



Energy Management in the European Sawmill Industry



Co-funded by the Intelligent Energy Europe
Programme of the European Union

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Final Project Report, published May 2015

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Participating countries

Austria, Belgium, Germany, France, Italy, Latvia, Norway, Sweden and the United Kingdom.

Duration of the project: May 2012 - April 2015

Participating sawmills

The project has involved a lot of work at sawmills across Europe. In total, 54 sawmills have taken part in the network

Project partners

Norwegian Institute of Wood Technology	Norway
SP Technical Research Institute of Sweden	Sweden
Johann Heinrich von Thünen Institute	Germany
L'Institut Technologique Forêt Cellulose Bois-construction Ameublement	France
The Norwegian Sawmill Industries Association	Norway
InnovaWood	Belgium
Deutsche Säge- und Holzindustrie	Germany
Fédération Nationale du Bois	France
BSW Timber	United Kingdom
Mühlböck	Austria
Bergkvist-Insjön AB	Sweden
Amber Wood LTD	Latvia



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1 Summary

Ecoinflow was a three-year research project, co-financed by the European funding program Intelligent Energy Europe II. The main objective was to implement tailor-made Energy Management Systems (EnMSs) in sawmills and thereby reduce the annual energy use in the European sawmill industry. The project has promoted the sawmill industry through international engagement, collaboration and knowledge transfer. Partners from research institutes, sawmills, sawmill industry associations, and equipment suppliers have been actively involved in the project, representing nine European countries (Austria, Belgium, Germany, France, Italy, Latvia, Norway, Sweden and the United Kingdom). The project has successfully raised the awareness of the benefits that an EnMS could have on sawmill businesses.

The project aimed at energy savings of 1 TWh, a number that we knew from the start was ambitious. When summing up the results, we estimate that energy savings of 190–490 GWh have been achieved during the project period. Even though the 1 TWh target is not reached today, the ground is set to reach this within the next 3–4 years. During the project period, 27 sawmills have started implementing an EnMS. This means that energy savings resulting from the project will be realised in the coming years. It is also worth noting that the typical decision period at sawmills makes it difficult to manage the implementation of an EnMS and the post energy saving analysis of such a project during the project period of three years.

The main project outcomes are:

- [The SawEnMS handbook](#),
- [The SawBenchmark tool](#),
- [An Inter-European strategy for reduced energy use](#).

The SawEnMS handbook is a guide for sawmills on how to implement a practical EnMS. The handbook includes complementary tools, which are available on request from the project partners. The benchmarking tool is an on-line tool for evaluation of energy performance in the sawmill industry. By joining the benchmarking process, sawmills can compare their energy use with other sawmills in Europe and filter the results, for example by type of sawmill and by share of dried products. Both the handbook and the benchmark tool are available in six languages (English, French, German, Latvian, Norwegian and Swedish).

The Inter-European strategy for reduced energy use includes recommendations for stakeholders in the sawmill industry.

The recommendations for sawmills include:

- 1) work with energy efficiency in a structured way,
- 2) gather information on the financial support that is provided for energy efficiency projects in your country, and
- 3) focus on your drying process first.

The recommendations for policy makers include:

- 1) make sure that energy efficiency is an important topic in national and European research and development programs,
- 2) incentive programs for implementing EnMSs should foresee a control loop, and
- 3) urge sector associations to document progress achieved by their members and to quantify their energy savings.

The SawEnMS handbook and the established national networks are keys to achieve energy savings in the TWh-magnitude in the sawmill industry sector in the coming years, and to continue the reduction in energy use towards 2020 and beyond.

2 Introduction

2.1 Background

There is a high potential to achieve energy savings in the European sawmill industry, for example by implementing an Energy Management System (EnMS). Some of the main barriers for energy savings in the SMI are lack of infrastructure and profitability of selling surplus energy products, such as bark, sawdust and chips. Other barriers are lack of knowledge on how to optimise the utilization of the energy input, and low awareness about the energy saving potential. Implementation of an EnMS enables a higher awareness of the current energy use, and better understanding of the potential of future energy savings.

The title of the project – Energy Control by Information Flow – implicates that it is necessary on the technical side to better control the energy use and utilization in the SMI. This can be done by installing meters for systematic measurements. Measurements, however, are of no use if the personnel do not know how to handle the information. The information flow through communication and knowledge transfer are important factors to be successful in implementing an EnMS.

It is clear that implementing an EnMS enables more accurate analysis of energy saving measures in the company. The motivations for companies are both better control of processes and resources, but also the economic benefits of the achieved energy savings. Energy savings in the sawmilling industry sector will lead to surplus of biomass, since sawmills are also large producers of biomass. Parts of this biomass can be utilized to replace fossil energy sources in Europe.



Illustration. Source InnovaWood.

2.2 Objectives

The main objective of the project was to facilitate the implementation of EnMSs in the sawmill industry sector. From experience, we know that this will result in significant energy savings, and the project target was to reduce the annual energy use of the European sawmill industry by 1 TWh. Using rough estimations, these ambitious savings corresponds to approximately 6% of the energy use in the SMI in the participating eight countries^{1,2}.

The project also aimed at developing a methodology for installing power and heat meters for monitoring of energy use in the industry. To support the industry in finding energy efficiency measures, the project aimed at defining the best industry practice on energy efficient technology and processes. To successfully spread the knowledge on EnMSs, the project has focused on disseminating the experiences from the best industry practices in the participating countries to the European sawmill industry.

The business environment for sawmills differ considerably in the European countries. In addition to technological differences, the legislative framework and the economic environment are important factors that influence both the economic framework and the decision making behaviour of the enterprises.

To enable a change towards a more energy efficient sawmill industry, it is important that these framework conditions favour an energy efficient sawmill industry. Ecoinflow has highlighted these issues relevant for policy makers and national and international funding schemes in order to secure the optimal conditions for the development of a more energy efficient sawmill industry.



Illustration. Source InnovaWood.

¹ 49 million m³ of sawn softwood (Reference: the European Organisation of the Sawmill Industry (EOS) 2009).

² 350 kWh per m³ sawn wood (Reference: the Nordic Timber Council 1995, Energy requirements for building materials).

2.3 Project partnership

From the start of the project, the partnership consisted of twelve partners from eight European countries. In addition, there has been cooperation with the sawmill industry in the northern part of Italy, summing up to project participation from nine European countries.

The composition of the project consortium came together through previous partnerships between the institute sector in Norway, Sweden, Germany and France, and acquaintances from other projects for each of these partners, networking and suggestions for a rigid consortium. The partnership provided an opportunity to establish a network that integrated practitioners, suppliers of production technology and the R&D environment. The interdisciplinary state of the project enabled communication between commercial actors, researchers and policy makers.

The network collaboration was organised at national levels, while the collaboration across country borders and within the international network was coordinated mainly by Tretetknisk.



Illustration. Source InnovaWood.

3 Working method and data collection from sawmills

From experience, we know that the decision period from energy saving proposal to final investment is long for companies in all sectors. Therefore, the project members focused on involving the sawmills in the work from the start and throughout the project period. During the project, we have made 57 official Ecoinflow visits to European sawmills and several more visits where Ecoinflow was presented in a more informal manner.

Initial sawmill visits were done to raise the interest for the project and to start the data collection of energy use. In this project phase, pilot sawmills were chosen where the pilot version of the handbook was tested. The energy data was used on the SawBenchmark website and the feedback from the sawmills was used to enhance the SawEnMS handbook.

The SawEnMS handbook has been further developed during the whole project period, and the final version was released in April 2015. The feedback on the handbook has been only positive and we know of several sawmills that have started their own EnMS project based on the handbook.

Dissemination of the results and development of the European strategy for stakeholders have been done in parallel with the other project activities. The internal communication between the partners were accomplished through periodic internet conference calls and six physical project meetings. The physical meetings were in most cases accompanied by a visit to a sawmill company to increase the interactions between the partners in the project.



Figure 1. A sawmill visit in conjunction with a project meeting in November 2013 in Bordeaux, France.

Due to practical considerations as national industry knowledge and locations, cultural understanding, certain language barriers, etc., the research institutes have been the main contact point in each country, leading the work locally. This division of responsibilities nationally was done in order to improve the involvement of the industry partners and networks, and to be able to follow up their working tasks in closer cooperation with their national contact points.

Austria, Latvia and United Kingdom did not have national research institutes present in the project group. For these partners Thünen Institute, Treteknisk and SP have cooperated and been the main contact point for Mühlböck, BSW and Amber Wood, respectively. The local sawmill network in Latvia has been managed by Amber Wood.



Figure 2. A sawmill visit in conjunction with the kick-off meeting in May 2012 in Oslo, Norway.

4 Main outcomes

4.1 The SawEnMS handbook

The Sawmill adapted EnMS – SawEnMS – described in the SawEnMS handbook is one of the major outcomes of the Ecoinflow project. SawEnMS is a light version of an EnMS, adapted for easy implementation in the sawmill industry.

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 based on the international standard for EnMSs, 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.

An EnMS is a document framework to support energy efficiency in an organisation. The EnMS helps the organisation to systemise the energy management work by utilising the Plan-Do-Check-Act (PDCA) method for continuous improvement. The benefits of implementing an EnMS are clear.

The companies with a certified EnMS express that the main benefit of implementing an EnMS is that it brings overall order in the company, and that the importance of the energy topic is raised in the company. When there is a cost estimation of the energy used, the top management is more eager to get started with the energy efficiency work.

