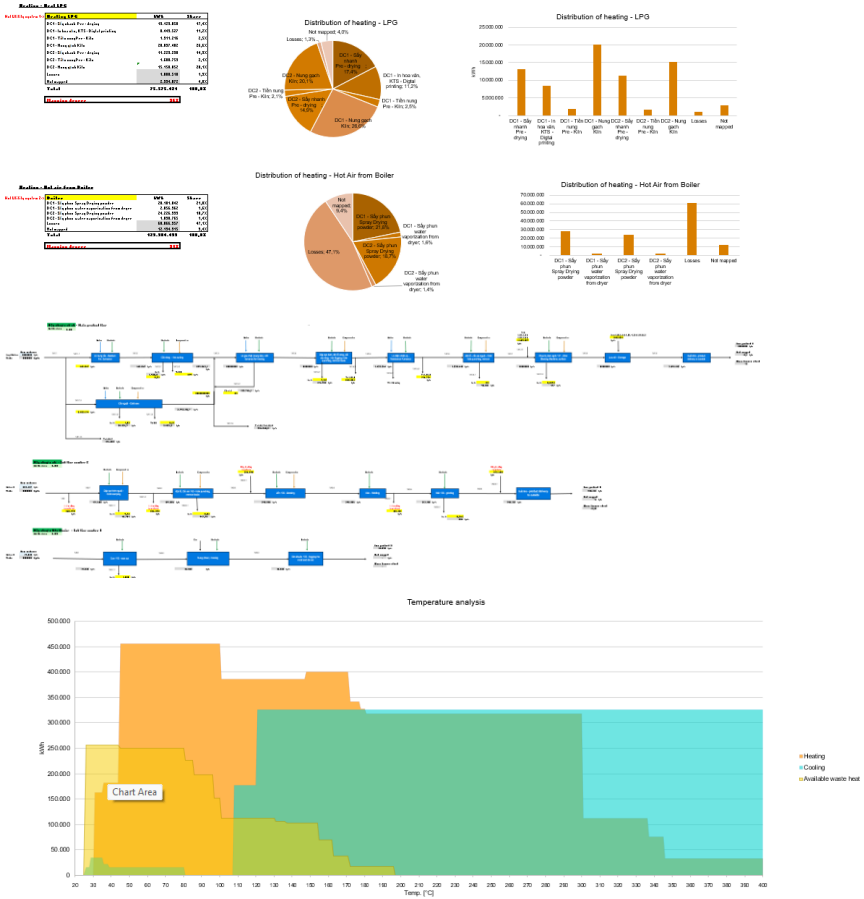




Value added

New elements – what and how

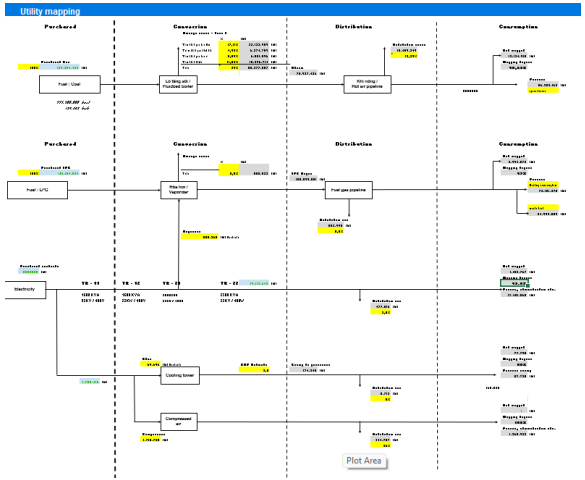
- Mapping
  - Solid baseline – everyone needs to agree
  - Clear proportions
  - Comparable between different systems
- Insight into the production
  - Overview of the energy service
  - Check if the process in understood
  - Basis for the process specific energy usages
- “Upgrading” the thermal analysis
  - Introducing different thermal analysis
  - Temperature and energy
  - Basis for other analysis like pinch and effect analysis can be introduced.



