Danish Energy Agency

LEAN and productivity

Experience and best practice from Danish businesses

LEAN and productivity focus on efficiency improvements – and overlap considerably with energy work

Danish businesses are constantly working to streamline all parts of their production, and concepts like LEAN, Six Sigma, 5S and TPM have gained ground in most sectors. Many businesses have started to use these methods in their energy work as well, with considerable overlap in methods and approaches. A business with high productivity and good logistics will typically also have better key energy indicators than a business with lower productivity.

Many methodological similarities

LEAN and productivity work with many methods similar to those in the energy area. For example

- Value Stream Mapping (VSM) - a thorough mapping of a production facility. Methods and process flow diagrams in this area very much resemble methods used for energy mapping.
- The efficiency of a production facility (Overall Equipment Efficiency, OEE) is a direct measure of the percentage of planned production time a facility takes to produce a product that can ultimately be sold. A low OEE represents many periods of standstill and many losses. And thereby also unnecessarily large energy consumption for idle time and reject production.
- The concept of MUDA covers waste, and waste can be many things: e.g. energy consumption for idle time, waste and waste heat losses or rejection of products and/or raw materials.
- The ongoing improvement process (KAIZEN) with regard to production and quality is cyclical and with constant evaluation, and it is parallel to the procedures within energy management (ISO 50001).
- Databased analysis of instability in production processes is a central element in Six Sigma methods. Moreover, structured measures (DMAIC, Define Measure Analyse Implement Control) are used to translate inconsistencies in production into improvement projects, which in many cases can improve energy efficiency as well.
- Key Performance Indicators (KPIs) are central elements in LEAN, as it must be possible to monitor improvements regularly.

LEAN and productivity can often facilitate discussion on issues outside of what management usually considers as energy-related work. Collaboration across areas can therefore provide new opportunities to improve energy efficiency.

Capitalise on the energy efficiency experience of other businesses

Through voluntary energy efficiency agreements with the Danish Energy Agency, Danish businesses have implemented numerous energy saving projects and have performed analyses of energy intensive processes and supply facilities, etc.

The Danish Energy Agency has compiled the most important experience from businesses into a number of feature articles targeted at businesses with energy efficiency (and therefore energy saving) potentials.

This feature article presents some of the results of energy saving efforts and provides guidance on work with LEAN and productivity.

Establish broad focus on efficiency
– and let sustainability and productivity go hand-in-hand

Did you know that…

- Danish businesses have completed more than 1,000 energy saving projects from 2010 to 2016 under the voluntary agreement scheme (energy and carbon taxes subsidies in return for energy efficiency improvements)?
- Energy efficiency improvements can improve the market position of a business?

Danish businesses have traditionally anchored their energy work in the technical part of the organisation, for example in a maintenance department or the department, etc. responsible for the supply facilities.

LEAN and productivity have a broad approach to efficiency and thereby focus on many different factors that influence a company's efficiency. This is regardless of whether these factors are technical areas, planning department, product development, quality and logistics or employees in production.

With regard to energy efficiency, LEAN can be viewed as a collaboration area involving new focus areas or, in some cases, as part of the organisation in which energy work is anchored directly.

Did you know that…

- Many Danish businesses can increase productivity significantly - and that this will have a direct impact on energy losses during idle time and standby operation?
- Principles from the circular economy, including reuse, use of alternative raw materials and development of less resource-intensive products are key issues in LEAN?

Energy efficiency is a competition parameter

When you optimise and improve your energy consumption, you immediately reduce your costs. Moreover, you become part of the green transition and help Denmark reduce its carbon footprint and strengthen its position as one the most energy efficient countries in the world.

When you make optimal use of your energy resources, you also improve your competitiveness and prepare the ground for new business opportunities, increased exports and growth. This is good for Danish exports and it is good for your bottom line.

CASE • **Novopan Træindustri A/S**

The company manufactures chipboards for the building industry and had problems with inefficiency and waste in production of a specific product. The solution was a process analysis that increased productivity by 50% and reduced waste by one-third. Energy consumption is unchanged, and with higher productivity, this corresponds to savings of 0.3 kg of oil and 0.7 kWh of electricity per board.

These improvements were implemented at almost no extra cost.

Did you know that…

- Companies like Novo Nordisk, Sun Chemical and Aarhus Karlshamn have used LEAN and productivity concepts widely in their green transition?