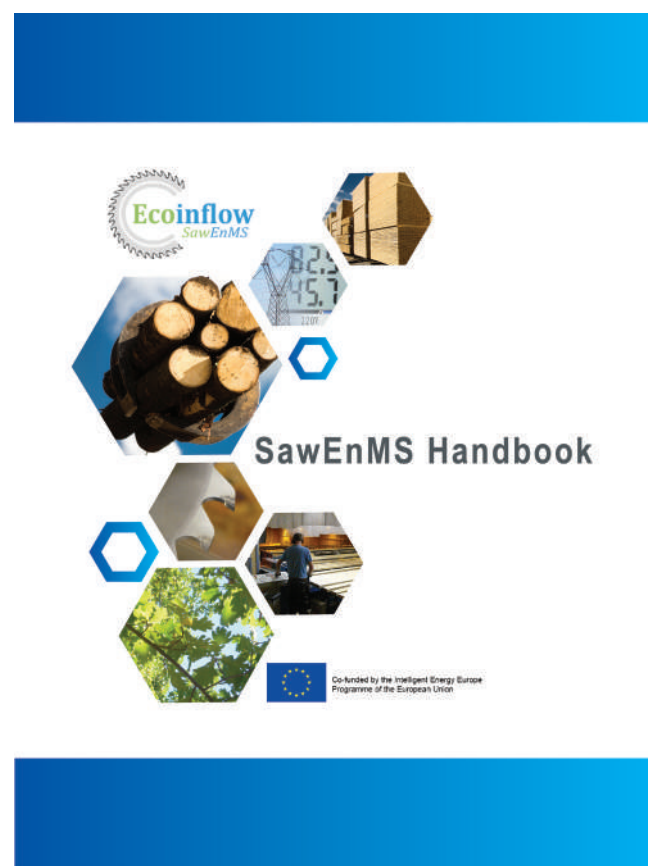


Figure 3. The SawEnMS handbook

In the ISO 50001 Energy Management standard, the PDCA method is an important part to ensure continuous improvement. The standard describes the actions needed to accomplish a certified EnMS and includes guidance for use.

The actions can be performed in any order; however, the suggested order below is suitable in many cases.

1. Appoint an **Energy Management Team** that is responsible for energy management and have the authority to make decisions concerning energy management.
2. Decide on an **Energy policy**.
3. Perform an **Energy review**.
4. Decide on **Energy targets** (expressed as key performance indicators that can be measured and followed up).
5. Develop an **Energy action plan** on how to follow the Energy policy and how to reach the Energy targets.
6. **Include energy efficiency aspects in routines** for operation and maintenance, design of processes and products, and procurement of equipment, services and materials.
7. Create routines for **monitoring and following up** the company's energy performance regularly.
8. **Competence assurance**, evaluate the need for additional training.
9. Create routines for **internal and external communication**.
10. Create routines for **internal revision of the EnMS**, e.g. how to discover and correct shortcomings of the EnMS.
11. Create routines for the **continual work with the EnMS** (to accomplish PDCA).

Few sawmills in the Ecoinflow countries have a certified EnMS like ISO 50001. We believe the situation is the same in the rest of Europe.

Several guidelines and institutions support implementation of EnMSs. However, the guides do not always simplify the process of implementing an EnMS and before SawEnMS, there were no sector-specific guides for the sawmill industry. The need for a tailor-made guide for the European sawmilling industry was strong.

Not all companies may need to implement a complete and certified EnMS, they can achieve large savings by following some of the steps towards a certified EnMS. It is better to do little work than no work at all, and when a structured energy efficiency work has started rolling, it generally keeps rolling.

A small number of European sawmills have implemented EnMS as a result of national support programmes for energy efficiency. Results from energy saving and EnMS projects in Norway (16 sawmills) and Sweden (10 sawmills) respectively show average energy savings of 6–7 % . However, there are examples of sawmills reducing their electricity use by almost 20 %, indicating that an EnMS generally leads to savings, but the results are strongly dependent on the baseline situation and on the engagement and willingness to take action at the specific company. As a reference, the European project ExBESS reports 1-7% energy savings/year for small to medium sized companies that are implementing an EnMS.

Sawmill adapted Energy Management System - SawEnMS

The Sawmill adapted EnMS (SawEnMS) is a light version of ISO 50001, and is adapted for simple implementation in the sawmill industry. SawEnMS emphasizes seven of the eleven steps in ISO 50001 and suggests a structure and sequence of steps that are especially relevant for sawmills. The table below shows how SawEnMS relates to ISO 50001.

Table 1. List of concepts of ISO 50001 and how they relate to the steps of SawEnMS.

ISO 5001 concept	SawEnMS
EnMS requirements	
Management responsibility (top management, management representative)	Top management appoints a management representative and an Energy management team (step 1) and approves the Energy policy (step 2) and Energy targets (step 4).
Energy policy	Energy policy (step 2)
Energy planning	
Legal requirements and other requirements	Partly included in Energy policy (step 2)
Energy review	Energy review (step 3)
Energy baseline	Results from Energy review (step 3) determines the baseline for Energy targets (step 4).
Energy performance indicators	Energy use per unit of production (total and per sub process) is set as overall energy indicator for sawmills in the Energy review (step 3). Also used in benchmarking.
Energy objectives, energy targets and energy management action plan	Energy targets (step 4) and Energy action plan (step 5).
Implementation and operation	
Competence, training and awareness	Partly included in Internal communication (step 7).
Communication	Internal communication (step 7). External communication only mentioned in relation to Energy policy (step 2).
Documentation	No specific instructions regarding document control, but encouraged in all steps and reinforced by templates and tools.
Operational control	Energy Efficiency Routines (step 6)
Design	Energy Efficiency Routines (step 6)
Procurement of energy services, products, equipment and energy	Energy Efficiency Routines (step 6)
Checking	
Monitoring, measurement and analysis	Energy review (step 3) being revised and updated once a year.
Evaluation of compliance with legal requirements and other requirements	
Internal audit of the EnMS	Not specifically included, but through continuous revisions of all steps.
Nonconformities, correction, corrective action and preventive action	
Control of records.	
Management review	

SawEnMS is described in the SawEnMS Handbook together with a number of guidelines, templates and other tools, the SawEnMS tool pack. The handbook describes how to work with energy savings in a systematic and continuous way, i.e. how to implement and run an EnMS light. The handbook is intended for hands-on use by co-workers on site at sawmills. Emphasis has been on keeping the handbook short, hands on and with relevant examples, while still not being too brief or shallow.

A test version was developed by the end of year 2013 and evaluated by 16 test pilot sawmills during 2014 (five in France, four in Germany, two in Norway and five in Sweden). The final version was released spring 2015 in six languages. Thirteen sawmills has implemented all seven steps (or a certified system) and fourteen has implemented at least one step by end of April 2015. For the pilot sawmills about half has implemented all steps and the rest is struggling halfway or less, about one year after the release of the first test version. Just as for certified management system, it takes time for a system to be implemented in an organisation.

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 successful EnMS implementations.

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



Illustration. Source SP.

The seven steps are:

1. Appoint an **Energy team**.
2. Decide on an **Energy policy**.
3. Perform an **Energy review**.
4. Decide on **Energy targets**.
5. Develop an **Energy action plan**.
6. Make sure your **Everyday activities** are energy efficient.
7. Spread the word within the company through **Internal communication**.

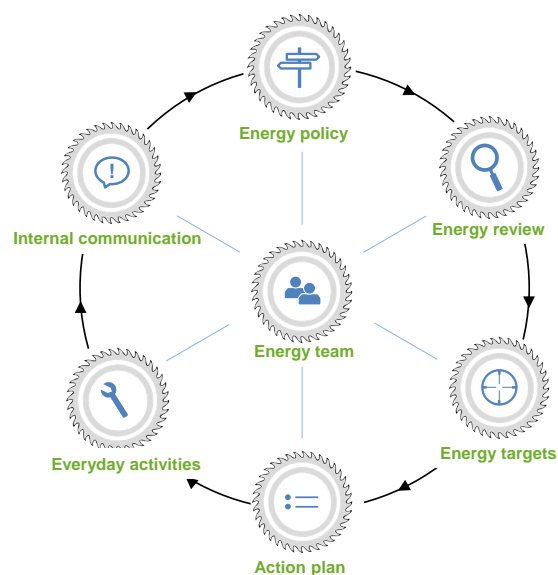



Figure 4. The idea of seven steps is seen as an infinite spiral of enhancements to reach a higher level of energy efficiency.

The handbook also has a “super light” three-step-version to get a quick start. Additionally, a number of tools, document templates, and guides are available to make the implementation easier.

All steps of the handbook starts with a short introduction of what to do in the step, expected outcome, available tools and guides and has a summary of the step in short. Samples of introduction sections for each step are shown in figures (Fig.5-12).

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	 Use the <i>Energy Team template</i> 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.



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 <i>Energy review tool</i> to organize data and draw flow charts.
More info	 Read the <i>Night Owl Walk – a quick guide for finding low-hanging energy fruits</i> .  <i>Guide for defining zones and finding locations for energy meters</i> .  <i>ISO 50002</i> , the international standard for Energy audits.  <i>sawbenchmark.com</i> – compare your energy use with other sawmills'.

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 <i>LCC tool</i> for calculating Life Cycle Costs of different alternatives when buying new equipment.
More info	 Read the <i>Night Owl Walk – a quick guide for finding low-hanging energy fruits</i> .

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.

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.

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 <i>Energy Policy template</i> 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.

Energy targets

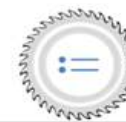




What to do	Set targets for the sawmill's energy efficiency work that are quantified, measurable and achievable.
Expected outcome	Clearly expressed goals to channel the company's efforts and measure your achievements against.
Template	 Use the <i>Energy Targets template</i> to define and approve your 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/m³ 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.

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 <i>Energy action plan</i> tool to keep track of ideas and planned actions.  Use the <i>LCC tool</i> for calculating the Life Cycle Costs of different alternatives.
More info	See <i>Ideas for energy efficiency measures</i> 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.

Figures 5-12. Showing the introduction section for each of 7 steps.

Document templates for parts of an EnMS

The templates are part of the support package. They are 1-page documents with a straightforward layout, pre-printed letter heads, headings and tables, etc, to simplify and speed up the administrative task and keep the energy manager's focus on the practical implementation instead of document design.

Document templates (word documents) are available for the following steps:

- [Energy Action plan](#),
- [Energy Policy](#),
- [Energy Targets](#),
- [Energy Team](#).

Calculation tool

Tools (excel spreadsheets) have been made for:

- [Life Cycle Cost calculation](#),
- [Energy Review](#).

