Practical experiences and efficient mapping of process heat energy in industry

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Agenda

1. Presentation of Viegand Maagøe
2. Energy Mapping
   • Why
   • How (Mapping the “Viegand Maagøe way”)
   • Results
4. Next steps
5. Summary
1. Viegand Maagøe

Introduction

Viegand Maagøe is a part of:

- Task XV (excess heat utilization)
- Task XIX (electrification in industry)
- Task LVIII (high temperature heat pumps)
2. Energy Mapping

Why

1. All Investments must be made on a solid and clear basis
2. It is important to establish a overview and common picture
3. Understanding the system and the system requirements
4. An energy map can be the basis for:
   • Energy managing system
   • A wide range of analysis
5. An energy mapping can be the basis for taking on the onion diagram approach
2. Energy Mapping

Why - Understanding the onion diagram

1. Every usage of energy ("energy service") in a facility has a reason – and this reason has to be understood, challenged and finally changed – by the right people.

2. Minimization of the "energy service" changes the need for utility power – cooling, heating, compressed air etc.

3. The approach might also be called "inside-out" – much more cost-efficient solutions are identified when the correct "baseline" is identified.

4. To identify the right "baseline", energy mapping is an important tool.
2. Energy Mapping

Before starting

1. Define a clear purpose
   - How will it be used, for what and by who?
   - Will it form the basis for a strategy
   - Screening and project development

2. Decision on level of detail and on available information
   - Should both electrical and thermal energy be included?
   - Which analyses should be applied to the different components?
   - How component specific should the analysis be?
   - Which kind of information is available
2. Energy Mapping

During mapping

3. Energy map: Mass and energy balance
   - Consumption in each section and at each utility
   - The different energy supplier
   - Process flows
   - Temperature requirements from process
   - Heat and cooling heat-exchangers
   - Steam injections
   - Etc.

After mapping

4. Supporting analyses: Energy, temperature, load, KPI, Costs.. 

5. Mapping maintenance: Implementation in management system

The energy mapping must be kept updated
2. Energy Mapping

How

1. Create an overview and a mutual understanding of the site and operating conditions.
3. The EPFD will be the basis for the entire mapping.
4. The EPFD must be seen in context with the site plan
5. Collecting data
6. Setting up the energy and mass balances

There are many ways to get there
2. Energy Mapping

How – Data collection

1. Operators
2. Trends
3. Manual readings
4. Digital readings/metering
5. Experience
6. Comparison from similar equipment
7. Theoretical calculations
8. Information's from suppliers
9. Performing tests
10. Process diagrams
11. Site plans
12. Metering plans
13. Etc.
2. Energy Mapping

How
2. Energy Mapping

How
2. Energy Mapping

### Results

- **Overview**
- **Product specification**
- **Divided between utility**
- **Share of total**
- **Basis for input (confidence)**
- **Type**
- **Included in analysis**
- **Add time profile**

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### Technology Collaboration Programme

*By IETS*
2. Energy Mapping

Results

- Pie charts or other graphical illustrations
- System review
- Temperature analysis
- Pinch analysis
- Load analysis
- KPI
- Historical analysis
2. Energy Mapping

Results – examples of working with the energy mapping

1. Temperature (pinch)
   Analysis for locating heat recovery potential and evaluating supply structure.

2. Effect (time pinch)
   Analysis for integration e.g. of heat pumps or biogas engines.

3. Hot water systems “Energivand”
   Analysis of improvement of hot water systems.

4. Pasteurization overview
   Challenging production setup
2. Energy Mapping

Results – examples of working with the energy mapping

5. Energy mapping
   • Mapping of process and utility
   • Developing a screening list
   • Prioritizing projects ideas

6. Temperature and effect analysis for the integration of heat pump
   • Set-up of temperature and effect analysis
   • Final conceptual design

7. Sparring during implementation phase
   • QA with project team during detailed design and implementation phase

8. Documenting of savings
   • Documentation of the final energy savings
2. Energy Mapping

Results – examples of working with the energy mapping

10. Heat pump on spray dryer
   • Energy mapping
   • Temperature and effect analysis
   • QA during design and implementation
   • Documentation of the energy savings

11. Heat pump on spray dryer
   • Energy mapping
   • QA during design and implementation
   • Documentation of the energy savings