CASE • OEE indicators provide greater energy efficiency in the paper industry

Skjern Papirfabrik processes recycled paper into paper and cardboard products for industrial use. The process involves a paper machine monitored using OEE indicators. This results in higher productivity and lower energy consumption.

The paper machine includes a drying section, which is the company's largest consumer of thermal energy, and the discharge air is the basis for production of district heating. There is thus a huge potential in optimising operation of the paper machine.

An OEE indicator expresses a machine's utilisation rate and is composed of three elements: Time utilisation, capacity utilisation and quality. The paper machine consumes energy during idle time, and therefore poor utilisation of time or capacity will increase energy consumption per tonne of finished product.

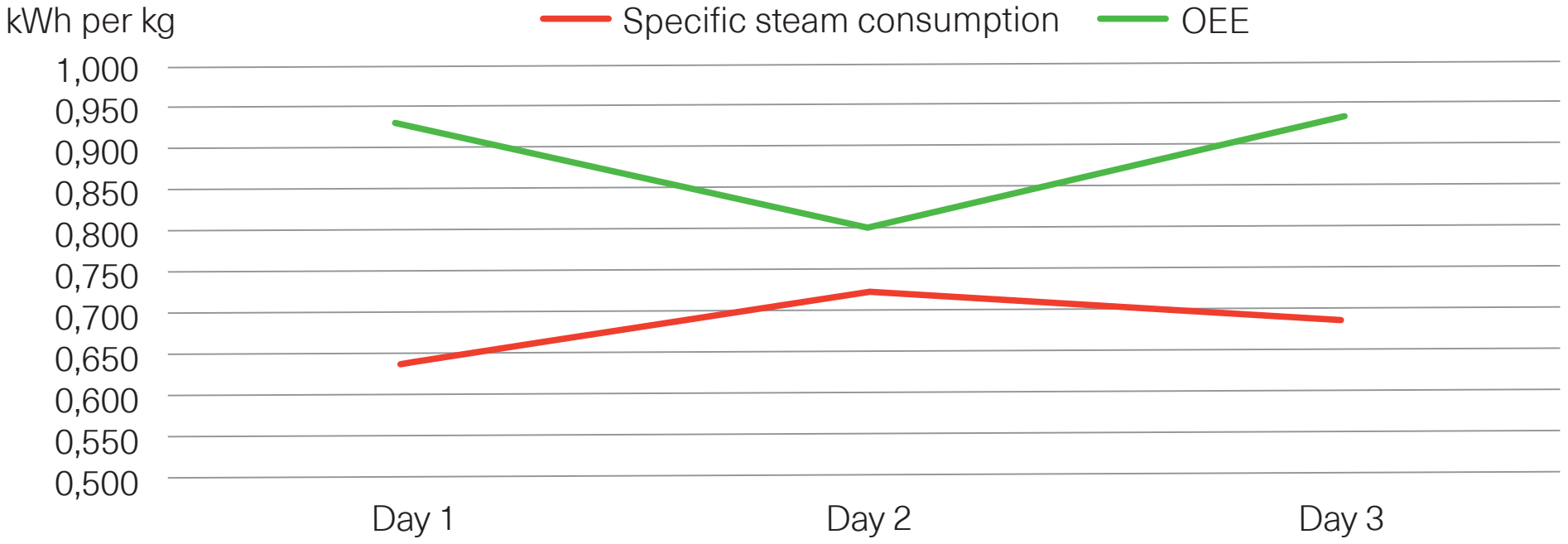
The investment

The initiative has not cost any direct investment, and exclusively involved changes in behaviour.

The result

Søren Skærbæk, energy and environmental manager at Skjern Papirfabrik, talked about working with OEE indicators:

"Traditional energy projects are good at reducing energy consumption, but day-to-day behaviour and impacts on energy consumption can be challenging. The advantage of an OEE indicator is that it speaks directly to the operators whilst also being an indirect key energy indicator."



The diagram above shows the registered OEE indicator for three days and the specific energy consumption in kWh per kg of finished product. As the figure shows, days with low OEE result in higher specific energy consumption.

CASE • Aage Vestergaard Larsen A/S uses systematic waste analyses to achieve better key energy indicators

Aage Vestergaard Larsen A/S is Scandinavia´s largest plastic recycling company. The company conducted an analysis to reduce waste during production, and this resulted in a detailed action plan and increased employee knowledge.

The analysis consisted of a systematic review of all process steps and an assessment of the type of waste that occurs. Waste that could be dealt with immediately was eliminated, and calculations, prioritisations and action plans were drawn up for the remaining, more complex waste.

