Ecoinflow
SawEnMS

SawEnMS Handbook

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Preface

This handbook is a part of the European project *Ecoinflow*. The main objective of *Ecoinflow* is to reduce the annual energy use in the European sawmills industry through international engagement, collaboration and knowledge transfer. The project uses the international standard ISO 50001 as a basis for implementing tailor-made Energy Management Systems (EnMSs) in the industry sector. The purpose of this handbook is to support sawmills when working with energy management. To support the implementation of Sawmill Energy Management systems (SawEnMS), a number of tools has been developed together with the SawEnMS handbook. The tool pack consists of:

Document templates for the following implementation steps:
- Energy Action plan
- Energy Policy
- Energy Targets
- Energy Team

Calculation tools for:
- Life Cycle Cost calculation
- Energy Review

Separate guides for:
- Defining zones for metering
- Night Owl Walk

The SawEnMS tool pack is available for download from *Ecoinflow* website (www.ecoinflow.com). The templates can be also found in Appendices of this Handbook.

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Introduction for the Plant Manager

The SawEnMS handbook is intended for the appointed Energy Manager in implementation of a systematic and continuous energy work – an energy management system (EnMS).

A structured work with energy issues requires resources in terms of working time and money for investment, but it also requires mandate and authority to make changes as well as decisions. This applies whether you have a certified energy management system or not. It is therefore necessary that the Energy Manager and the Energy Team are given the necessary resources and mandates to manage a systematic energy work in a good way. The size of the work can, however, vary over time. It often requires an intense work in the beginning, when the Energy Team needs to build up knowledge and skills and there also is a need to make an energy audit and often also to invest in some measurement equipment.

If the energy management work is to become continuous, it is also important that it becomes part of the daily work at the sawmill. This can be achieved, inter alia, by bringing energy as a standing agenda item at top management meetings and that energy can be found in, for example, in monthly or quarterly reports.

This guide contains many tips and recommendations for the Energy Manager, whose appointment includes preparing decision basis for you; on Energy Team members, energy targets, etc. If you initially take the time to follow up on the progress with the Energy Manager, many questions about the need of resources, mandates, and so on will be sorted out naturally.

In order to implement an energy management system, your role as site manager primarily corresponds to:

1. appointing an Energy Manager, who either is part of the top management team or who regularly reports to the top management team, and to appoint an Energy Team,
2. allocating resources to the Energy Team, person hours as well as money, and give the Energy Manager mandate and authority needed to influence the organization and operations,
3. decide on energy targets and on how to regularly follow up targets in the top management team, as example monthly or quarterly, and
4. supporting the Energy Manager. Meetings with the energy manager should initially take place every two weeks, but with time perhaps a shorter check-up once a month will be enough.

Pitfalls to avoid:

- Lack of regularly follow-up of long and short term targets by the top management team will risk energy work getting a lower priority or be neglected when activities that actually are monitored by the top management team are given higher priority in daily work.
- Energy Manager becomes a lone wolf energy enthusiast, who single-handedly pushes the energy work through the organisation. To avoid this, ensure energy manager rather becomes a controller in the implementation of various changes and actions, than responsible for the implementation of them.

Table of Contents

Introduction

This handbook is a guide for sawmills on how to implement a practical and applicable Energy Management System (EnMS). By following the guide, you will develop a framework for reducing energy use and costs in a systematic way.

SawEnMS is an EnMS tailored for the sawmilling industry. Though many parts of an EnMS is relevant to companies in any sector, the SawEnMS is made to ease implementation at sawmills, with relevant examples, advice and tools that can be implemented directly. Care has been taken to make it into a simple, yet robust and powerful, tool for working with energy management.

SawEnMS is largely based on the international standard for energy management systems, ISO 50001, but it is not intended as a complete EnMS that can be certified. Nevertheless, if you follow all of the steps of the guide, you will have a very good starting point for an EnMS ready for certification.

WHY IMPLEMENT AN ENERGY MANAGEMENT SYSTEM?

Energy use is one of the most important cost factors in the sawmilling industry. While the price of energy is normally set by others, the energy use is to a certain extent possible to influence by the company itself. By introducing and using an EnMS, sawmills can directly influence their energy use. The systematic approach also very often leads to improvements of the production processes.

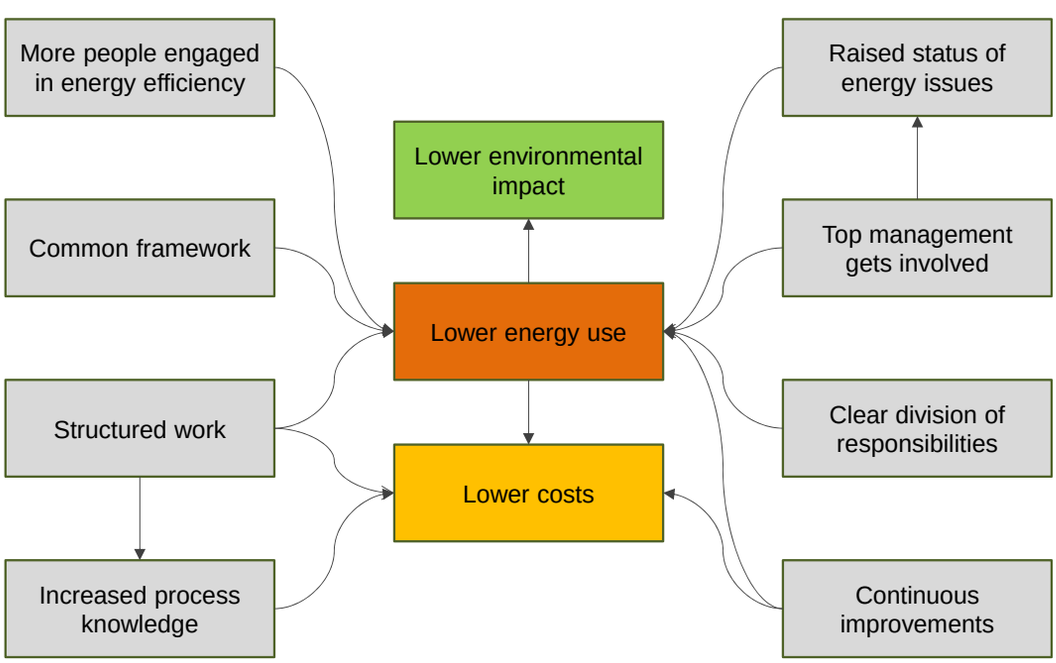


Figure 1. Direct and indirect gains possible to reach by introducing and using an EnMS.

An EnMS leads to both direct and indirect benefits. The most commonly mentioned benefits reported by the companies are:

- **Economic savings** thanks to:
  - lower energy use,
  - increased level of systematic work in general.
- **Reduced environmental impact**, which may be a demand from customers. For business-to-business products, the choice of supplier can be based on the environmental performance of the product.
- **Increased knowledge, awareness and control** of the company's energy use, which makes it easier to identify areas for improvement and to make well-founded decisions, e.g. when purchasing new equipment.
- Even if there have been previous efforts to reduce energy use in the company, an EnMS **speeds up the process and makes it better structured**.
- By doing an energy review, many companies **quickly find areas for improvement** that give great savings but require only small investments.
- By working in a structured way, engaging more people in the energy management work, from different parts of the sawmill, **knowledge and experiences are more easily shared**, which may lead to greater savings.
- Energy issues are included at an early stage in various planning processes.
- An EnMS puts energy issues on the table for the top management, which **raises the acceptance and status of energy efficiency work** throughout the organization.
- By working with energy issues continuously and in a structured way, energy **becomes a part of the daily agenda** and the awareness of its importance is raised.
- An EnMS makes sure documents and routines are followed up and updated.

Overview of SawEnMS

SawEnMS consists of seven steps including instructions, advice, examples and sawmill-specific tools. The sevens steps are:

- Appoint an **Energy team**.
- Decide on an **Energy policy**.
- Perform an **Energy review**.
- Decide on **Energy targets**.
- Develop an **Energy action plan**.
- Make sure your **Everyday activities** are energy efficient.
- Spread the word through **Internal communication**.

SawEnMS does not involve any certification and implies no obligations to do things in a particular way or in a particular order. However, the suggested approach is based on experience from actual EnMS implementations that have been successful.

For sawmills that want a jump-start for the EnMS work, a quick-start approach is presented on page 14. The quick-start approach is simplified in the sense that a minimum of administrative work is included.

In the text below there are references to templates and reports in Word, Excel or PDF-format. The templates can be found at the Ecoinflow webpage: www.ecoinflow.com or in Appendices of the Handbook. External resources are marked with an arrow: .

THE FULL VERSION

The full version of SawEnMS includes all of the seven steps mentioned above. The work is centered around the Energy team, and the six remaining steps are repeated continuously. The figure below illustrates this.

For sawmills that want to extend their EnMS to be certified in accordance with ISO 50001, advice is given in “Additional information” in the end of this handbook.