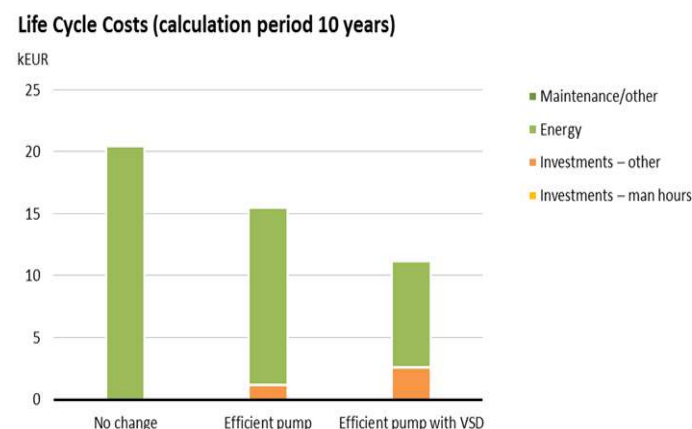


Figure 13. Example LCC tool.

The [calculation tool for Life Cycle Costs](#) was developed for comparing three alternative investments. It includes three examples to help a new user to get started; pump, lighting and also an example with implantation of an EnMS. The figure 13 shows results from the pump example.

The [Energy Review tool](#) is created to make one of the most demanding steps for a company that has not previously worked with energy savings easier. The purpose of the tool is to assist sawmills in reviewing their overall energy use and in dividing it into sub processes. The tool follows the guidelines for defining zones/units and finding locations for energy meters.

A reasonable level of subdivision is a key factor in successfully analysing the baseline situation and finding possibilities for energy efficiency measures, but it is important to recognise that this will not happen overnight. Each sawmill must start from its own unique position and improve the level of detail – by estimations or measurements – during the continuous work with its EnMS.

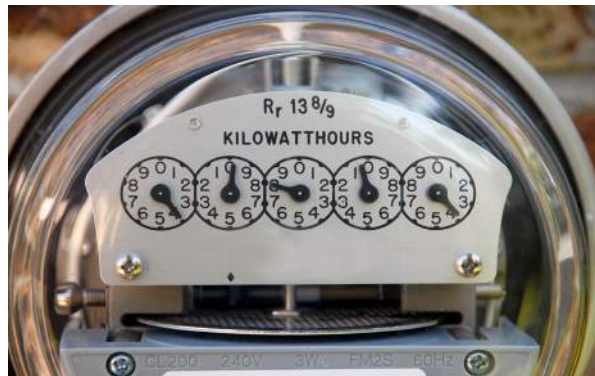


Illustration. [Source rgbstocks](#).

The aim of the tool is thus threefold:

- To assist sawmills in determining a relevant sub process division, by suggesting common sawmill sub processes and showing examples.
- To show which energy flows may be useful to quantify, but leaving data entry optional.
- To visualise energy and material flows, by automatically generating a simple flow chart that illustrates the size of each flow, as well as flows that are still unknown, see figure 14.

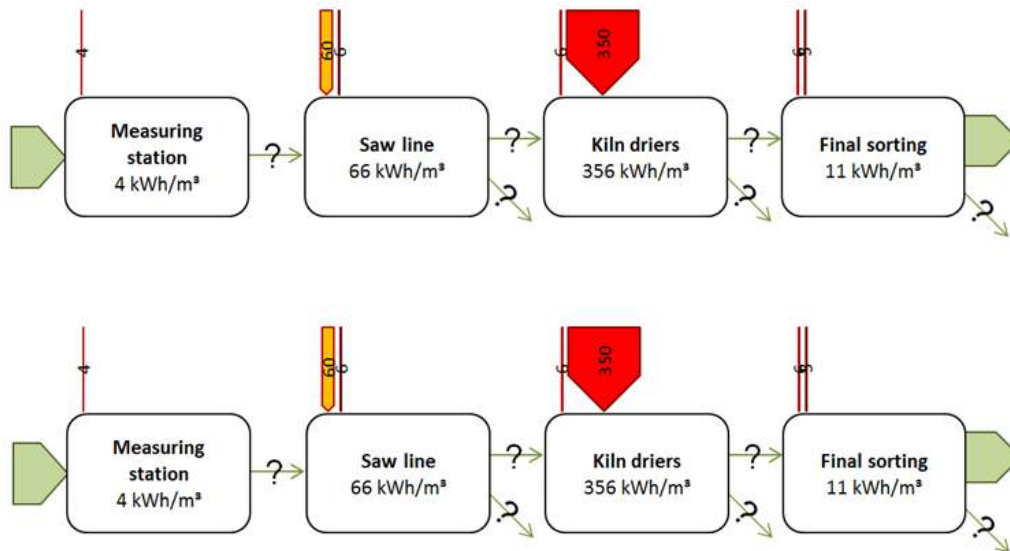


Figure 14. One section of the energy flowchart, showing streams for electricity (light red with yellow filling), heat (dark red with light red filling) and wood/wood residual (green). In this examples, the kiln driers use 6 kWh/m³ electricity and 350 kWh/m³ heat. The incoming timber, and outgoing sawn products (green) are known, while the wood streams in between are unknown (indicated with question marks).

Guidelines

There are two guidelines in the SawEnMS tool pack: the Night Owl Walk Guideline and the guide for dividing the sawmill into subdivisions.

The [Night Owl Walk Guideline](#) shows how very low hanging fruits (saving measures) can be identified by making a structured walk through a sawmill after the last shift has left. At this time of the day (or usually time of night), it is easy to hear the noise of equipment left running like fans and motors, it is also easy to detect larger compressed air leakages and of course find lighting left turned on, and so on. The guide has been tested at eight sawmills. The identified electrical savings were between 0.75–2.2 kWh/m³ sawn wood for six of them, while two identified measures saved about 6 kWh/m³ sawn wood.

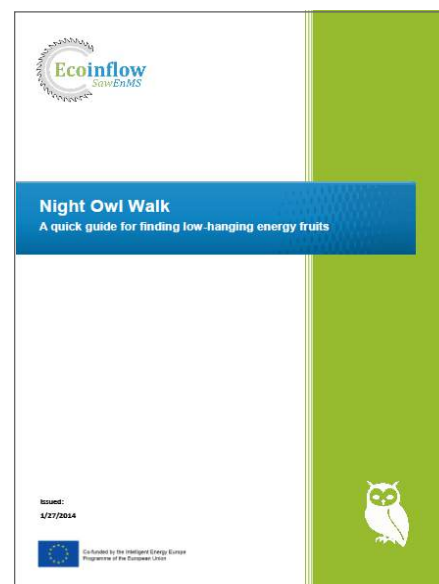


Illustration. Source [Ecoinflow](#).

The [Guide for defining zones](#) and finding locations for energy meters, divides a mill into zones, and help decide where to start the energy efficiency work and where to find the best locations for placing energy meters. The zoning definition is also used in the Energy Review Tool (see above). The figure to the right show example of zones.

Generally, there are only a few measurements of energy use made on a regular basis for companies in the sawmilling industry sector. This can be an obstacle for the implementation of an energy management system. Few fixed installed sub meters and/or no measurements made before and after energy saving measures make it hard to find out where to start as well as prove savings made.

The guide includes examples of different measure equipment and tips what to consider before purchase.

You can read more about all tools, templates and guides in SawEnMS package in the report “D2.5 Development and implementation of EnMS – technical report”.

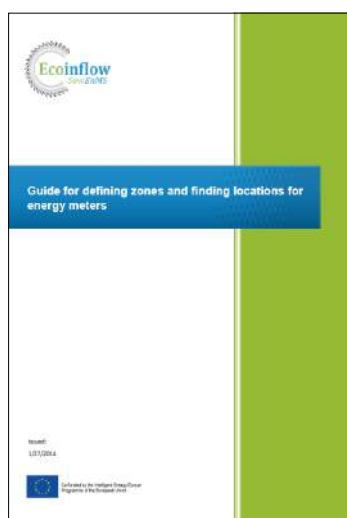


Illustration. Source [Ecoinflow](#).

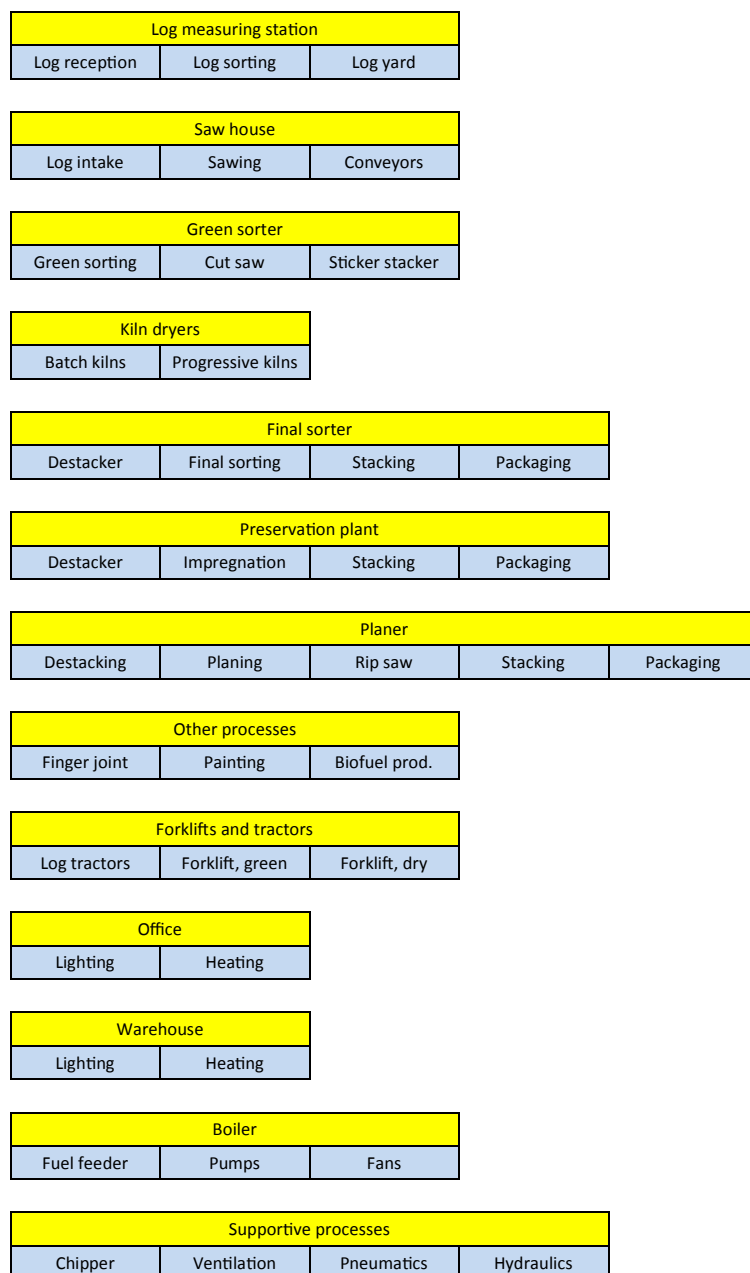


Figure 15. Example from the Guide for defining zones and finding locations for energy meters.