Value added

New elements – what and how

- Overview of utility systems
  - Connections between different systems
  - Identifying and quantifying losses
- Securing that all energy users are covered
  - Mapping degree
  - Link between energy supply and users
- Forecasting and history
  - The mapping can be for a simple forecasting depending in the model flexibility.
  - Used for process specific or unit specific changes
  - Benchmark can be integrated
- Continuous improvements
  - Integrated into energy management system



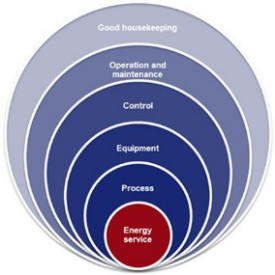
Yearly data

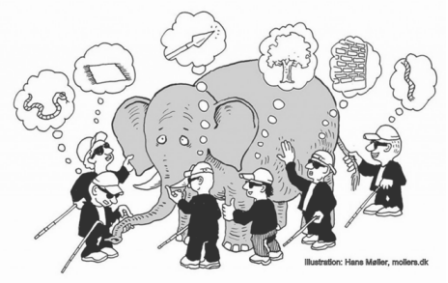
Energy Data	Year 2023	
Purchased Electricity	21.748.413	kWh/y
Purchased LPG	101.104.524	kWh/y
Purchased Coal	123.304.433	kWh/y
Purchased DO	2.666.317	kWh/y
Total Purchased Energy	[redacted]	**kWh/y**
Production data Line 1		
Raw material - Clay - đất sét, Fenspat , Phong Hóa,...	77.692,5	Ton/y
Total Raw materials	**77.692,5**	**Ton/y**
Additives production line 1	353,6	Ton/y
Total Additives	**353,6**	Ton/y
Production data Line 2		

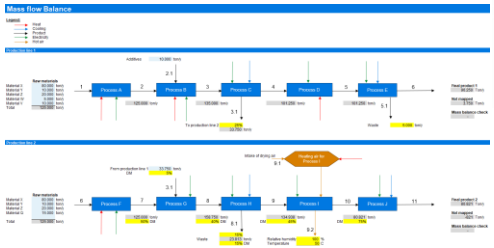
Value added

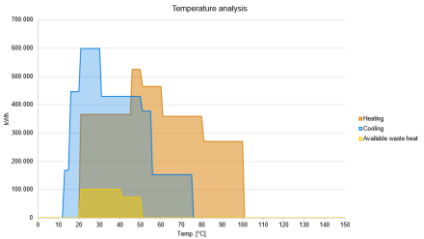
The gain of the new method and focus areas

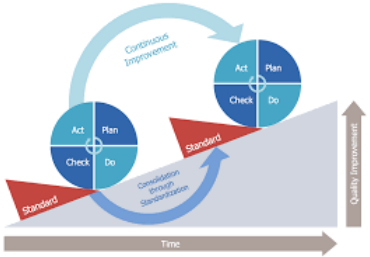
- Understanding the energy service
- Getting a common picture of the system
- Mapping the mass and energy balance
- Analyzing the results (e.g. mapping degree)
- Understanding how energy is managed