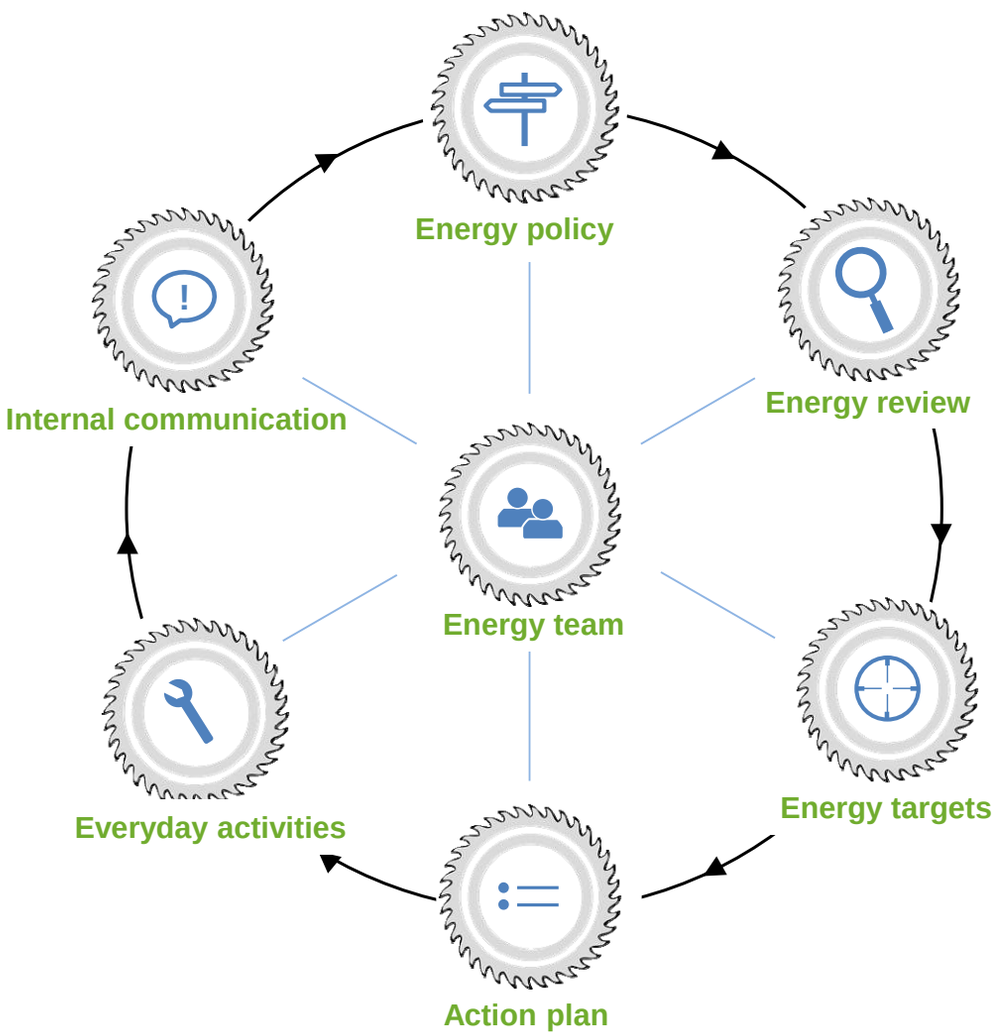


Figure 2. Visualisation of the full version of a SawEnMS implementation.

THE QUICK-START APPROACH

SawEnMS can be approached by first implementing a simpler version. This approach is intended for sawmills that have recognised that an EnMS will help save energy and money, but do not have the resources to start right away with all activities. Thus, only the most important actions are included to secure a continuous work with energy efficiency.

Compared to the full version, the tasks that have a more administrative or "indirect" character are excluded: Energy policy, Energy targets and Internal communication. This is not to say that these steps are less important; only that a quick way of starting with EnMS can be to do the more "direct" steps first. This "light" version of SawEnMS can be scaled up to the full version at any time, by adding the remaining actions one by one.

The actions included are the ones that give the largest and most immediate results. The work starts with appointing an *Energy team*, and then the three actions *Energy review*, *Action plan* and *Everyday activities* are repeated regularly.

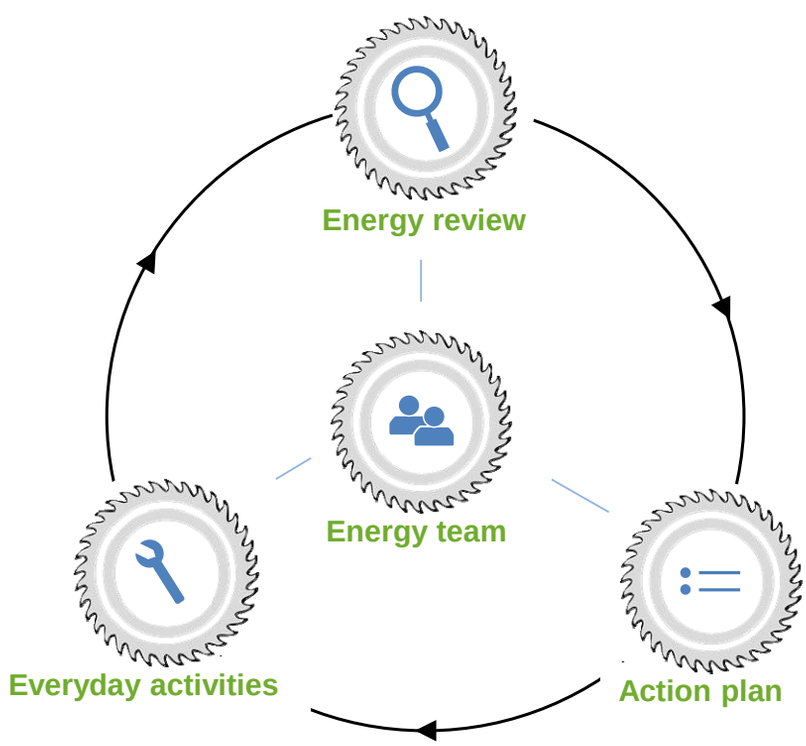


Figure 3. Visualisation of the quick-start approach of a SawEnMS implementation.

Energy team

What to do?	The top management appoints a management representative for the EnMS and forms an Energy team with the required competence, authority and resources.
Expected outcome	The sawmill has a team of skilled and engaged people that leads the work towards increased energy efficiency.
Template	The *Energy Team template* formalises the Energy team and state the responsibilities of the team.

IN SHORT

The **Energy team** is a group of people appointed by the top management to lead the work with the energy management system. The top management first appoints a management representative. This person will be responsible for the EnMS and for reporting to the top management. The management representative then forms the Energy team. The number of members of the team depends on the size and energy intensity of your company, but it is important that the team includes people with the necessary competence and engagement.

HOW-TO

The Energy team will be responsible to ensure progress to achieve better energy efficiency. This includes:

- Making sure the energy management system works as intended and that it is maintained and reviewed regularly.
- Setting up and maintaining the Energy policy, Energy review, Energy targets and Action plan.
- Regular reporting to the top management on the company's energy performance, if the energy targets are reached or not, and on how the energy management system performs.
- Communicating the progress of energy savings and making sure the Energy policy and the general work to achieve energy efficiency is well-known throughout the company (internal communication).
- Planning, defining responsibilities, and ensuring that the activities support the Energy policy.

Company functions useful to include in the Energy team are for example:

- Quality manager,
- Energy manager,
- Environmental manager,
- Production manager,
- Maintenance manager,
- Electrical engineer's manager,
- Manager(s) of large energy user (like boiler manager, kiln manager).

Suggested procedure:

1. The top management appoint a **management representative for the EnMS**.
2. The management representative appoints an **Energy team** of a few skilled and engaged persons in the company. The management representative may or may not be a formal member of the team.

    Use the *Energy team template* to formalise the Energy team members and state the team's responsibilities.
3. Hold a **first meeting** within the Energy team, start to plan the work and distribute tasks and responsibilities.
4. Hold **regular meetings** to report and discuss energy matters as described above.

PITFALLS TO AVOID

- ! The team must have the authority to perform actual energy efficiency measures; it must not only be an Energy team on paper. This can be achieved by letting a member of the top management lead the energy team or making sure (and make everyone know) that the Energy team leader has straight access to the sawmill site manager.
- ! The team must have resources (time and money) to hold meetings, perform energy measurements and act. A team without resources will not be able to achieve the targets.
- ! The team has to meet regularly. If no meeting schedule is set up, there is a risk is that the first meeting will be the last.
- ! The team must report regularly to the top management. If no reporting is scheduled and maintained, the risk is that the work progress is lost when leading people change position or employment.
- ! Responsibilities must be clear within the group, e.g.: who will lead the work of the energy efficiency project. “Shared responsibility is no responsibility.”
- ! Consider the hierarchical structure of your organization when forming the team. The team members must have the authority to point out important energy matters without being withheld by others “higher” in rank.

Energy policy

What to do?	Develop an Energy policy which is approved by the top management.
Expected outcome	The sawmill has a policy that clearly states your commitment to work with energy efficiency.
Template	Use the *Energy Policy template* to define and approve your policy.

IN SHORT

The Energy policy is a document, normally quite short, with a statement of your company's commitment to work systematically to increase your energy efficiency. It states the position of energy management within the organization and sets the direction of the energy efficiency work.

HOW-TO

The purpose of an Energy policy is to set out the overall, main principles of the company's energy use and energy management system – your vision and engagement concerning energy issues. It should state that your company:

- is committed to work systematically to increase the energy efficiency,
- is committed to follow legal requirements related to energy (this should be the minimum level of commitment),
- will make sure the Energy team has the necessary resources in terms of time, money and access to information,
- will set up and follow up Energy targets.

Examples of legal requirements are national legislation on energy efficiency or emission levels. Large sawmills may be affected by the obligation to perform Energy reviews (audits) according to the Energy Efficiency Directive.

Make sure the Energy policy is appropriate for *your* company. It must not be so general that it could apply to any company, but it should still be easily understandable for everyone in the company and for the public.

If your company already has an Environmental policy (perhaps as a part of ISO 14001), the Energy policy can be incorporated into this and form an *Environmental and Energy policy*. However, the energy issues must still be clear and precise.