4.2 Case studies and benchmarking

a) Overview

An important part of the project was delegated to establish a relevant framework for comparing energy use in sawmills and to identify key success factors that lead to energy and resource efficiency in production. In order to evaluate energy efficiency and possible energy savings, a sector-wide best industry practice was established. The benchmarking exercise included all sawmills participating in the project. This part offers an opportunity to share the best practices implemented in sawmills between countries, production technologies in different types of sawmills, etc.

The industry partners participating in the project were able to benchmark the energy performance of their production units. This led to the development of a coherent and shared methodology enabling a European-wide benchmarking, taking into account the diversity of the sawmilling industry (5 sawmills groups have been determined). This study have been organised by project partners (mostly SP, Treteknisk, TI and FCBA) through interviews at the industrial sites.

Results from the benchmarking have been used to identify and evaluate the practices of sawmills that have developed internal energy use policies. Sawmills with no specific energy use policy have been compared with the previous group in order to determine the potential savings and their expectations of EnMS.

The Table 2 provides an overview of the number of sawmill members in the network.

The different members of the consortium have visited sawmills all over Europe (England, France, Germany, Italy, Latvia, Norway and Sweden).

Table 2. Overview of the number of sawmill members in the network.

Country	Number of sawmills
France	19
Norway	7
Sweden	5
Germany	12
Italy	3
Latvia	1
UK	7
Total	54

During those visits, the members have collected detailed information on what seemed to be best practices in term of energy saving. Some of the available information is very detailed, while others lack some information as measures were implemented through common sense without financial elements or technical details.

b) Description of best practices and case studies

One of the main objectives of Ecoinflow is to share information on how to save energy, specifically suited for the European sawmilling industry and to edit standard sheets for the best cases of Energy management policies with explanation on the practice and the generated gains in terms of energy savings or economical savings. Data collected and results from the benchmarking have been analysed and graded in terms of efficiency, reproducibility and relevance.

They are specified thanks to visual criteria, from low to high. The return on investment is estimated according to the following criteria: short, medium and long term.

The case studies have taken place on sawmills in each of the following countries: France, Germany, Norway and Sweden. The case studies were identified based on results from the benchmarking analysis. The case studies provided an opportunity to explore the energy saving potential from specific measures that are identified in the benchmarking study. Through the case studies, the specific energy saving measures and strategies were tested by sawmills.

The following energy saving measures has been evaluated:

- Passive energy saving measures,
- Active energy saving measures,
- Fundamental shift of energy utilisation,
- If the case sawmills allow, implementation of add-on technology.

Each of the best practice are presented under the following headings:

- Background and issues,
- Technical description of the device(s) providing different configurations observed in each sawmill,
- Potential gains: energy savings, other improvements, reproducibility and possible points to note (difficulties, advanced installation advice, limitations).

Levels of investment required (both human and financial) various practices are classified by key sectors of sawmills energy business:

- Energy management,
- Energy savings in the workshop (process, drying, boiler).




The human investment, the return on investment and the costs can vary greatly from a sawmill to another and for each factsheet. They depend on a multitude of parameters and process variables (process types, quality of equipment used, expected lifetime of machinery and equipment, involvement of management staff, etc.). So, in order to help in the choice, for each identified good practices, human investment, return of investment and costs has been estimated as described in Table 3.






Illustration. Source [rgbstocks](#).

Table 3. Human investment, Return on investment and Cost.

1. Human investment

Low		<ul style="list-style-type: none"> • Few employees (1-2) and a single sector involved • Time-limited
Medium		<ul style="list-style-type: none"> • Several people involved (more than 2) • Time-limited
High		<ul style="list-style-type: none"> • Strong involvement of the company on several different services • Over a long period (at least two months)

2. Return on investment

Short term		<ul style="list-style-type: none"> • Less than 1 year
Medium term		<ul style="list-style-type: none"> • Between 1 and 4 years
Long term		<ul style="list-style-type: none"> • More than 4 years

3. Cost

Low	€	<ul style="list-style-type: none"> • From 0 € to 2 000 €*
Medium	€ €	<ul style="list-style-type: none"> • From 2 000 € to 20 000 €*
High	€ € €	<ul style="list-style-type: none"> • More than 20 000 €*

*Estimated value.

10 full sheets have been written and are available by industrial users on the SawBenchmark.com website.

Energy management

A handbook supporting the implementation of EnMSs in sawmills has been finalized during the project. The sawmill-adapted EnMS is called SawEnMS and consists of:

- a handbook directed to staff at sawmills involved in energy management,
- a website with additional information,
- a set of document templates and calculation tools designed to help sawmill to implement the necessary EnMS steps.

Potential gain: difficult to calculate because it depends on the degree of involvement of the sawmill.

Some examples observed during the visits to sawmills:

- Revision of the energy contract for the winter period,
- Monthly monitoring with a list of overruns, monitoring the cause of downward trends,
- Consulting with new energy suppliers,
- Centralised shutdown of the power supply on completion of shift,
- Hire an employee dedicated to energy,
- Analyse shutdowns of each machine (times, causes, preferred actions), progress group, software for monitoring troubleshooting maintenance,
- Shutdown of machinery during peak hours in winter,
- Monitoring consumption of vehicles,
- Reduce speed of forklift trucks.

Reproducibility: The concept of an EnMS has very high reproducibility. Some sawmills have already started processes similar to an EnMS; with quantified objectives, deadlines, return on investment, energy team, and it's working well.

Energy savings in the workshop

Variable Frequency Drives (VFD)

Background: The operation of electric motors can account for up to 70% of the industry's energy use.

Potential gain: 20 to 30% depending on the characteristics.

Reproducibility: It is advisable to carry out a feasibility study before undertaking this type of investment.



Figure 16. Variable frequency drives. *Source FCBA.*

Heat exchanger on air compressor

Background: Compressed air, produced by the compressors using electricity, can account for up to 15% of a company's energy costs.

Potential gain: Energy savings as a result of the technology: 20% (recovery of the heat).



Figure 17. Heat exchange system for the compress. *Source FCBA.*

Reproducibility: This operation can easily be used in any sawmill or enterprise with a compressed-air compressor.

Heat Capacitor bank

Background: At a European level, the calculation shows that by raising the power factor to 0.95 ($\cos \varphi$), the reactive energy compensation would mean a potential energy saving of 48 TWh per year.

Potential gain: Example from France: For energy subscribers using from 36 to 250 kVA, the reduction in contract power is approximately 15%. For all: reduction in active energy loss in the region of 3%.

Reproducibility: A heat capacitor can be used in any sawmill or enterprise whose power supply generates reactive energy.



Figure 18. Capacitor bank for a canter line. *Source FCBA.*

Compressed air (tracing leaks)

Background: Compressed air, produced by the compressors using electricity, can account for up to 15% of a company's energy costs.

Potential gain: Energy savings as a result of the technology up to 40% of overall savings.

Reproducibility: Each enterprise has its own system, which should be maintained.



Figure 19. Air “drier” for compressed air compressor. *Source FCBA.*

Lighting

Background: In general, operating and maintenance costs can represent up to 90% of the overall cost for lighting, while the remaining 10% consists of investments.

Potential gain: Energy savings from 20 to 30%, depending on the characteristics.

Reproducibility: The best systems should be adapted to the specific requirements of each enterprise (desired luminosity, layout of the building, etc.).



Illustration. *Source rgbstocks.*

Suction unit

Background: When wood is being sawn, it is necessary to use a suction unit or a scraper system to evacuate sawdust, chips and other waste.

Potential gain: Electronic variable speed drive: up to 50% of overall savings
Tubulator: up to 50% additional capacity

Reproducibility: Each enterprise should use systems that best suit the quantities to be transported.

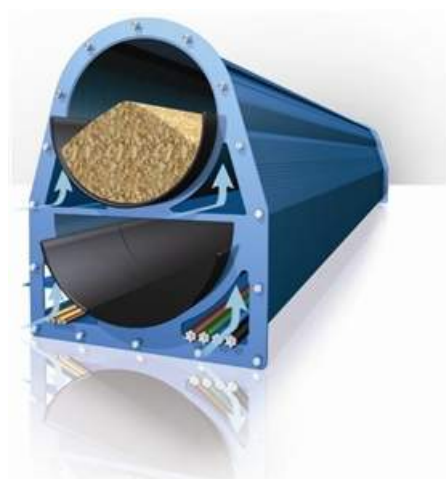


Figure 20 Transport of sawmill by-products via a Tubulator. *Source BRUKS.*

Kiln drying: heat recovery units in wood drying kilns

Background: During the drying process, one of the major sources of energy loss is the saturated exhaust air from the kiln.

Potential gain: Energy savings from 5 to 15% of recovered heat energy.

Reproducibility: This system is proposed as an option for use on many new kilns and can be adapted to suit kilns currently in operation.



Figure 21. Heat recovery unit of a kiln. *Source FCBA.*

Kiln drying – variable frequency drive of kiln fans

Background: The drying unit has the highest impact in sawmills in terms of energy use.

Potential gain: Energy savings up to 25%.

Reproducibility: This operation can easily be used in any sawmill or enterprise with one or more kilns.



Figure 22. Some of the variable frequency drives for the kilns. *Source FCBA.*

Wood fire boiler - Cogeneration

Background: In order to deal with the recurrent increases in energy prices and optimise fuel resources produced by sawmills, manufacturers are looking closely at an energy supply solution using wood.