New project ideas

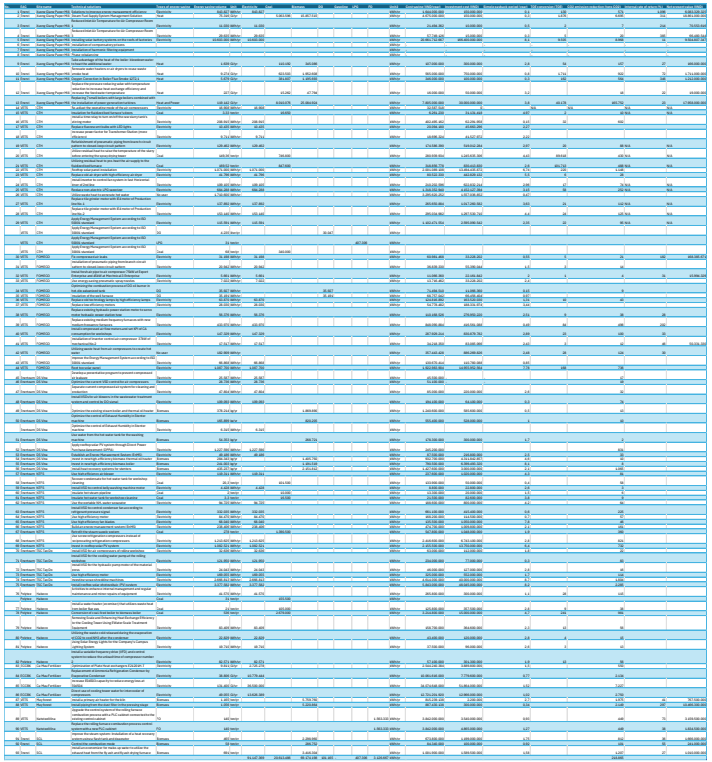
Examples

Outcome from the Demo Audits

- 20-50 projects has been identified from each audit
- 5-15 projects from each audit has been categorized as level B
- 2-8 projects from each audit has been categorized as level A

90 Level A projects

14 Level A projects



New project ideas

Examples

Specific project areas

- Long range of “standard” utility projects
- Maintenance (leakages, combustion, replacement)
- **Losses** (insulation, condensate)
- Fuel shift (biomass, electricity)
- **Heat recovery** (LPG evaporation, air and feed preheating)
- **System design** (delta-T hunting)
- **Process technology** (forming, drying, grinding)
- Control (KPI, combustion, speed, humidity, ML, standby)
- Preparation of raw material (scrap)
- **Equipment efficiency** (fan blades, motors, compression)
- Management (policy, organization, information, investment)

New project ideas

Examples - **losses** (insulation, condensate)

Proposed project

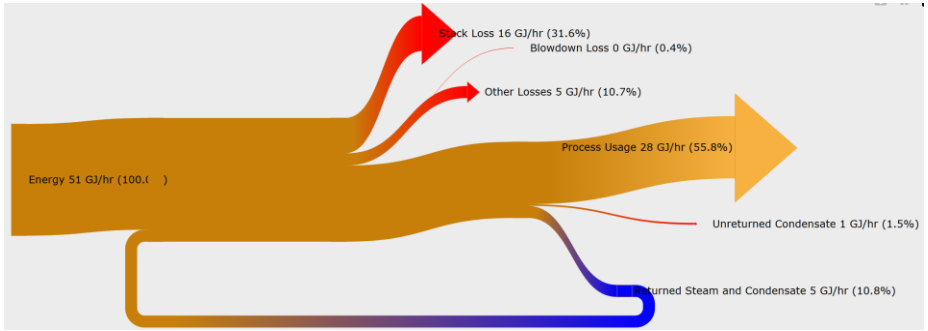
- Installing a new biomass fired boiler with a capacity of 25 tph with higher efficiency to replace a low-efficient existing boilers using coal and biomass as fuels

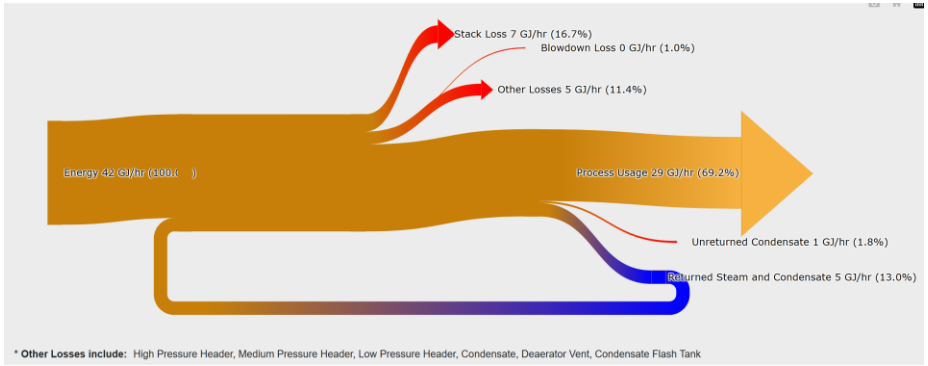
Savings:

- Thermal: 5.9%, 21 GWh/year
- Payback time: 2.4 years

Non-Energy benefits:

- Phase out of fossil fuels
- Reduction of thermal pollution





New project ideas

Examples - **process technology**

Proposed project

- Chancing process technology from hot to cold forging

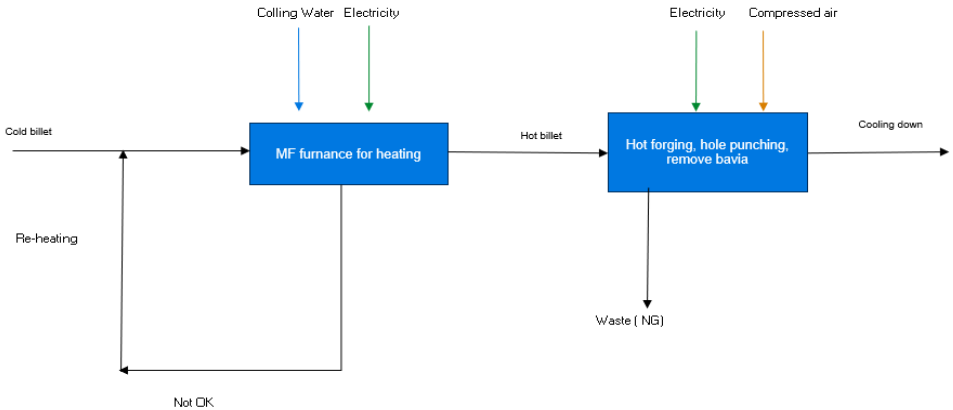
Savings:

- To be determined through a pre-feasibility study

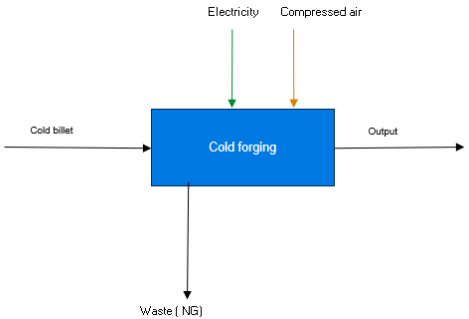
Non-Energy benefits:

- Lifespan
- Working environment
- Improved control

Before:



After:



New project ideas

Examples - **Heat recovery** (LPG evaporation, air and feed preheating)

Proposed project

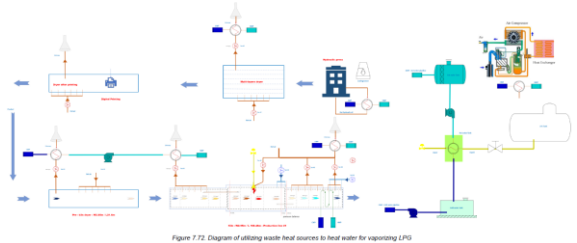
- Utilizing waste heat for vaporizing LPG

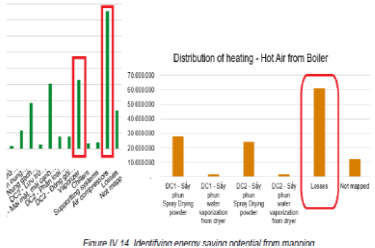
Savings:

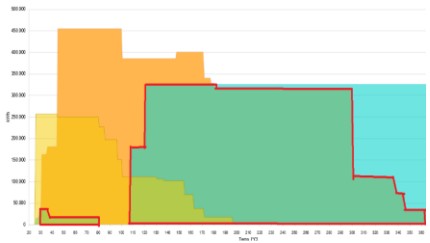
- Electrical: 3,3 %, 0,7 GWh/year
- Payback: 3.15 years

Non-Energy benefits:

- Reduced dependency on the grid
- Improved lifespan
- Enhancing safety











New project ideas

Examples – **equipment efficiency**

Proposed project

- Homogenizing the metal feed to the furnace by shredding

Savings:

- Electrical: 3-5%; 2.7 GWh/year
- Payback time: 7.8 years

Non-Energy benefits:

- Increased capacity (reduced maintenance costs)
- Improved lifespan
- Enhancing safety





New project ideas

Examples – **delta-T hunting**

Proposed project

- Increasing the heat transferring area reducing the compressor consumption by 0.3% and the ammonia chiller by 3%

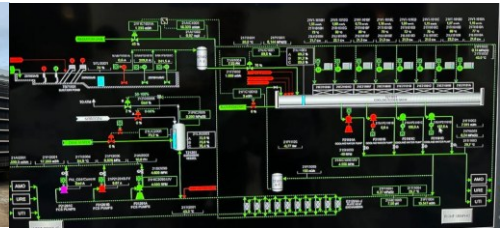
Savings:

- Electrical: 1.5 %; 2.7 GWh/year
- Payback time: 1.5 years

Non-Energy benefits:

- Increased production capacity and supporting future capacity expansions



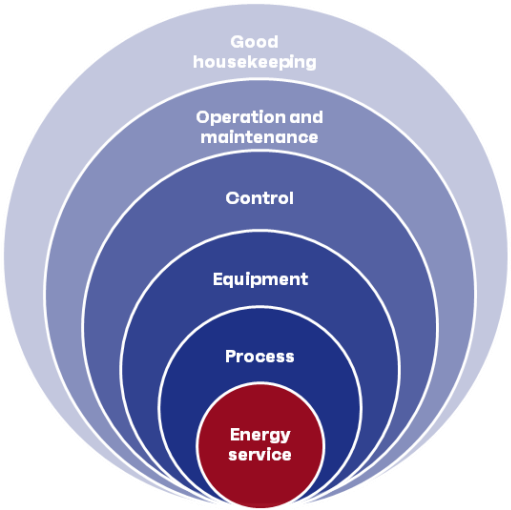


Flow configuration	Counter flow	
Medium	Hot: Water	Cold: Water
Flow (m3/h)	17,203	15,547
T In (oC)	43.3	29.7
T out (oC)	34.9	39
Delta T (K)	8.5	9.3
Heat flow rate Q (kW)	167,064	
Pinch point Delta T-pinch (K)	4.3	
Heat Transfer effective kA (kW/K)	35,360	
Efficiency	0.68	

Flow configuration	Counter flow	
Medium	Hot: Water	Cold: Water
Flow (m3/h)	17,203	15,547
T In (oC)	43.3	29.7
T out (oC)	33.8	40.17
Delta T (K)	9.5	10.47
Heat flow rate Q (kW)	188,023	
Pinch point Delta T-pinch (K)	3.133	
Heat Transfer effective kA (kW/K)	52,332	
Efficiency	0.77	

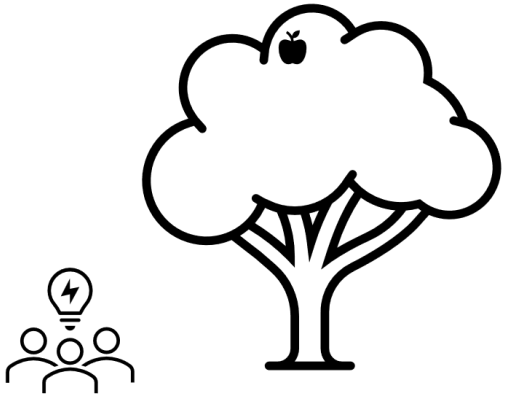
Lessons Learned

- The systems needs to be understood including both process and utility
- Data is many things – it is not just about measuring but also about knowledge and experienced engineering
- A baseline is essential.
  - First of all, the baseline must be made on available data
  - Secondly, the decision must be made to improve the baseline by generating more information
- Analysis are needed for developing financial efficient and sustainable projects
- A step-by-step approach is needed



Lessons Learned

- We can see that the project suggestions becomes mores diverse
- Projects are also being developed around the energy service
- The present way of using energy is being challenges
- Knowles is being generated, that can create the basis for an efficient uses of energy and a low carbon foodprint
- The energy mapping is (or can be) time consuming = costly. However the mapping will result in more useful and well-documented projects. It is the consultant's obligation to highlight the long-term benefits of mapping for the company.



THERE ARE NO QUICK FIXES

Recommendations for future improvements

- Working and getting confident with the mass and energy balance approach. Experiences has proven that this:
  - Improves the data quality (can also be used as quality insurance)
  - Reduces the audit time
  - Creating confidents in the backbone of the audit and the basis for the project identification
- Using AI for inspiration for improving specific areas. This can be a way of more into specific process elements. This can reduce the time and expand the horizon.
- Focus on being very specific in the reporting and recommendation. Often very generic information has a very limited value for the reader
- Do not be afraid of being creative and challenge the process



Continuous improvement by working experience

Questions



Viegand Maagøe

Thank you



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