Suggested first-time procedure:

1. Make a **draft Energy policy** within the Energy team.
2. Discuss the suggested policy with the top management, and let them **approve a preliminary version**.
3. If you did the draft version before doing the Energy review and started setting Energy targets, you may want to **revise the Energy policy**, since you have probably gained more knowledge after these steps and have a better idea about what you can and wish to achieve.
   Discuss your suggestions with the top management and let them approve the final version.
4. **Present the Energy policy** to all employees (see also *Internal communication*).
5. Consider **communicating the policy externally**, for example on your website.

Suggested revision procedure:

1. Each year, bring the policy up for discussion at an Energy team meeting. Discuss whether something should be changed.
2. Follow the same procedure as above to present the suggested updated version to the top management, have it approved and present it to all employees.

PITFALLS TO AVOID

! The Energy policy must not be so general that it does not direct the company towards the energy targets. The company must be committed to do something to be trustworthy.

! The Energy policy must not be so strict that it feels impossible to live up to.

EXAMPLES

We aim to make effective use of energy in our production of wood products and intend to maintain our high level of use of renewable energy sources. Our efforts to achieve energy efficiency should lead to continuous improvement in the reduction of environmental impact, with established legal requirements constituting the minimum of acceptable standard. It is in the company's interests that as much as possible of the work done to achieve energy efficiency is carried out as a part of everyday operations. This means that work done in conjunction with energy management is to be integrated with the environmental management system through:

- *our choice of suppliers,*
- *identification of directives and laws,*
- *formalisation of our goals,*
- *our choice of auditing.*

Martinsons (Sweden), Energy policy (source: www.martinsongroup.com)

A part of our environmental strategy is the engagement for a responsible energy management and the development and implementation of measures and strategies to increase energy efficiency in our company.

Our Energy policy aims to:

- *reduce energy costs,*
- *optimize productivity and energy efficiency,*
- *protect the environment,*
- *increase the availability of fossil resources for useful purposes.*

I. van Roje & Sohn Sägewerk und Holzhandlung GmbH & Co. KG (Germany), Environmental and energy policy (source: www.van-roje.de)

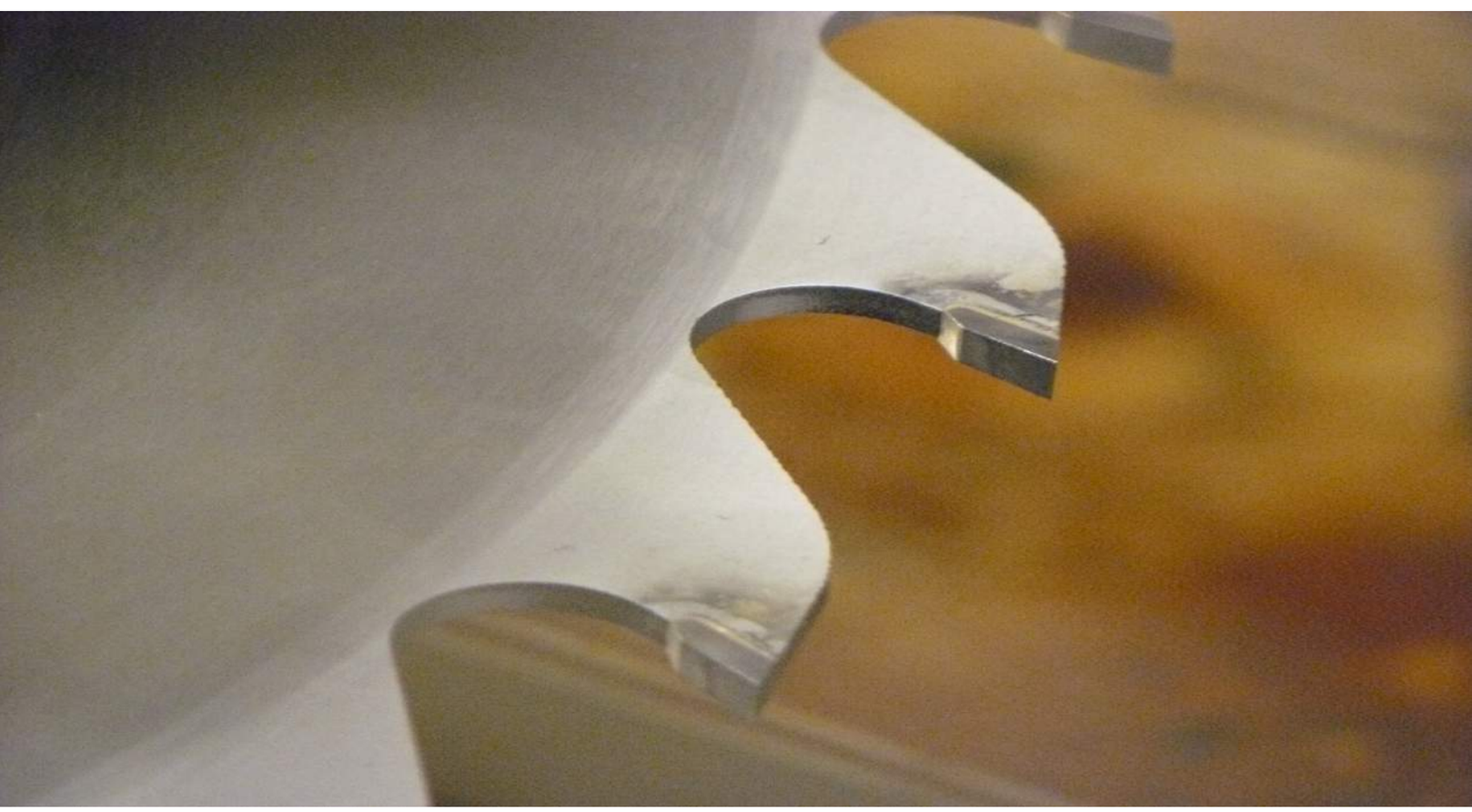
Norra's environmental and energy policy is the norm for the whole association. It is a living document that is the basis for all environmental improvements.

We shall work for the sustainable use of resources taking into consideration the environment and energy consumption, and the finances of the business. Priority shall be given to proactive measures and training.

We will consider legislation and regulations as minimal requirements and based on this make continual improvements. All work with improvements for the environment and energy consumption are the personal responsibility of the members, employees and contractors.

We have a policy of transparency in questions of the environment and energy towards our customers, employees, members, suppliers and other stakeholders.

Norra Timber (Sweden), Environmental and energy policy (source: www.norra.se)



Energy review

What to do?	Map your current energy use and identify potential opportunities for energy savings.
Expected outcome	Knowledge about your current energy use and potential saving measures.
Tool	Use the *Energy review tool* to organize data and draw flow charts.
More info	Read the *Night Owl Walk – a quick guide for finding low-hanging energy fruits.*
	Guide for defining zones and finding locations for energy meters.
	ISO 50002, the international standard for Energy audits.
	sawbenchmark.com – compare your energy use with other sawmills'.

IN SHORT

The purpose of the **Energy review** (sometimes called *energy mapping* or *energy audit*) is to quantify your sawmill's current energy use and identify opportunities for energy savings. By doing this, you get an overview of the situation and find out which aspects are most important for your energy use. The energy review can be based on data from different sources, e.g. invoices from energy suppliers or measured data. You may also find that additional energy measurements are needed. The energy review can also include, for example, 'night owl walks' to find unnecessary energy users during off-production hours.

HOW-TO

In this task, you will increase your knowledge and awareness of your energy use. You can choose to do the Energy review in a more or less detailed way – more detailed information will require more work and time, but will also give you a better understanding of your current situation. It will also increase the possibility of finding opportunities for improvement. However, it is often a good idea to start at a reasonable level of detail and then improve it gradually as you revise the Energy review. You can then strive to "improve the resolution" until you reach your desired level of detail.

The Energy review can either be performed by some members of the Energy team, or by hiring a consultant with experience from Energy reviews in industries. The instructions below are intended for sawmill staff doing their own review.

Suggested first-time procedure:

1. **Define the plant you are studying**. Before you begin to collect information on your energy use, it's important to define what is included, i.e. what system boundaries you will use and what sub-parts your company or plant consists of. Will you include the entire plant/company? Will you make separate Energy reviews for different units? Also, note the annual production of the plant for the year you will study, since you will need that to calculate your specific energy use.

    This step corresponds to the *General info* section of the Excel tool.

2. **Collect data on your *total* energy use and corresponding costs**. If you haven't collected these kinds of data previously, good places to start are invoices and consumption data from your energy suppliers. Collect data for all forms of energy carriers you may use:

   - electricity,
   - boiler fuels; purchased fuels as well as own by-products (wood chips and bark),
   - district heating
   - transport fuel, e.g. diesel,
   - natural gas,
   - oil.

   If the sawmill also produce fuel or energy for sale, make sure it is included in a way that distinguish the sold fuel or energy from what you use for your

own plant.

This step corresponds to the *Overview* section of the Excel tool.

3. If possible, **compare the data you collected to previous years' results**. Even when doing your first review, it may be worth the effort to collect data for a few years back.

   This step corresponds to the *Recent years* section of the Excel tool.

4. **Make a flow chart** or similar graphical representation of the plant. This gives you an overview of the production line and will help you decide what energy data you shall try to collect in the next step, as well as ease the organization of the data. The flow charts can contain both material and energy flows (see examples below).

   This and the next step corresponds to the *Sub processes* section of the Excel tool, which automatically draws a simple flow chart based on the sub processes you choose.

5. **Break down the energy use from step 2 into sub processes and/or specific equipment.** In other words, try to figure out where the energy goes. See below for more advice on this step.

   By organizing the data with the Excel tool, the result will be shown graphically (in proportion to the sizes of the energy flows) in the flow chart.