Potential gain: Energy savings as a result of the technology is 5 to 15%

Reproducibility: This system is one of the priorities in the development of renewable energy.

Many best practices detected during the sawmill visits have been implemented with common sense without any analysis on investment, return on investment, technical needs, etc. Today, the SMI is aware that energy management is essential to maintain market share and to increase benefits. E.g. in France some the two major challenges in the coming years will be: lack of raw material and high energy cost.

Energy represents between 3 and 10% of the turnover and some best practices can be implemented without any investment or with state subsidies.

c) Online benchmarking tool (SawBenchmark)

The consortium members developed an on-line benchmarking tool for evaluation of energy performance in the sawmilling and wood manufacturing industries based on the benchmarking framework developed in the project. After an evaluation of the feasibility of existing tools, a pilot benchmarking tool has been made available to industry partners within the consortium for evaluation.

More than a simple benchmarking tool, the developed tool has also provided some recommendations to improve energy efficiency in sawmills by promoting the good practices identified in the previous task and the project's results.

The challenge was to develop a simple tool in order to provide a low entry (easy access and easy-to-use). The developed tool provides some recommendations to improve energy efficiency in sawmills by promoting the good practices identified.

Using the online tool, the sawmill company can connect online and get the chance to compare the energy use to an existing panel of European sawmills for which energy data has been collected and analysed. The comparison consists in locating the “new” company in the panel in regard to a set of energy-oriented indicators. The tool should trigger an interest for the energy recommendations and pedagogical content disseminated on the website and pointed at the reader as the results of the online tool are delivered to him/her.

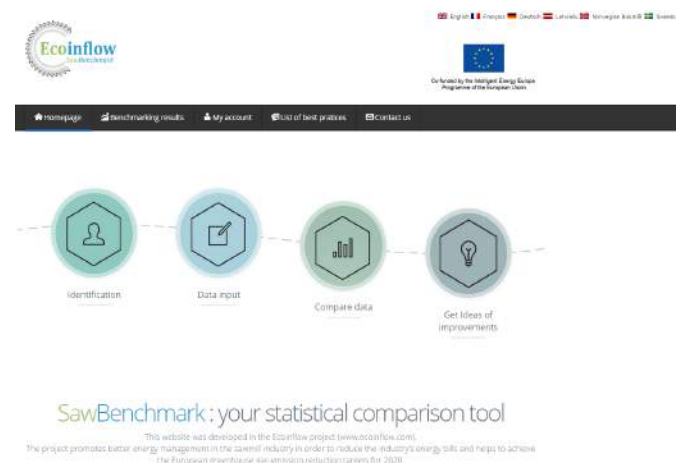


Illustration. Source Ecoinflow.

Table 4. Statistics studies Sawmills 5 subgroups.

Group number	Volume received (m3)	Material yield (%)	Drying(%)	Species
1	< 300 000	<0,45		Hardwood
2				Softwood
3		≥0,45	100%	
4			<100%	
5	≥300 000			

Industrial partners of the project have evaluated various criteria like:

- Applicability of the tool tested with respect to differences in infrastructure, raw material and technologies,
- Functionality of the tool developed evaluated with respect to relevance of inputs and outputs that can be used by mills for decision making and management,
- Ranking of production units tested in order to secure that the comparisons are relevant and correct.

The diversity of the sawmilling industry in energy use has been taken into account. Statistical analysis revealed that the sawmills have to be divided into 5 subgroups as described in the Table 4.

Several examples charts of what can be seen on the “Sawbenchmark” website are presented in Figure 23 and 24.

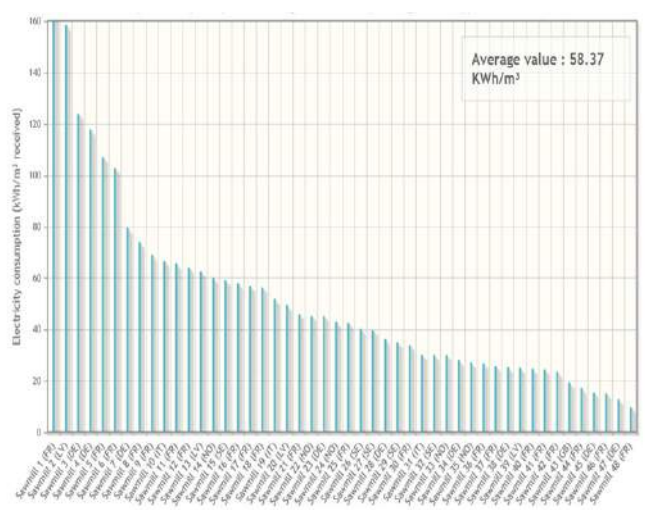


Figure 23. Electric consumption per m3 of logs received depending on the sawmills. Source FCBA.

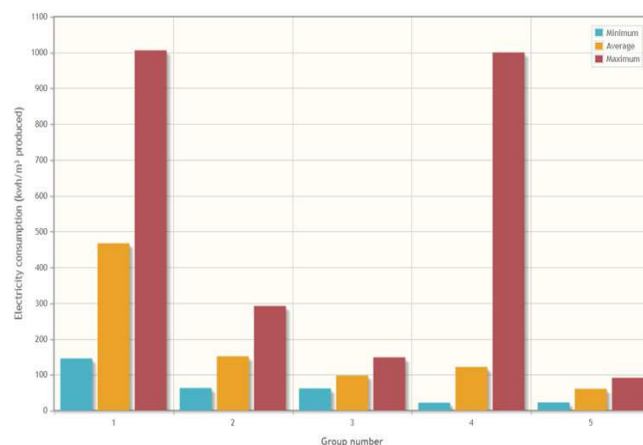


Figure 24. Average electricity consumption per m3 of sawn wood and subgroups. Source FCBA.

You can read more by consulting the Saw-Benchmark website where more than 20 graphs are available to sawmillers (www.sawbenchmark.com). This site is made available for sawmills interested in comparing their energy use to other sawmills. It offers also the opportunity for companies to compare their own energy use to fifty European sawmills. The energy use of the company is compared with the average value from all the sawmills, but also with subgroups divided according to specific characteristics of the mills (for example: volume timber received at the sawmill, if softwood or hardwood is processed, the material yield).

The feedback from sawmill partners has been that the website is easy to understand and to use. The layout with graphs provides a good and quick overview (values appear when you move the mouse on it). The companies found it interesting to compare the energy use with sawmills with similar size and type of production. However, more than a simple benchmarking tool, the developed tool also provides some recommendations to improve energy efficiency in sawmills by promoting good practices identified in the project. Some sawmills will use the graphs and values as commercial arguments for their customers.

4.3 The EnMS network and achieved energy savings

The EnMS Network was established in an early phase of the project and has grown continuously during the course of the project. The pilot sawmills who tested the first version of the sawmill EnMS and its handbook have been the backbone of the network. During the project, more and more sawmills have joined, either as member of the project or by getting access to the website and its information and tools. The website, seminars, workshops, fairs, and the other project activities have pushed more sawmills to join the project.

The high number of on-site visits to sawmills, which has increased commitments and made the word spread, has also made more sawmills interested in the project. Contact data for sawmills, research institutions and associations has been collected in a database. Contact data to experts within the consortium is available at the SawEnMS website, and all sawmills have a personal contact person within the project consortium.

During the duration of the project, Ecoinflow visits have been made to 57 sawmills and several more visits have been made where the Ecoinflow project was presented in a more unofficial way. By the end of April 2015, the

The project aimed at energy savings of 1 TWh, a number that we knew from the start was ambitious. When summing up the results, a rough estimate is that we have reached energy savings of 190–490 GWh during the project period. The project group feels that even though the 1 TWh target is not reached today, the ground is set to reach this within the next 3–4 years. The SawEnMS Handbook and the established national networks are keys to achieve an energy saving of this magnitude in the coming years, and to continue the energy reduction in the industry towards 2020 and beyond. During the project period, 27 sawmills have started or finished implementing an EnMS. This means that energy savings resulting from the project will be realised in the coming years. It is also worth noting that the typical decision period at sawmills makes it difficult to manage the implementation of an EnMS and the post energy saving analysis of such a project during the Ecoinflow project period of three years.

4.4 An Inter-European strategy for reduced energy use

4.4.1 General

The strategy for reduced energy use in the European sawmill industry is one of the main outcomes and it is based on the evaluation of three major aspects:

1. The energy and greenhouse gas inventory of the European sawmill industry.
2. The available potentials to reduce the energy use and greenhouse gas emissions in the European sawmill industry.
3. The status of the policy framework related to energy efficiency issues in the sawmill industry.

4.4.2 Evaluation of the fundamentals to build the strategy on

The energy and greenhouse gas emission inventory

In order to quantify the primary energy use, final energy use and greenhouse gas emissions of the European sawmill industry, an inventory was calculated which shows the respective numbers for today, until 2020 based on a scenario, and for every country of the EU-28 and Norway singularly.

This inventory is based on a bottom up approach by combining product specific information on the energy use of the European sawmill industry with national statistics. In order to estimate values for the year 2020, a projection based on the EU Reference Scenario³ was conducted. The scenario is used to define the baseline for national economic figures and energy conversion calculations which are in accordance with the A1 IPCC scenario (more globalized and economy oriented world). It primarily predicts a growth in production and consumption for sawn wood products and the increasing importance of the eastern parts of Europe.

a) Product specific values

Product specific values were calculated for Germany, Norway, France and Sweden. The values are differentiated by the type of product, the type of energy that was consumed and the wood species which was processed in the sawmills. Table 5 shows the results.

With regard to these values it already became clear, that the specific energy use of sawmills deviates heavily between the countries or/and between single companies as described by Diederichs (2014)⁴ for Germany in detail. Further on, the share of renewable fuels used for energy generation is different in the countries which has an impact especially on the fossil based carbon dioxide emissions produced at the sawmill sites.

Unfortunately, for all other countries of the EU-28, average values had to be applied for the calculation of the national sawmill industry inventories since no specific data is available.

³ European Commission (2013) Energy, Transport and GHG Emissions, Trends to 2050, Reference Scenario 2013.