12. Waste heat utilization from biogas engine
   • Energy mapping
   • Temperature and effect analysis
2. Energy Mapping

Results – examples of working with the energy mapping

1. Full electrification in food ingrediency
   - Significant cost savings
   - 70 % energy saving
   - 100 % carbon reduction

2. Waste heat recovery by heat pump in brewery
   - Significant cost savings
   - 30 % energy saving
   - 40 % carbon reduction
2. Energy Mapping

Results – examples of working with the energy mapping

3. Central heat pump system in a dairy
   - Significant cost savings
   - 33 % energy saving
   - 50 % carbon reduction

4. Waste heat collection in a dairy
   - Significant cost savings
   - 15 % energy saving
   - 20 % carbon reduction
3. Bottlenecks

1. The overall bottleneck is that a energy mapping is a time consuming exercise
2. Investing in a project where there is no direct return
3. The mapping process can have a long duration
4. The quality of the output will depend on the quality of the input
5. There can also be geographical bottlenecks

How can we open up for the bottlenecks?
Viegand Maagøe, DTU and IPU, have got at grand from EUDP, to develop a energy mapping tool, by medio 2024

Why a new tool?

Motivation:
- To secure the right focus
- Getting value for money
- Open source

Working thesis:
- 80 % “correct”
- 20 % of the work
- Steady state

Experiences shows when taking up the right approach efficiency gains up to 70 % can be archived, which is only possible if you start up in the right way.
4. Next steps

EEMAP

The Tool:
- Based on exciting experience
- Not an expert tool
- Short mapping time and extend
- Build in quality indicators
- Build in analysis and reporting
- "low" level of details

- Three developing companies
  - SKAGEN DENMARK
  - OVODAN
  - SKJERN PAPER

- Three testing companies
  - PPG
  - ROYAL UNIBREW
  - AVISTA Green
4. Next steps

EEMAP

The mapping covers the entire production site. The energy mapping is divided into four categories: utility, process, space heating and Cleaning.

The main mapping principles are energy and mass balance.

The mapping is based on a drag and drop principals, where each mapping element is connected.

Each mapping element can be mapped on three different level of details, depending on the data available and the purpose of the energy mapping.

A vide range of simple check indicators will be build in the tool.

The acceptable mapping degree will depend on the purpose of the energy mapping.
4. Next steps

EEMAP – company profile

• In this section of the mapping informations about the company and responsible persons can be entered.

• Example of informations:
  • Company info
  • Main responsibility
  • Other persons who has a influence on the energy consumption
  • Registration of all referances used as a part of the energy mapping

• This will also be used as a part of the rapporten (e.g. energy management)
4. Next steps

EEMAP – Production details

- In this section overall information related to the energy consumption and process can be entered.
- Example of informations:
  - Purchages energy (natural gas, electricity, bio fuels, etc.)
  - Sub metering for space heating, hot water, CIP, etc.
  - Process information
    - Type and amount process inputs
    - Type and amount of process outputs (e.g. final product)
4. Next steps

EEMAP – Utility and process

- Utility mapping: The utility mapping is based on energy balances over the different utility systems and related distribution systems.

- Process mapping: The process mapping is based on energy and mass balance over the different components. The process mapping maps the specific energy service.
4. Next steps

EEMAP – space heating and others

- Space heating mapping: The space heating mapping is based on an energy balance for each building. The mapping can be laid out to illustrate the building layout.

- Cleaning mapping: The cleaning mapping is based on energy and mass balance. The mapping will cover CIP and other cleaning systems.
4. Next steps

EEMAP - results

- The results can be displayed in energy, CO2 and/or costs
- Supporting analysis
- Reporting
4. Summery

- Ambitions targets must have the right basis for decisions
- Energy mapping is the right way of supporting the onion diagram approach
- Energy mapping in itself doesn’t add value, but it is how you use it that adds value
- Experiences show savings up to 70% be achieved
- Getting the most out of the investments
- A tool like EEMAP will ease the way for many companies to take on the right approach, on the path to fulfilling their climate strategy.
Thank you - Questions
• Oplæg fra Konferencen

• The presentations should include the following (as much as possible):
  • A short summary, e.g. a quarter of a page shall be included in the proceedings (please add two summary slides to your presentation)
  • The role of and possible potential for decarbonization (main aspect)
  • Area Overview
  • Technology/system status
  • Work in the Task (Task XV) (if applicable)
  • Consequences for industrial oil and gas usage (if applicable)
  • Need for further work