6. **As you progress, you will probably discover opportunities for improvement and ideas for energy efficiency measures.** Write these down (you will enter them in an *Action plan* later.)

7. **Compare the results with other sawmills**, in your own company or other companies.

   ! *Visit sawbenchmark.com to benchmark your energy use with other sawmills'.*

8. **Discuss the review** within the Energy management team and **report** it to the Top management.

Suggested revision procedure:

1. Using the results and what you learnt from the last year's Energy review, repeat the steps above and **update the review with new data**.
2. **Consider increasing the level of detail**. Now that you have more experience, can you add measurements to be able to add more subdivisions?

ADVICE FOR MEASUREMENTS AND ESTIMATIONS

- Use a top down approach: Measure electric power with a power meter in the outgoing groups from the switch gear or transformer. This gives an overview of the normal consumption for different segments of the sawmill. In the next step, groups with high electric consumption are looked at more closely; either by metering or by counting equipment / motors, reading rated power and estimating the used energy (see below).

- Frequency converters/variable speed drives almost always have a built in power meter, display and data bus. Read displayed power (kW) and multiply with yearly hours of operation (h/y) to get an estimated yearly energy usage (kWh/y). Connect the frequency converters to a data link to get an AMR system (automatic meter reading) almost for free.
- If you don't have the resource to measure each motor, it is possible to estimate the consumption by assuming that the motor uses on average 65 % of its rated power, except kiln fan motors, where 90 % is a better estimate. For other support systems, such as lighting system, compressed air systems, and so on, there are numerous guides available on internet.
- Wood drying kilns often use about 25-50 % of total electricity and up to 80-90 % of the heat. This makes them important in the energy mapping as well as for finding energy conservation measures. Lack of renovation, over drying and lack of variable or intermittent fan control are neither good for quality, production capacity nor energy.
- It might also be possible to measure the whole zone's energy use and turn off some function and see the new use. That way, it is possible to get an estimate of the normal energy consumption of the "turned off" function.
- Saw dust extraction (via pneumatic air suction systems) is sometimes very inefficient and might need extra attention. It often explains cold draught and high comfort heat demand from planning mills in cold climates.
- Your energy supplier might have good information about your monthly, daily and/or hourly energy use from their meters.
- A good way to find unnecessary energy use is to visit the sawmill at night – sometimes called "night owl walks". At night, you can identify what equipment has been left on after production hours and that can easily be turned off. Additionally, when the production areas are still and quiet it is easier to find pneumatic air leakages and other machinery that is running but should be turned off.

  See the separate document *Night Owl Walk – a quick guide* for advice and instructions.
- For a deeper audit, the ISO 50002 standard on Energy audits can be followed.

PITFALLS TO AVOID

- ! Don't start with too high ambitions. Make the first energy review "good enough". This will increase the chances of getting a review that is easy to follow up from year to year. You will revise the review at least each year, and then you can improve it gradually, for example by introducing metering of large energy users.
- ! Don't forget to consider the energy you sell.

EXAMPLES

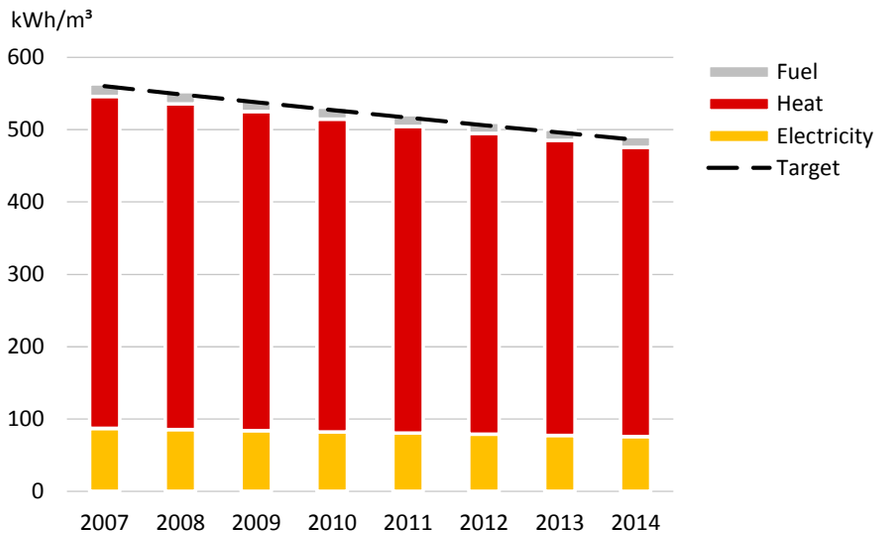


Figure 4. Example of a graph (with fictive data) showing the overall energy use for a number of years (produced with the Energy review tool).

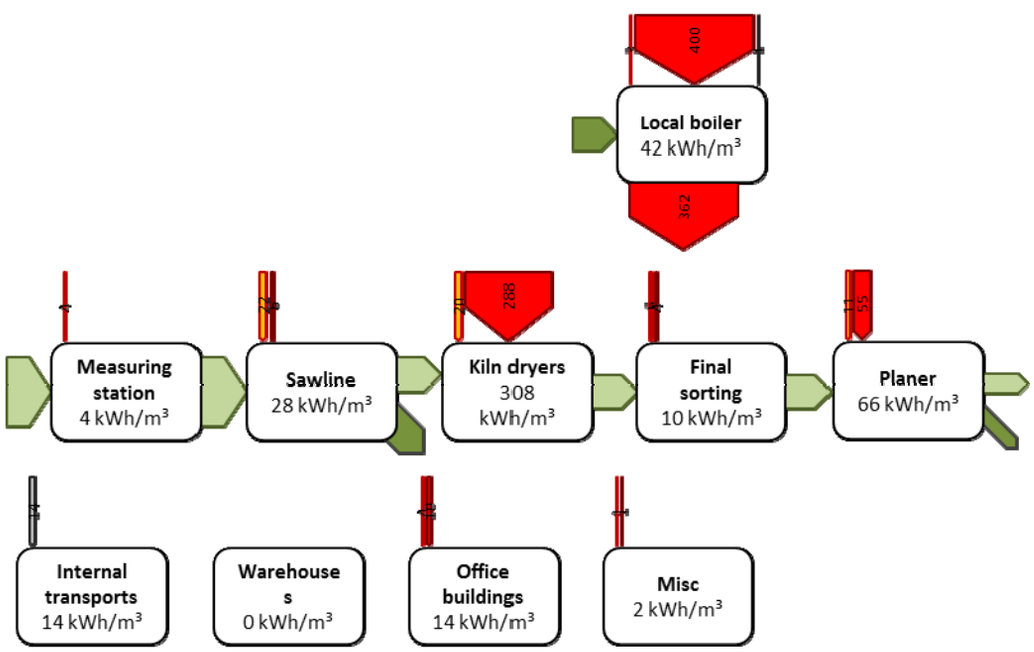


Figure 5. Simple flow chart (with fictive data) produced with the Energy review tool (question marks indicate unknown values).

This example shows how self-produced heat from wood chips can be treated as heat into/out from the local boiler and distributed to other users (mainly the kiln driers). The yellow arrows are energy from electricity, red are heat and grey are diesel**.**

Energy targets

What to do	Set targets for the sawmill's energy efficiency work that are quantified, measurable and achievable.
Expected outcome	Clearly expressed goals to channel the company's efforts and measure your achievements against.
Template	Use the *Energy Targets template* to define and approve your targets.

IN SHORT

Energy targets set the goal for the company's energy efficiency work. Energy targets are quantified key performance indicators (KPIs). They are proposed by the Energy team and decided by the top management. These may be both general, long-term targets and detailed, short-term targets. Specific (relative) targets are often appropriate, e.g. a quantified reduction measured in kWh/m^3 of finished product. Energy targets can also be expressed as important activities to be realized that have an important impact on the energy use, e.g. to replace certain equipment within a given timeframe.

HOW-TO

By setting up energy targets, your company expresses what you want to achieve in terms of energy. The targets shall motivate and challenge you in your work to increase your energy efficiency, and they shall correspond to your Energy policy.

When you have performed the Energy review and know the baseline, and possibly benchmarked against similar companies, you have probably found opportunities to make improvements and should have an idea about what you want to achieve, both in the long run and in shorter time frames. In this step the Energy team will formulate these in a document that is approved by the top management.
It is important that the targets:

- are quantified, measurable and achievable,
- have a defined timeframe, and
- correspond to your commitments expressed in the Energy policy.

Depending on the size of your company, you may want to have overall energy targets and targets that are specific to certain departments or parts of your company. You may, for example, have a general goal to reduce your specific energy use by 2 % per year, and a goal to reduce the use of diesel by 5 % per year and reduce the energy use at kiln dryers by 3 % per year. An energy target can also relate to specific measures, such as the replacing or rebuilding some of your kilns within the next three years.

Suggested first-time procedure:

1. Study the results from the Energy review. Based on the data from the last year, or preferably a few years back, **decide what will be your baseline** (usually the result from the last year's measurements) and discuss what you think would be a reasonable level to aim at.
2. Set up **draft energy targets.** Separate them into short-term (for example the next five years) and long-term targets. Remember to express energy use targets as energy per production unit – kWh/m³ – since production may vary from year to year. Do not forget other types of targets, for example to replace equipment.

   Use the *Energy targets template* to express the targets in a correct way.
3. Take your suggested targets to the top management and discuss with them
4. The top management approves the **final version**; make sure the top management team also decide how they will follow up and how often they will follow up.