⁴ Diederichs S (2014) 2010 Status quo for life-cycle inventory and environmental impact assessment of the core sawmill products in Germany. Wood Fiber Sci 46:65–84

Table 5. Specific final energy use of sawmills to produce sawnwood products in the reference year 2011 (*average weighted by production volume of the country).

Indicator	Unit	DE	NO	FR	SE	Avg.*
Coniferous sawnwood, green						
Electricity	kWh	21,8		33,6		24,8
Diesel	kg	0,90		1,30		1,00
Coniferous sawnwood, kiln dried						
Electricity	kWh	43,4	90,0	53,6	80,0	59,8
Diesel	kg	1,30	1,60	1,30	1,50	1,38
Fuel for heat	MJ	1972	1044	1994	1008	1598
thereof renewables	%	100	100	80	98	96
thereof fossil	%	0	0	20	2	4
Coniferous sawnwood, kiln dried, planed						
Electricity	kWh	72,2	130,0		90,0	82,7
Diesel	kg	1,70	2,90		1,60	1,73
Fuel for heat	MJ	2284	1134		1044	1714
thereof renewables	%	100	100		98	99
thereof fossil	%	0	0		2	1
Non coniferous sawnwood, kiln dried						
Electricity	kWh	124,2		268,0		209,8
Diesel	kg	1,60		3,60		2,79
Fuel for heat	MJ	6198		2887		4228
thereof renewables	%	100		80		88
thereof fossil	%	0		20		12

Table 6. Share of specific sawnwood product in the production mix in 2011 expressed in [%](*average weighted by production volume of the country).

Product	DE	NO	FR	SE	Avg.*
Coniferous					
Sawnwood, green or air dried	50,0	0,0	87,3	3,0	37,1
Sawnwood, kiln dried	33,5	25,7	4,1	67,0	40,2
Sawnwood, kiln dried, planed	16,5	74,3	8,6	30,0	22,7

This lack of data has been observed on many levels during the project and is an essential aspect for optimizations recommended in the strategy. The available data however is based on the results of available literature and other studies conducted by the project partner as only a few comprehensive measurements were conducted during the project.

Besides the product specific energy use values, the share of sawmills specified on coniferous and non-coniferous wood was described for Germany, Norway, France and Sweden. Further on, the share of green (not dried) and

dried as well as planed sawnwood was differentiated (Table 6) as the different products were associated with a different energy use. Especially the drying process consumes a lot of energy. Therefor differentiation between the products is necessary. Again a severe lack of available information was observed. Several values had to be estimated (for further details please refer to Deliverable 4.2. (Current and potential savings in primary energy use and GHG emissions of the European SMI) and Diederichs (2015)⁵ were this problem has been discussed thoroughly).

5 Diederichs S (2015) Empowering woodworking industry stakeholders to reduce environmental impacts. Dissertation, Department of Biology, University Hamburg

b) National statistics

The bottom up approach builds upon national statistics on the production volumes of sawn-wood in each country of the EU-28 and Norway. It also includes the carbon and primary energy intensity of the electricity production in the respective countries. The projection until 2020 primarily builds upon results from Mantau (2010)⁶ and the EU Reference Scenario described above. Specific information is available in Deliverable 4.2. (Current and potential savings in primary energy use and GHG emissions of the European SMI).

c) Results

The energy and greenhouse gas inventory of the European sawmill industry allows to understand the share of every country's sawmill industry to the total European sector while including the country specific parameters. It further helps to understand how the sawmill industry in each country is likely to develop in the next years until 2020. With this information, the most relevant countries to focus on in the strategy were identified.

Figure 25 shows the relevant indicators for each country in the EU-28 and Norway estimated for 2020.

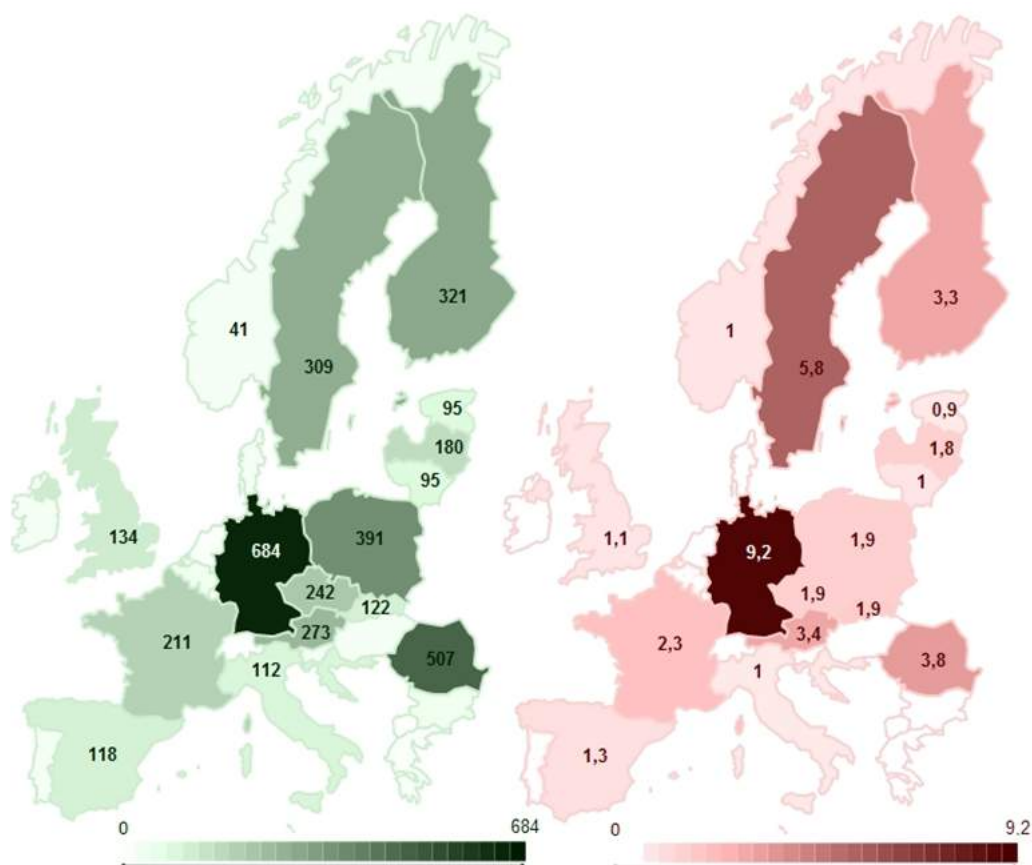


Figure 25. Total greenhouse gas emissions [Mg per year] (left) caused by the production of sawmill products and final energy use [TWh] (right) in the SMI in the EU countries in 2020.

⁶ Mantau U, Saal U, Steierer F, et al. (2010) Real potential for changes in growth and use of EU forests. Final Report. Hamburg

The available potentials

The identification of available energy saving potentials in the European Sawmill industry is based on two major pieces of background information. Firstly, several potential measures for the sawmill industry were identified in terms of their saving potential and the necessary circumstances which need to be in place to enable the sawmills (technically) to implement the measure. For example, the use of trailers on the log yard is only possible if enough space is left to reorder the piles and enlarge the pathways.

Secondly, for each of the identified circumstances, experts were interviewed to estimate the deviation of the circumstances in the European sawmill industry. For example, experts were asked to estimate how many sawmills in Europe (in terms of production volume) already use trailers and how many have organisation space left. Combining these two pieces of information allows estimating the available technical potentials in the European sawmill industry for each measure.

a) Potential measures

In total 24 different measures were analysed in terms of their potential to reduce the energy use in the sawmill industry. For each measure the source of information (case study, estimation) was identified, the type of energy that was saved (electricity, thermal energy, diesel), the uncertainty of the information (high, medium, low) and if quantitative information was available at all (knowledge (yes/no)). All potentials were grouped by location (log yard, milling hall, etc.). Table 7 shows the list of potential measures in the milling hall as an example. Deliverable 4.2 (Current and potential savings in primary energy use and GHG emissions of the European SMI) lists the potentials for all locations of a sawmill.

Table 7. Case studies and examples for energy saving measures in the milling hall.

Measure	Action	Energy	Source	Uncertainty	Knowledge
Freewheeling	Idling time and electricity consumption was identified by electricity measurement, reduction potential was estimated for automatic stops	⚡	🏭	■	✓
Suction	Electricity consumption of exhaustion was measured. Electricity consumption of scraper was estimated. and compared	⚡	🏭	□	✓
Freewheeling	Reprogramming of PLC to stop conveyors when empty.	⚡	🏭		
Finished-Cut	The amount of wood that needs to be dried can be reduced by cutting green boards almost finished, and just make small adjustments after drying.	🔥	🏭	□	✓
Optimize tools	Tools can be optimized like reducing the width of saw blades	⚡	🏭	■	✓

⚡ Electricity, 🔥 Heat, 🏭 Diesel, 🏭 Case Study, 🏭 Estimation, □ High, □ Medium, ■ Low

Table 8. Circumstances on the log yard, survey results for the deviation of circumstances in the European sawmill industry.

	Value
For all roundwood processed in sawmills, which share is ...	83 %
... moved by forklifts and on-site trucks that run on diesel	7 %
... moved by forklifts and on-site trucks that have GPS	41 %
... processed on log yards with organisation space left	13 %
... processed on log yards where trailers are used or supersize grapplers	47 %
... stored (iterim) between debarking and milling	40 %
... arriving at the log yards in time-peaks	7 %
... processed on a log yards with online optimisation of lifts and moves	6 %
... processed on a log yards with automatic fuel consumption monitoring	3 %
... processed on log yards where drivers get lessons in eco-driving	9 %
... processed on log yards which comprehensively use pneumatic systems	

b) Deviation of circumstances in the European sawmill industry

In total, the potentials were sorted to 42 different circumstances. For each of them the deviation in Europe was estimated by experts. Table 8 lists the results for the circumstances relevant for the potentials on the log yard as an example. Deliverable 4.2 (Current and potential savings in primary energy use and GHG emissions of the European SMI) lists the circumstances for all locations.

c) Results

The highest optimizations potentials in terms of primary energy use and greenhouse gas emissions were identified to be located at the drying process. About 20 % reductions can be achieved here. In total, approximately 25 – 30 % reduction is possible if all measures are implemented where it is technically possible. Table 9 lists the potentials in each field of action. The measures were aggregated to “General Maintenance” which includes all actions like “night owl walks” and checking the air pressure system for leakages, “optimize process control” describing measures like reordering the piles on the log yard as well as reducing freewheeling, “refurbish engines, light, conveyors and hydraulics” and “optimize drying process” aggregating all actions in connection to the drying process.