Aage Vestergaard Larsen A/S produces around 12,500 tonnes of regenerated raw materials a year for the plastics industry. In the picture, the company's CEO Franz Cuculiza is examining the plastic waste collected before it is processed.

The investment

The analysis was conducted as an internal project without significant investments.

The result

A detailed action plan for reducing waste that will reduce electricity consumption by 3-4%.

Morten Seiling, management system operator at Aage Vestergaard Larsen, talked about how he was surprised about the huge amount of total waste. Morten Seiling also highlighted the individual employee's increased understanding of the consequences for the overall process of inappropriate routines in one or several process steps.

How to work with LEAN and productivity in the energy area

- experience and *best practice* from other businesses

Several possible approaches for energy work

If you are considering applying LEAN methods in your energy work, you may consider the following questions:

- Are your future energy efficiency efforts primarily about technical renovation projects, or could LEAN concepts be relevant?
- Relevant LEAN concepts may be excessive idle time, reject production or waste. Or perhaps a broader analysis of productivity and bottlenecks in production in order to achieve a higher production flow with lower specific energy consumption.
- To what extent is it relevant or desirable to increase employee involvement in energy work?

This could be by including energy as a focus area in self-governing teams, at regular whiteboard meetings in production or similar. Energy management often has little focus on involving production staff in the energy work, and experience shows that LEAN is strong in this area.

- Do the LEAN concepts mainly serve as inspiration for energy management work, or can energy management be fully anchored in and governed by the LEAN organisation?

Experience shows that one of the benefits of a LEAN organisation is that it is very efficient in terms of implementing improvement projects across the organisation. A risk could be that energy savings will take second place to other improvement projects.

Conduct a thorough analysis

The overall picture of the possibilities to increase energy efficiency improvements is complex. It is a good idea for your business to conduct a thorough and systematic analysis before concluding where your energy work should go.

Among other things, such an analysis will identify energy losses in the manufacturing process, regardless of whether the loss is due to machinery, process aspects or human factors. Seek inspiration from other businesses or involve an experienced consultant in the process.

CASE • **VitasheetGroup**

VitasheetGroup produces plastic products, primarily for industry and agriculture. The production process includes energy intensive pre-drying of the raw material ABS polymers. After having analysed the process, the company removed the pre-drying process and replaced it with an absorbent that binds the moisture chemically.

This saved VitasheetGroup 210 MWh of electricity annually.

How to get started
– and achieve the best results

Methods and concepts from LEAN should first be considered as a source of inspiration for new initiatives to promote energy efficiency improvements. In some cases, these methods may, however, have a huge impact on long-term efforts.

Remember...

...to apply for subsidies for productivity projects that also achieve energy savings.

You can apply for subsidies from an energy company, but you have to do so before launching your project - otherwise this possibility will no longer exist.

If energy work is carried out in close collaboration with the LEAN organisation, you should be aware that the organisation will quickly ask for "tools" to identify improvement projects.

Relevant tools for energy work may include:

- Use of energy balances, i.e. Sankey diagrams, for processes or individual machines to map the energy flow in processes and production units. This is an effective tool to identify losses and waste.

- Use of composite curves and Pinch analyses to identify cooling needs, waste heat and heating requirements, including heat recovery potentials.

- Use of the "onion diagram" for a systematic review of process energy needs to minimise consumption.

- Analysis of temperature differences and heat exchange configurations to identify capacity limits and possibilities to boost production.

- Use of analysis models for heat pump systems to assess whether it is relevant to fit these into the energy supply structure.

- Analysis of idle time and leakage outside working hours to identify waste.

- Use of operational key energy indicators, for example COP analyses, for ongoing monitoring of the efficiency of cooling systems, compressed-air systems etc. and in connection with follow-up on improvement projects.

Good energy mapping will often serve as a good basis for discussing the methods above.

Learn more

You will find six remaining feature articles in this series:

- **Evaporation, drying and distillation**
- **Ventilation and extraction systems**
- **Cooling, compressed air and vacuum systems**
- **Kilns and melting processes**
- **Energy management and employee involvement**
- **Waste heat recovery and waste heat utilisation**

Furthermore the Danish Energy Agency have elaborated checklists (in Danish) for efficiency improvement initiatives, specification requirements for equipment, and analyses of efficiency potentials in the Danish Industry.

For further information, please contact:
Center for Global Cooperation
Phone: +45 33 92 67 00
ens@ens.dk

Photos: Scanpix and KAM