Suggested revision procedure:

1. Use the results from your updated Energy review to **follow up your targets**. If you did not reach a target this year, analyse why and bring the results to your Action plan.
2. If the end date of the targets have been reached (for example after five years have passes), **set up new targets** with the same procedure as above.

PITFALLS TO AVOID

- ! Set high targets, but not so high that they are not realistic, technical or economical achievable.
- ! Do no set targets that are too easy to achieve – then there is no point in having them.
- ! Avoid targets that are not quantified or have a clear timeframe, e.g. “lower our energy use” – it should be, for example, “lower our overall specific energy use by 8 % each year” from year 2015 until year 2020.
- ! Include how the target is measured, either in the target description or in a footnote. Avoid targets that are not measureable – you need to be able to know if they are reached.

EXAMPLES

”

We shall:

- *Reduce our electricity use by 5 % per year (calculated as kWh/m^3 produced sawn wood during the years 2015-2020, with the base year 2014).*
- *Reduce total transportation fuel consumption for internal transports (forklifts, tractors etc.) from 18.6 kWh/m^3 sawn wood (year 2015) to 15.0 kWh/m^3 sawn wood by year 2018. The target include contracted (timber yard) entrepreneurs’ fuel consumption.*
- *Reach a renewable energy sources (RES) share of 85 % by 2025, including all used fuels, purchased as well as by-products (bark, sawdust and chips).*
- *Replaced the boiler with a more efficient one.*

(Generic example)

”

- *Reduce the total annual energy use of the SKF Group by 5 % below the 2006 level by 2016.*
- *Reduce the energy use per production output (value added) by 5% year-over-year during the period (2012-2016).*
- *We continue to build all new manufacturing sites and logistics centres according to the LEED standard for buildings.*
- *We will continue to work on energy management within our existing sites.*
- *Explore the possibilities to increase the use of renewable energy for the SKF Group together with WWF.*

SKF (Sweden), Energy targets (source: www.skf.com)

Action plan

What to do	List all your ideas for improving your energy efficiency and make a plan for implementing them.
Expected outcome	An inventory of ideas and actions and a plan for how to make them happen.
Tool	Use the *Energy action plan* tool to keep track of ideas and planned actions. Use the *LCC tool* for calculating the Life Cycle Costs of different alternatives.
More info	See *Ideas for energy efficiency measures* below for inspiration and ideas from other sawmills.

IN SHORT

The **Action plan** describes what actions you will take to reduce your energy use; it's an inventory of your ideas for energy efficiency measures, and a plan for what, when and how you will act to reduce your energy use. "Actions" may be improvements of certain equipment, behavioural changes, installation of meters/ automatic meter reading system, improved/detailed energy mapping, etc.

Each action should be quantified and measurable; it should have an assigned responsible person and a time frame. In order to be able to prioritize actions and analyse if they are profitable, you should also calculate or estimate the energy savings and investments of each action.

HOW-TO

In its simplest form, the action plan is a list of ideas and potential measures that will take your work with energy efficiency forward.

For each action or idea, you should try to calculate or estimate the energy and cost savings it would lead to, and the investments necessary. By doing that, you can estimate how profitable the action is, for example by calculating pay-back time or the Life Cycle Cost (LCC). Some ideas will probably prove to be unprofitable or impossible from a technical point of view, or other reasons. Nevertheless, it is a good idea to document the ideas. They may become profitable in connection with rebuilding, renovation or change of production equipment further ahead.

Suggested first-time procedure:

1. **List all ideas for energy savings** you have come up with so far. For each idea or action, the action plan should specify:
    - The equipment or other change concerned.
    - A short description of the measure.
    - A person responsible for the action.
    - The time frame or deadline.
    - Calculated/estimated energy savings.
    - Calculated/estimated investment.
    - Pay-back time (as a quick way to determine if the measure is profitable; you may also use more sophisticated methods).
    - Status (planned, on-going, discarded, etc.).

     The *Energy action plan* Excel tool is prepared for entering all required data, and will calculate your total potential savings.
2. When you have an inventory of ideas, discuss them within the Energy team and **make a plan** for realising them. **Prioritize** which actions you should start with and plan in what order you make the actions. Consider the difficulties and time frame when prioritising the actions.
3. If the proposed measures require investments and decisions at management level, bring your ideas to a meeting with them and use your calculations and engagement to convince them to act.

Suggested revision procedure:

The Action plan should be a living document which you update and work with regularly. It should be discussed at every Energy team meeting. What actions are on-going? What actions should you prioritise next? Are there actions that you dismissed before, but may have become interesting now?

PITFALLS TO AVOID

- ! Make sure there is a responsible person for each action.
- ! An action without a deadline will often not be done. Deadlines are important, both to set up and to follow.
- ! Make sure the action plan is followed up regularly – this is one of the main tasks at your Energy team meetings.

Everyday activities

What to do	Make sure the things you do every day are energy efficient.
Expected outcome	Everyday energy savings without thinking.
Tool	Use the *LCC tool* for calculating Life Cycle Costs of different alternatives when buying new equipment.
More info	Read the *Night Owl Walk – a quick guide for finding low-hanging energy fruits.*

IN SHORT

In order to make sure energy efficiency is included in the everyday work at your company, your routines, from simple habits to formal routines should take energy efficiency into account. This applies to everything from turning off lights to operate the plant as energy efficient as possible, or be involved and set energy requirement in improvement and retrofit projects.

A very important part of this step is to include energy efficiency demands in your procurement policies, i.e. making sure that whenever you buy new equipment, you take energy efficiency into account.

HOW-TO

Go through your company's way of working and carrying out things, its formal and informal routines, and determine which ones may have an impact on energy use. Think of how you can add, subtract or adjust routines in ways that will save energy, both short term and long term. Common routines that are affected are:

- everyday habits and/or routines for starting and closing the plant,
- routines for operating the plant and its equipment,
- maintenance routines,
- routines for procurement of equipment, services and materials, and
- routines for carrying out retrofit/improvement projects, for design of processes and products.

Suggested procedure:

1. Within the Energy team, discuss your **daily habits and everyday routines**. Do you make sure lights and equipment are turned off when the last person leaves the sawmill? What about offices and other buildings/areas? Discuss if you could improve this by changing your habits and/or routines, or if there are technical solutions (such as presence-controlled lighting).

   ! *If you did a Night Owl Walk, results from that will probably provide excellent input to this discussion. What equipment is not turned off when the last production shift is over? How could you add this to the written routines or habits? If you do not have one already, a routine for closing and shutting down on weekdays and before weekends is a simple but effective measure.*

2. Go through your current routines for **operating** the plant and its equipment. Could these be improved in any way to support an energy efficient operation? For example, think about when and how often various equipment is turned off or running stand-by.

3. Move on to your routines for **maintenance**. Maintenance routines are probably an integral part of your work with your production process and to minimise down-time. Has energy efficiency been taken into account in these routines, for example by considering how often scheduled maintenance is carried through? Maybe it is feasible to do maintenance at shorter intervals if that makes a certain machine run more efficiently?

   ! *This is especially relevant in the case of sawblade exchanges. What is the result if you analyse your exchanging intervals with energy use in mind? There are examples of sawmills that have found it profitable to change blades more often than they used to, and thus run their saw more energy efficiently.*

4. Next, study your **procurement routines** or policies. Do your routines value energy efficiency as an important quality when you choose equipment or supplier of materials or services?

   A procurement routine that takes energy efficiency into account may for example state that choices between technically equal options should be based on Life Cycle Costs, i.e. on which alternative is cheapest in the long

run, not on which has the lowest initial investment cost or the shortest pay-back time. Such calculations should include energy and maintenance costs during the entire lifetime of the equipment. This goes for any equipment, but the more energy it uses, the more important it is to consider this carefully. In sawmills, one of the most influential decision is the investment in new kiln dryers.

 The *LCC tool* helps you perform simple Life Cycle Cost calculations.

! *An alternative, which many companies find easier and less time-consuming, is to have a policy to buy equipment with a minimum energy label. There are energy labels for several product segments, for example light sources and electric motors.*