Table 9. Reduction effect of different measures on total primary energy use and greenhouse gas emissions in 2020 compared to the reference scenario.

Group of Measures	Greenhouse gas emissions	Primary energy consumption
General Maintenance	-1.8 %	-0.9 %
Optimize process controll	-2.7 %	-0.9 %
Refurbish engines, light, conveyors and hydraulics	-6.0 %	-3.0 %
Optimize drying process	-19.3 %	-20.5 %
Total	-29.8 %	-25.3 %

The policy framework evaluation

With regard to the projected energy use of the European Sawmill industry in 2020, the most 10 relevant countries in terms of primary energy use in their sawmill industry were identified:

1. Germany,
2. Sweden,
3. Romania,
4. Austria,
5. Finland,
6. France,
7. Slovakia,
8. Czech Republic,
9. Poland,
10. Latvia.

The sawmill industry in the listed countries will be responsible for more than 70 % of the total primary energy use of the European sawmill sector in EU - 28 and Norway if the current status quo of specific final energy use remains at the same level. This also implies, that the policy tools which support the development of energy efficiency in the sawmill industry have the highest impact in these 10 countries.

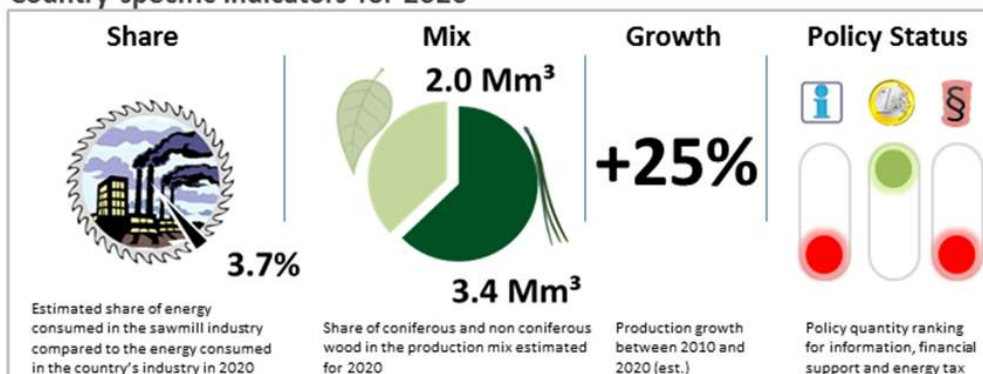
Therefor the implemented policy packages in these countries were analysed in terms of their completeness and if optimization is needed. To do this, the implementation of energy efficiency measures was compared to a typical innovation process which consists of five stages (Knowledge, Persuasion, Decision, Implementation, and Confirmation). For each country it was checked, how many policy tools were available for each stage and if all stages were covered by supporting tools.

For example, going through the “Knowledge stage” enables the companies to be aware of the saving potentials which lie dormant in their company.

On policy level this is supported by motivation and information campaigns, support of collaboration-networks to aggregate similar interests as well as by support for the implementation of EnMSs in the companies.

Further on, the price of energy in the different countries was analysed to understand the economic relevance of energy efficiency in the specific countries. In total, more than 50 policy tools in the 10 countries were analysed. For each country, a fact sheet with key indicators for the stakeholders was designed. Figure 22 shows the sheet with key indicators for Romania.

Country specific indicators for 2020



Relative Importance to EU Sawmill Industry in 2020

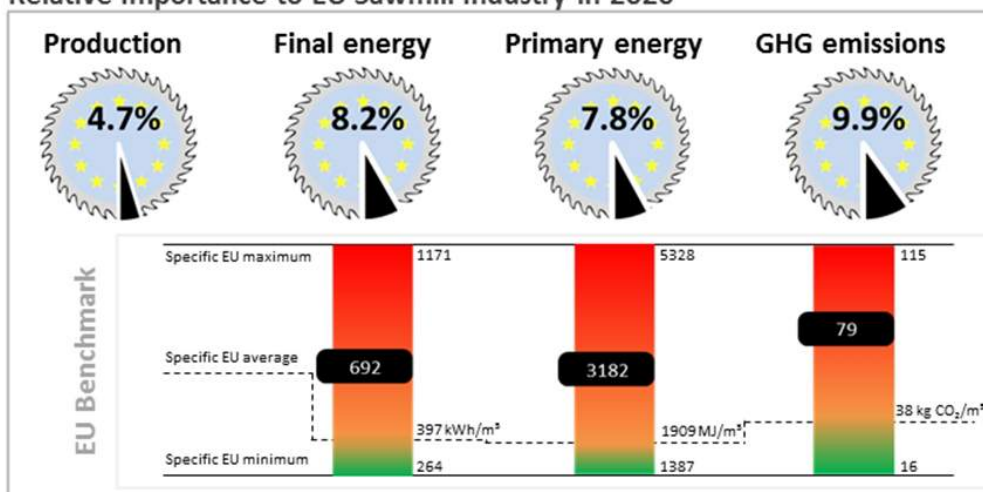


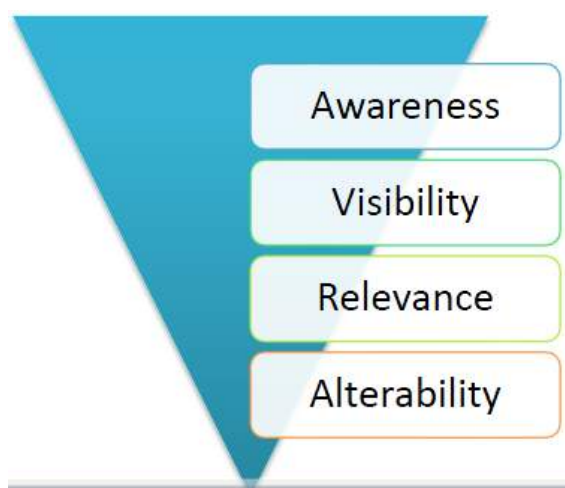
Figure 26. Key indicators for the sawmill in Romania.

The sheet shows in an easy way how important the sawmill industry sector is in the respective country in terms of energy use and the importance of the country's sawmill industry relative to the sawmill industry in EU - 28 and Norway. The importance is reported by indicating the country's sawmill share of final energy use, primary energy use and greenhouse gas emissions in the European context. It further shows the specific energy use and greenhouse gas emissions of an average product from the country's sawmill industry compared to the European mean value.

In addition, the sheet shows the share of produced coniferous and non-coniferous sawn wood in the country as well as the growth of the country's sawmill industry between 2010 and 2020. Finally, the availability of policy tools in the country is rated by a traffic light system. It shows the availability of policy tools which support the availability of information on energy efficiency and networks as well as the availability of financial tools which either support the implementation of EnMS or energy efficiency measures directly. The third traffic light indicates the level of energy prices in the country. In this context red indicates low energy prices.

4.4.3 The strategy for reduced energy use

The Inter-European Strategy for reduced energy use recommends measures and optimization options to the European sawmill industry towards a more energy efficient industry sector. It displays the available potentials differentiated by technical and geographical fields of action and gives recommendations to the stakeholder on how a reduction of 4.5 TWh/yr in the European sawmill industry as described for the long-term outcomes of Ecoinflow could be accomplished.



Increasing the energy efficiency is based on management decisions following positive cost benefit analysis!

The following recommendations with country specific characteristics can be given:

Raise awareness:

The first and most essential requirement which pushes the issue of energy efficiency into the everyday routines of increasing the profit of a company is awareness. The management of a company must be aware, that dealing with the subject is worth the time.

Policy tools supporting information and motivation of sawmills to undertake energy efficiency improvements need to be strengthened in all Europe but especially in Romania, Slovakia, Latvia, the Czech Republic and Poland. In these countries, the availability of information programs was found to be rather low. Lessons learned in Austria and Finland that seem to run successful policy tools to promote energy efficiency information availability should be shared to implement successful policy packages in these countries. For the countries with a high share of non-coniferous sawn wood production (Romania, Slovakia, Latvia), lessons especially learned in France may be of great help.

Associations on national level especially in Romania, Slovakia, Latvia, the Czech Republic and Poland should take advantage of the available information on energy efficiency in SMI on European level. This includes the results of the Ecoinflow project like the best practice sheets and the SawEnMS Handbook. Further on, the available information from other countries like Austria can be translated and disseminated to the SMI in these countries. Networks should be established to better disseminate the information and bundle similar interest. Policy tools can support this.

Increase visibility:

The energy use and the cost of energy respectively need to be integrated in the cost accounting of the company. Only if the energy costs of a product and its process steps are visible, innovation and optimization can be focused on a specific part of the production to reduce these costs.

Sawmills should install energy meters, conduct energy audits and break down the energy use to sub-processes. The implementation of an EnMS according to ISO 50001 or according to the SawEnMS Handbook is recommended. Associations should support harmonization of energy indicators on sawmill level and support expert networks to share knowledge between the sawmills.

On policy level, financial support for energy audits beyond the EED directive should be offered.

Increase Relevance:

The daily routines in a sawmill focus on the most important issues and problems which need to be addressed to increase the profit of the company. Only if the use and cost of energy is relevant in comparison to other pending issues, they will be on the daily agenda. This is determined by the total energy use and its price.

If energy prices are low, companies are less interested to reduce their energy use. Especially in Romania, the Czech Republic, Poland, Sweden and Finland this is the case. Energy tax can be bound to the implementation of EnMSs to increase the willingness of the sawmills

Provide Alterability:

Increasing the profit means to decide on changes. If the reduction of energy and the associated costs should be a part of this, they need to be alterable by following a certain procedure. Therefore, measures which lead to the reduction of the energy use need to be available, be known and known to increase the profit of the company.