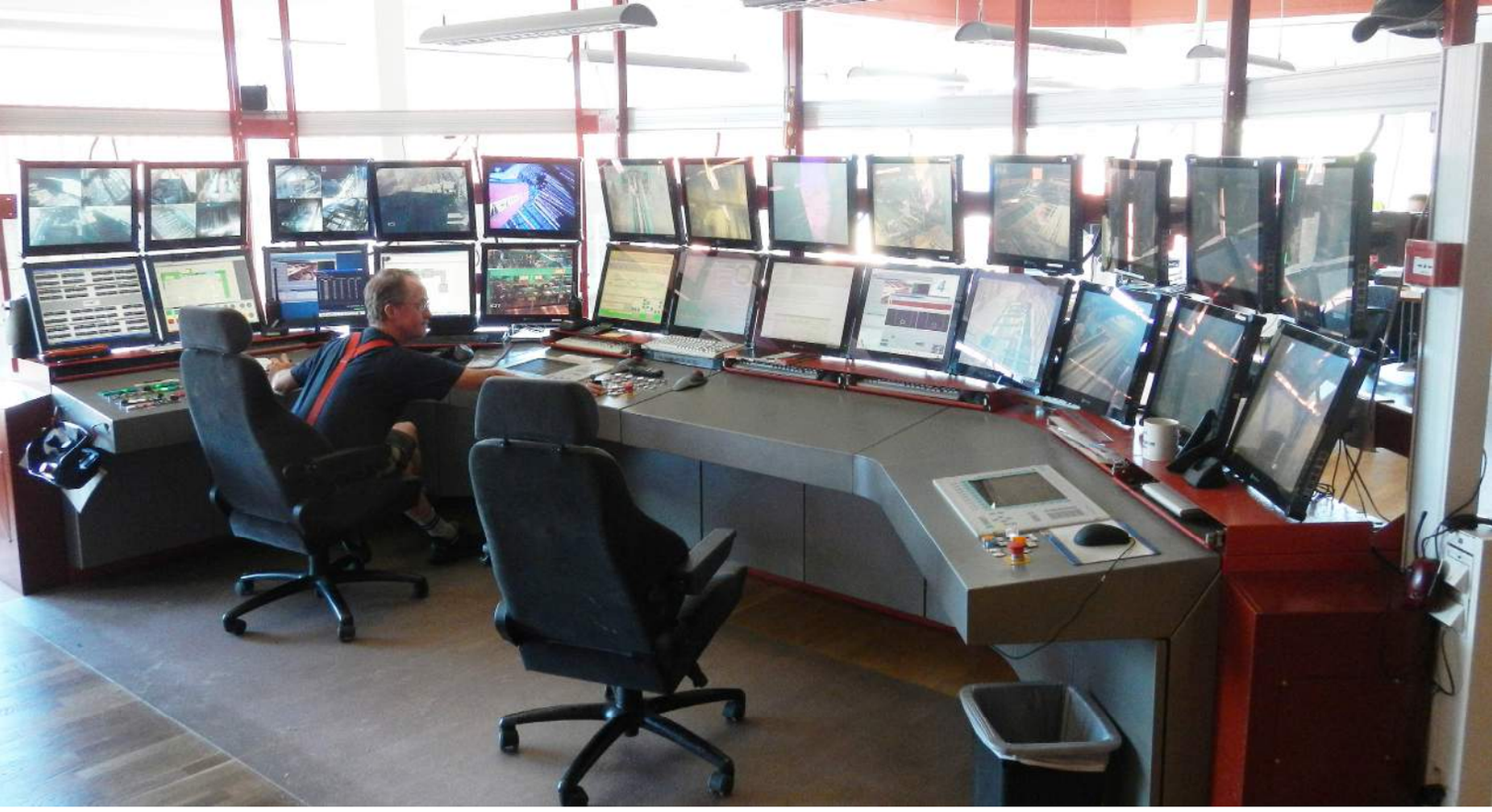
Example: Electrical motors 1-20 kW running more than 2500 hours per year must not be oversized with more than 10 % and have energy class IE3. For motors with less than 2500 h/year either IE2 or IE3 can be chosen. LCC tool must be used for motors larger than 20 kW.

! *Implementing a motor replacement programme, where all motors are mapped and replacement motors are decided (and in some cases even put on-shelf) makes it possible to make swift replacement at breakdown with the most cost efficient motor, saving both downtime and energy costs.*

5. Whenever you carry out retrofit projects or **design new processes or products**, for example rebuilding the plant for another type of product, remember to have someone responsible for energy efficiency. It is always possible to do things in many ways, where one is more energy efficient than the other.

PITFALLS TO AVOID

! Make sure the routines are not just “boring routines”. In the start, do not focus too much on writing new routines; they tend to end up in a shelf never to be used. Initially it is better to improve routines that actually are in use, written or by practical use.



Internal communication

What to do	Involve all employees by communicating the energy policy, the energy targets and the efficiency efforts.
Expected outcome	A staff working together towards the specified energy targets.

IN SHORT

If you shall be successful in reducing your energy use, everybody needs to contribute, and in order to do that, everybody needs to know what's going on. Thus, **internal communication** is vital for a well-functioning EnMS. You need to inform all employees about the company's energy use and costs, and show them how they can contribute to influence it.

HOW-TO

Suggested first-time procedure:

1. **Inform all employees** that you have set up an Energy team and will start to work actively with energy savings.
2. Within the team, **discuss how you should communicate** your energy use and actions. Some ideas are listed in the section below.
3. **Make a plan** for your regular internal communication, e.g. a procedure for informing about the latest energy savings.
4. **Set up a system for collecting suggestions** from all staff. All staff should know who they can talk to if they come up with an idea. You may also put up a letterbox for this purpose.
5. When you have decided upon an **Energy policy** or **Energy targets**, communicate those to all staff. It may also be a good idea to inform about these at an early stage, that you *will* work with these, to collect suggestions from all staff.

Suggested revision procedure:

Internal communication will be a very important part of your energy management system, and you need to work with it continuously. Set up routines for reporting the energy use regularly (e.g. once per month or every six months). Discuss regularly at the Energy team meetings what you should communicate and how.

IDEAS FOR INVOLVING THE EMPLOYEES

- Have a start-up meeting where all personnel are attending, to highlight that a program for energy saving has started, and that all have to be involved to make the program successful.
- Encourage all personnel to think about new ideas for energy efficiency measures and bring these to the Energy team. Consider setting up a simple system for collecting suggestions. Take all suggestions seriously and document them (add them to your Action plan!).
- Report the progress regularly so that everyone feels that this is something important that is followed up continuously. Emphasize that everybody contributes to a successful result. Information can be more effective than operating rules and instructions.
- Report about success stories. Name members of staff that have contributed to achieve savings. Let your staff feel proud to be involved and able to contribute to the company's energy saving targets.
- Consider publishing internally, at regular intervals, energy consumption per shift, per driver, per company unit or per functional unit, so that employees can see the effects of their actions. Try to establish energy efficiency indicators as a means for internal benchmarking and competition.
- If your company have several sawmills, consider establishing regular internal benchmarking at sawmill level. Sound competition can inspire further improvements. Make sure different units share knowledge with each other.

- Educate the staff in “energy thinking” to make everyone aware of the importance and the possibilities to make a change.

PITFALLS TO AVOID

- ! Boring information or no information at all will endanger and hinder your EnMS activities. You need to engage your colleagues – make the information relevant and interesting.
- ! Do not underestimate the importance of communication. Without feedback, the staff will lose interest in energy savings.
- ! Too much information can be as discouraging as no information. Keep the information flow at a sound level, both in time and in details.
- ! In a few cases, it’s better *not* to inform. One such example is Night owl walks. If you inform about these beforehand, more equipment than usual might get turned off that night and you don’t get a correct picture of the situation.

Additional information

GENERAL ADVICE

- Don’t start the energy management system with too high ambitions. Set high but realistic targets.
- Keep the paper documents in binders and electronic documents in folders marked, so they are easy to find and understand.
- Keep the whole staff informed and involved – energy efficiency starts with you!
- Make it natural to think energy.

WHAT IS FURTHER NEEDED TO BE CERTIFIED?

If your company wants to go one step further and certify your Energy management system according to the ISO 50001, you will need to complete the simplified EnMS described in this handbook with a few additional actions. The most important of these are:

- **External communication.** You need to decide whether you should communicate your work with energy efficiency externally.
- **Regular internal revisions of the EnMS**. By doing your own revisions, you will be able to discover shortcomings and improve the EnMS continuously. This is an important source of improvement, and may also be included in the simplified version.
- **Education, training, competence.** You need to ensure that your staff has the right competence to work with energy related tasks, for example by including education and training as a part of your EnMS.
- **Documentation and control of documents**. You must have a well-functioning system for document control of all documents related to the EnMS, including approval, reviews, version handling etc.

Ideas for energy efficiency measures in sawmills

LOG YARD

- Shift fuel from diesel to natural gas,
- Eco-driving (educate truck drivers),
- Reduce driving distances for forklifts and handler,
- Reduce number of "lifts and moves" of logs and packages,
- Allow idling of forklifts and tractors – it is better than driving around aimlessly,
- Use GPS-systems for planning of logistics on log yard and storages,
- Coordinate time of incoming trailers,
- Change from pneumatics to hydraulics for feeding units,
- Change from pneumatics or hydraulics to electric feeding units,
- Install frequency converters,
- Reduce idling of conveyors.

MILLING

- Reduce speed when possible,
- Reduce width of sawblades,
- Install frequency converters,
- Reduce freewheeling operation periods,
- Change from pneumatics to hydraulics for feeding units,
- Change from pneumatics or hydraulics to electric feeding units,
- Change from extraction of air to scraper or band conveyors for chips and saw dust,
- Reduce tool cycle times,
- Refurbish engines,
- Choose motors of correct size,
- Automatic stop of conveyors when empty – no idling,
- "Almost finish"-cut green boards to reduce wood for drying.

DRYING

- Shift fuel from diesel to natural gas,
- Shift from fossil fuel to wood fuel,
- Install heat exchangers,
- Install frequency converters on fan motors,

- Turn off fans at sufficient times in the drying program,
- Reduce fan speed at sufficient times in the drying program,
- Renovate wood drying kiln chambers,
- Optimise drying (air flows, settings etc.),
- Reduce overdrying,
- Optimise drying by weighing/calculation of moisture content,
- Use higher drying temperatures, gives shorter drying times,
- Add extra insulation,
- Reduce air leakage,
- Flue gas heat recovery from boiler,
- Simplify changing of drying programme, to use the most efficient instead of the easiest,
- Measure moisture content continuously during drying,
- "Pre dry" boards outdoors (risk for increased cracks),
- Correct amount of wood in the kiln,
- Make sure heat batteries are in good condition and not clogged.

INFRASTRUCTURE

- Install frequency converters for air extraction,
- Install frequency converters for compressors,
- Maintain compressed air system,
- Divide compressed air system into segments,
- Heat recovery from ventilation,
- Install efficient lighting,
- Presence-controlled lighting,
- Optimise lighting (level, daylight etc.),
- Presence-controlled ventilation,
- Pipe insulation (add/refurbish),
- Use waste heat for space heating,
- Use waste heat for pre-drying of bio fuel,
- Use waste heat for other purposes,
- Reactive power/cos phi compensation.

GENERAL

- Reduce stand-by (power and/or time),
- Increased general awareness of energy efficiency (turn off lights, close doors, reduce stand-by etc.'),
- Pre drying of biofuel.

Appendices

APPENDIX 1: ENERGY TEAM TEMPLATE

APPENDIX 2: ENERGY POLICY TEMPLATE

APPENDIX 3: ENERGY REVIEW TOOL

APPENDIX 4: ENERGY TARGETS TEMPLATE

APPENDIX 5: ENERGY ACTION PLAN TOOL

APPENDIX 6: LIFE CYCLE COST CALCULATION TOOL

Appendix 1- Energy Team template

Energy Team at [your company name]

The top management has appointed **[...]** as the *management representative* for our Energy Management System (EnMS). The management representative is responsible for the EnMS and for reporting to the top management.

Our *Energy Management Team* consists of the following persons:

- [Name, function]
- …
- …

The Energy management team is responsible for taking our company's work to achieve better energy efficiency forward. This includes:

- Making sure the Energy management system works as intended and that it is maintained and reviewed on a continual basis.
- Setting up and maintaining the Energy policy, Energy review, Energy targets and Energy action plan.
- Reporting to the top management on the company's energy performance and on how the Energy Management System performs.
- Communicating what's going on and making sure the Energy policy and the general work to achieve energy efficiency is well-known throughout the company.
- Planning, defining responsibilities and ensuring that the activities are supporting the Energy policy.

Place, date

…….

Signature

…….

Appendix 2 – Energy Policy template

Energy Policy for [your company name]

[Place your text here – see SawEnMS handbook for examples. At a minimum, it should state that your company:

- is committed to work systematically to increase your energy efficiency
- is committed to follow legal requirements related to energy
- will make sure the Energy Management Team has the necessary resources in terms of time, money and information
- will set up and follow up Energy targets]

Place, date

…….

Signature

…….

Document name	Author/responsible	Date created
Energy Review		
	Version/revision	Last updated

Appendix 3 - Energy Review Tool

NOTE: An improved version of Energy review tool is avaiable on request. For any futher info contact project coordinator at henning.horn@treteknisk.no .
This document represents an example (without real data) on how the Energy review tool can be used .

General info

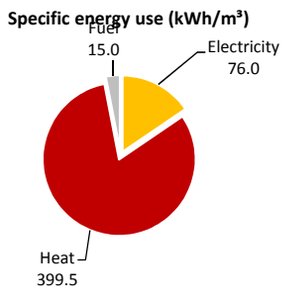
Sawmill:
Year: 2013
Description:

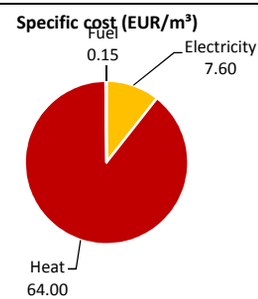
System boundaries:

Production (m³ sawn wood): 100,000

Overview

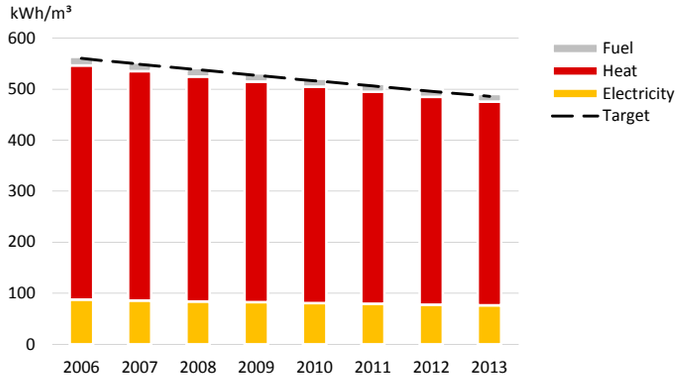
	Unit	Consumption (units/year)	Price (EUR/unit)	Conversion factor (MWh/unit)	Total energy use (MWh/year)	Total cost (EUR/year)	Specific energy use (kWh/m³)	Specific cost (EUR/m³)
Electricity					**7,600**	**760,000**	**76.0**	**7.60**
Bought electricity	MWh	8,100	100	1	8,100	810,000	81.0	8.10
Sold electricity	MWh	-500	100	1	-500	-50,000	-5.0	-0.50
Heat					**39,950**	**6,400,000**	**399.5**	**64.00**
Self-produced heat/wood chips	m³ lv	65,000	100	0.63	40,950	6,500,000	409.5	65.00
Bought heat (district heating)	MWh			1	0	0	0.0	0.00
Sold heat	MWh	-1,000	100	1	-1,000	-100,000	-10.0	-1.00
Fuel					**1,500**	**15,000**	**15.0**	**0.15**
Oil	m³		100	10	0	0	0.0	0.00
Natural gas	Nm³			0.0108	0	0	0.0	0.00
Diesel	m³	150	100	10	1,500	15,000	15.0	0.15
Other					0	0	0.0	0.00
Total					**49,050**	**7,175,000**	**490.5**	**71.75**





Recent years

	2006	2007	2008	2009	2010	2011	2012	2013
Total energy use (MWh/year)	**56,343**	**55,238**	**54,155**	**53,093**	**52,052**	**51,032**	**50,031**	**49,050**
Electricity	8,730	8,559	8,391	8,226	8,065	7,907	7,752	7,600
Heat	45,890	44,990	44,108	43,243	42,395	41,564	40,749	39,950
Fuel	1,723	1,689	1,656	1,624	1,592	1,561	1,530	1,500
Production (m^3 sawn wood):	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Specific energy use (kWh/m^3)	**563.4**	**552.4**	**541.6**	**530.9**	**520.5**	**510.3**	**500.3**	**490.5**
Electricity	87.3	85.6	83.9	82.3	80.7	79.1	77.5	76.0
Heat	458.9	449.9	441.1	432.4	424.0	415.6	407.5	399.5
Fuel	17.2	16.9	16.6	16.2	15.9	15.6	15.3	15.0
Specific energy use target (kWh/m^3)	560.0	548.8	537.8	527.1	516.5	506.2	496.1	486.2



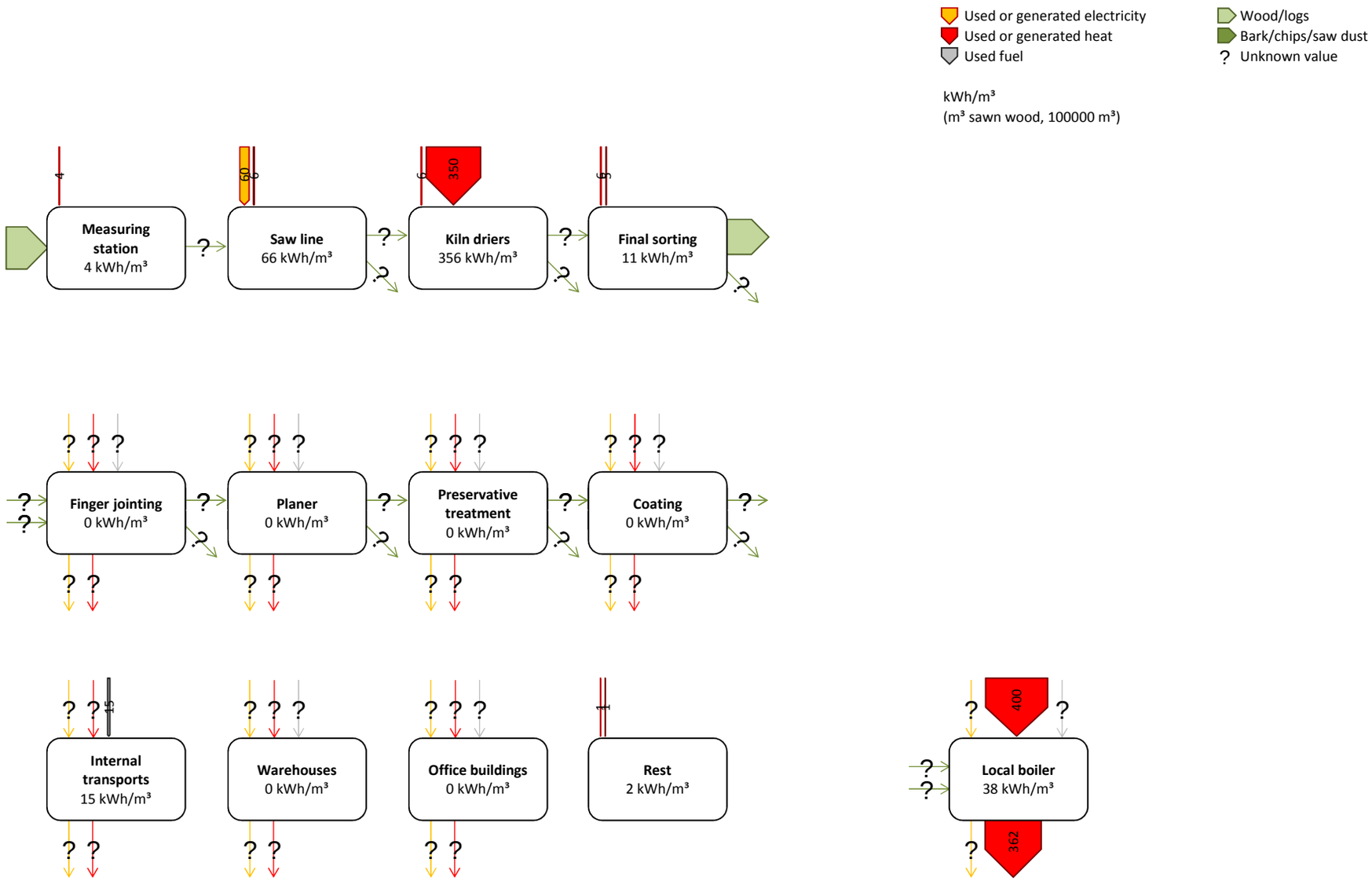
Sub processes

Note 1. Specific energy use is always calculated using the total production volume from General info. Subprocess material flows are merely informative.
Note 2. Empty fields are drawn as questionmarks in order to highlight missing information (i.e. possible future points for measurements). Nonexisting flows should be set to zero.
Note 3. In an ideal world, total data and subprocess data should match (use the table below to compare). Unknown data may be assigned to a "Rest" subprocess.

	Net energy use (MWh)		
Data	**Electricity**	**Heat**	**Fuel**
Plant total (above)	7,600	39,950	1,500
Distributed on subprocesses (below)	7,700	39,950	1,500

	Energy input (MWh)			Useful energy output (MWh)		Material input (m³)		Material output (m³)	
Subprocess	**Electricity**	**Heat**	**Fuel**	**Electricity**	**Heat**	**Logs/wood**	**Bark/chips etc.**	**Logs/wood**	**Bark/chips etc.**
Line 1									
Measuring station	400	0	0	0	0	120,000	0		0
Saw line	6,000	600	0	0	0				
Kiln driers	600	35,000	0	0	0				
Final sorting	600	500	0	0	0			100,000	
Line 2									
Finger jointing									
Planer									
Preservative treatment									
Coating									
Line 3									
Internal transports			1,500						
Warehouses									
Office buildings									
Rest	100	100	0	0	0				
Local boiler		39,950			36,200			0	0

Flow chart


Used or generated electricity
Used or generated heat
Used fuel
Wood/logs
Bark/chips/saw dust
? Unknown value
kWh/m³
(m³ sawn wood, 100000 m³)
4
60
5
350
6
Measuring station
4 kWh/m³
Saw line
66 kWh/m³
Kiln driers
356 kWh/m³
Final sorting
11 kWh/m³
Finger jointing
0 kWh/m³
Planer
0 kWh/m³
Preservative treatment
0 kWh/m³
Coating
0 kWh/m³
15
Internal transports
15 kWh/m³
Warehouses
0 kWh/m³
Office buildings
0 kWh/m³
1
Rest
2 kWh/m³
400
Local boiler
38 kWh/m³
362

Appendix 4 - Energy Targets template

Energy Targets for [your company name]

Within the next X years (20XX-20XX), we shall:

- …
- …
- …

In the long term, until 20XX, we aim at:

- …
- …
-

[See SawEnMS handbook for examples.]

Place, date

…….

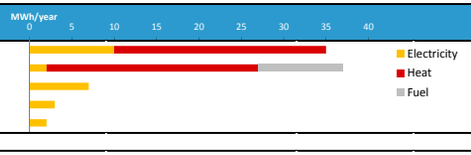
Signature

…….

Appendix 5- Energy Action Plan

Overview

Status	Number of actions	Energy savings (MWh/year) Electricity	Heat	Fuel	Economic savings (EUR/year)	Investment (EUR)	Pay-back time (years)
Under investigation	1	10	25	0	4,135	15,000	3.6
Planned - decision taken	1	2	25	10	5,000	15,000	3.0
In progress	1	7	0	0	5,000	15,000	3.0
Finished	1	3	0	0	5,000	15,000	3.0
Rejected	1	2	0	0	5,000	15,000	3.0
Total	**5**	**24**	**50**	**10**	**24,135**	**75,000**	**3.1**



Actions

Subprocess	Equipment	Action/measure	Responsible person	Start date	End date	Energy savings (MWh/year) Electricity	Heat	Fuel	Economic savings (EUR/year)	Investment (EUR)	Pay-back time (years)	Calculation method	Identification method	Current status	Comment
Kiln dryers	Kiln dryer 1	Example measure 1		01/01/2014	28/02/2014	10	25	0	4,135	15,000	3.6	Estimated	Discovered through EnMS	Under investigation	
Kiln dryers	Kiln dryer 2	Example measure 2		01/01/2014	28/02/2014	2	25	10	5,000	15,000	3.0	Calculated	Known since before	Planned - decision taken	
Sawline	Compressed air system	Example measure 3		01/01/2014	28/02/2014	7			5,000	15,000	3.0	Estimated	Discovered through EnMS	In progress	
Office buildings	Office buildings	Example measure 4		01/01/2014	28/02/2014	3			5,000	15,000	3.0	Measured/actual	Through equipment supplier	Finished	
Internal transports	Trucks	Example measure 5		01/01/2014	28/02/2014	2			5,000	15,000	3.0	Estimated	Other	Rejected	

Appendix 6 - Life Cycle Cost calculation (EnMS example)

General info

Project:	**EnMS implementation**
Case 1:	No EnMS
Case 2:	EnMS
Case 3:	-
Discount rate:	5%
Calculation period (years):	10
Currency	EUR

Investments

Investment	Unit	Year of first investment	Cost today (EUR/unit)	Estimated lifespan (years)	No. of investments in each case: No EnMS	EnMS	-	Comment	NPV/unit: Investment	Residual	Total
Man hours											
Initial workshop	hours	0	50	10			32	8 persons 2 hours + 1 per	50	0	50
Appoint an Energy Management Team, first meetings	hours	0	50	10			36	4 persons 3 hours 3 times	50	0	50
Developing an Energy Policy	hours	0	50	10			8	2 persons 4 hours	50	0	50
Performing an Energy review	hours	0	50	10			160	2 persons 2 weeks	50	0	50
Setting up Energy targets	hours	0	50	10			16	2 persons 8 hours	50	0	50
Developing an Energy Action Plan	hours	0	50	10			40	1 person 1 week	50	0	50
Developing Routines for energy efficiency	hours	0	50	10			40	1 person 1 week	50	0	50
Developing routines for internal communIcation	hours	0	50	10			16	1 person 2 days	50	0	50
Performing a first Night Owl Walk	hours	0	50	10			12	2 persons 4 hours + 1 per	50	0	50
Informing all personel	hours	0	50	10			120	30 persons 4 hours	50	0	50
									0	0	0
Other											
Consultant fee for Energy review	-								0	0	0
Eco-driving	-	1	3,600	7			1		5,865	1,579	4,287
Kiln renovation A	-	2	20,000	10			4		18,141	2,456	15,685
Kiln renovation B	-	7	20,000	10			5		14,214	8,595	5,619
New kiln control system A	-	0	15,000	15			4	including decreased mois	15,000	3,070	11,930
New kiln control system B	-	2	20,000	15			10		18,141	5,730	12,411
									0	0	0

Annual costs/savings

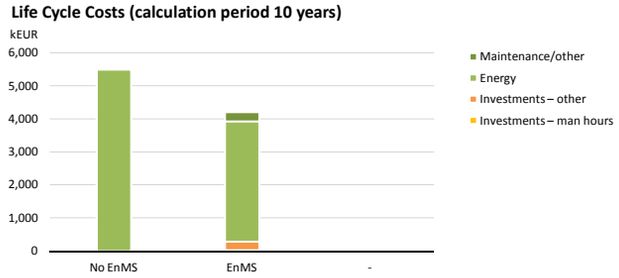
Cost	Unit	Starts from year	Price today (EUR/unit)	Annual price increase	Annual units in each case: No EnMS	EnMS	-	Comment	NPV factor
Energy									
Electricity	MWh	0	50	3%	8000	8000		Cost today	9.0
Biofuel	MWh	0	0	2%	25000	25000		Cost today	8.5
Fuel	MWh	0	100	4%	2000	2000		Cost today	9.5
Fuel saving - eco-driving	MWh	1	100	4%		-400			8.5
Kiln renovation, bioenergy	MWh	2	15	2%		-1000		bio energy * 10 % savings	6.6
Kiln renovation, bioenergy	MWh	7	15	2%		-1250		bio energy * 10 % savings	2.3
New kiln control system, bioenergy	MWh	0	15	2%		-500		bio energy, 5 % savings, 4	8.5
New kiln control system, electricity	MWh	2	15	2%		-2500		bio energy, 10 % savings,	6.6
New kiln control system, bioenergy	MWh	0	50	3%		-700		electricity, 35 % savings,	9.0
New kiln control system, electricity	MWh	2	50	3%		-2000		electricity, 40 % savings,	7.0
Reduced standby	MWh	0	50	4%		-96		5 % of equipment, 30 % o	9.5

Maintenance/other									
Administration of the system	hours	0	50	2%		80		2 weeks	8.5

Regular meetings with Energy Team	hours	0	50	2%	72	4 persons, 3 hours, 6 time	8.5
Updating/revising the Energy Policy	hours	0	50	2%	0		8.5
Updating/revising the Energy review	hours	0	50	2%	40	1 week	8.5
Following up/updating Energy Target	hours	0	50	2%	0		8.5
Updating/revising Energy Action Plan	hours	0	50	2%	360	1 person, 1 day / week	8.5
Updating/revising routines	hours	0	50	2%	0		8.5
Internal communication	hours	0	50	2%	96	1 person 1 day / month	8.5
Recurring Night Owl Walks	hours	0	50	2%	24	(2 persons, 4 hours + 1 pe	8.5
				2%			8.5
							7.7

Results [kEUR]

	No EnMS	EnMS	-
Investments – man hours	0	24	0
Investments – other	0	267	0
Maintenance/other	0	287	0
Energy	5,487	3,630	0
Total	**5,487**	**4,207**	**0**
Diff, abs		**1280**	**5487**
Diff, %		**23.3%**	**100.0%**



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