Slovakia may have problems to reach its 2020 energy targets and new policy packages might be implemented or the existing ones may be changed. Since the SMI in the country is responsible for about 3.3 % of the total final energy consumed in the country's industry, associations may push for a SMI specific financial support package. This package should also focus on new investments since it is most likely that new sawmills are going to be built in the next years according to the scenario.

In the Czech Republic, Poland and Finland, new policy packages might be implemented or the existing ones may be changed, but the energy use of the SMI compared to the countries energy use is very small. Hence, no SMI specific package can be expected. In these countries, associations should check if the available policy packages fit the needs of the SMI and push for corrections if needed. In Poland, the focus should be on new installations and refurbishment. In the Czech Republic and Finland, refurbishment and maintenance of older mills is rather important.

Further on, some general recommendations can be given for sawmills, associations of the sawmill sector and policy.

Recommendations for sawmills:

- Implement an EnMS according to ISO 50001 or according to the SawEnMS Handbook which is tailored especially for sawmills.
- Get information on the financial support that is provided for energy efficiency networks, energy audits and investment into energy efficient technologies in your country.
- Focus on your drying process first. 81 % of the available potentials are assumed to be located here. The following aspects should be regarded in particular in combination with the introduction of an EnMS:
 - Maintain the fans,
 - Maintain the walls and doors,
 - Maintain and clean the heating coils,
 - Improve your knowledge of drying parameters,
 - Avoid over-drying,
 - Load the kilns correctly,
 - Maintain and optimize the air steering,
 - Take air-drying (pre-drying) into consideration,
 - Maintain the engines at fresh air- and exhaust flaps,
 - Calculate the cost and benefit of frequency converters,
 - Calculate the cost and benefit of heat recovery units.

Recommendations for associations of the sawmills sector:

- Inform your members about the available financial tools to support the implementation of EnMSs and energy efficiency measures.
- Translate and disseminate the available information and training material from other countries to your members.

- Push politicians to improve the financing framework for information and investment support by showing them the energy efficiency potentials of the sawmill industry in your country.
- Harmonize the way how EnMSs are implemented by your members. The SawEnMS Handbook can be used for guidance.
- Harmonize the way how measurements are conducted by your members. Benchmarking can only be conducted if measurements are comparable.
- Provide platforms for energy efficiency networks to strengthen the communication between sawmills.
- Provide platforms for cooperative procurement of energy efficient technologies.
- Ask your members to disseminate success stories of implemented EnMSs and installation of energy efficient technologies.
- Develop an energy efficiency report for the sector or your members respectively and analyse, document and disseminate the achievements that were made.

Recommendations for policy makers:

- Make sure that energy efficiency is an important topic in research and development programs national and European.
- Incentive programs for installing EnMS should foresee a control loop to make sure that supported activities are not only documented on paper but have been implemented and have achieved the expected results.
- Urge associations to document progress achieved by their members and to qualify energy savings.

5 Communication and dissemination of the results

The Ecoinflow consortium recognised the dissemination activities as an essential part of the project. The dissemination and communication strategy was designed at initial stage of the project. The strategy defined the key objectives, identified the main target groups, defined timelines for the dissemination activities and described the main dissemination tools of the eastern parts of Europe. The key objectives of the dissemination strategy were:

- to make known as widely as possible the findings and recommendations of Ecoinflow,
- to engage with project's target groups (in particular sawmill managers and operators) and to obtain feedback,
- to stimulate discussion among stakeholders on project's outcomes and recommendations,
- to increase the political awareness and create beneficial framework conditions, and
- to strengthen the knowledge base of both end-users and policy makers

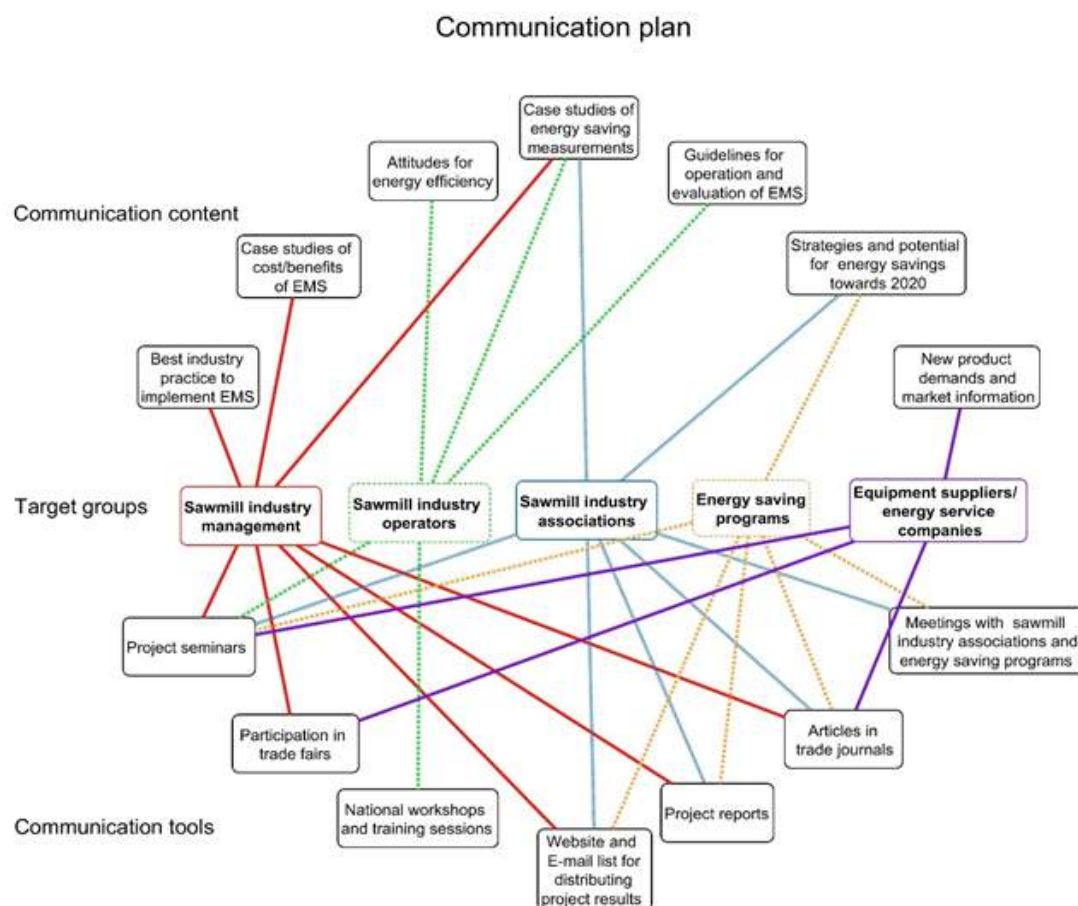


Figure 27. Communication plan.

Table 10. Key project actors.

Target Group(s)	Group role	How will the target group(s) benefit from this action?
– Sawmill industry management and operators	prime target group and directly affected by this action.	Energy savings, cost savings, energy efficiency, improved utilization of raw material, increased sales of by-products, development of expertise, decision support, competence training, training sessions, demonstration of energy measurements
– Sawmill industry associations	Important role in communicating the possibilities and strategies for energy savings beyond this action.	Development of expertise, stronger member group, estimates of energy savings for the European sawmill industry, common tools for energy management, European energy network
– Energy saving programs	to provide in-depth industry information that will trigger additional action from this group.	Industry know how from technical reports,

During the project lifetime the consortium efforts were focused on raising the awareness on project among the project main target groups, in particular sawmill managers and operators.

The high involvement of sawmills was essential for making Ecoinflow a successful project. For that purpose different dissemination tools were used:

- Project websites (www.ecoinflow.com –main website, www.sawenms.com-handbook testing and Ecoinflow network portal, www.sawbenchmark.com– online benchmark tool for energy efficiency comparison),
- Promotional material: brochures, SawEnMS handbook, newsletters, presentations, video articles, training kit, etc.,
- Presentations at relevant events from the sector (e.g. Ligna fair, thematic international and national conferences and workshops, etc.),
- Organisation of the national training workshops and session.

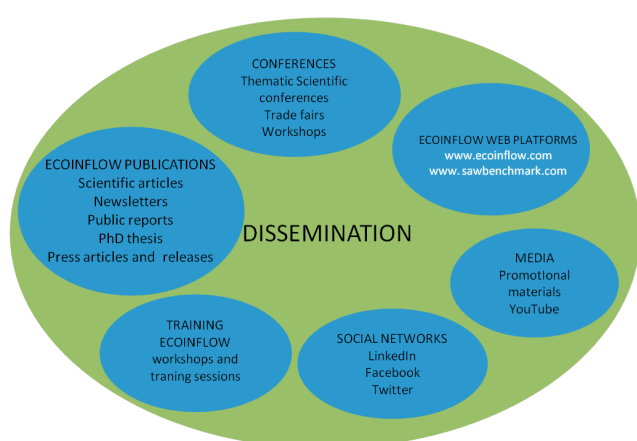


Figure 28. Dissemination tool.

5.1 Project websites

The Ecoinflow website has been used in promotion of the project activities and as the main gateway to both the professional sector and the general public. The project consortium identified language barriers as possible obstacles for fulfilling the project achievements and outcomes, therefore, the web content was offered in six languages assuring better acceptance and understanding of the project concepts. The Ecoinflow project information has been made available in English, German, French, Latvian, Norwegian and Swedish. The main portal also offered a project internal section for data exchange and project management. This section aimed to facilitate project management and internal communication: it serves as a repository of management-related activities and contents, including project meeting information, deliverables, reports, templates and corporate image documents.



Figure 29. Project websites: the Ecoinflow main site and the SawBenchmark site.

The Ecoinflow website has several specific objectives:

- to perform an informational role by publishing core information about the project in an accessible and easy to understand manner,
- to promote the project by highlighting new outputs as they are made available (such as SawEnMS handbook, benchmark tool, case studies, training workshops project dissemination activities etc),
- to fulfil a network-building role by attracting people who are generally interested in the topic to the site, so visitors start to link to the site, bookmarking it and relying on it as a good source of information about energy efficiency in sawmill industry,
- to fulfil a monitoring role by allowing the consortium to analyse site traffic, interest amongst visitors, etc.

All project partners contributed to the website update by supporting the translation of specific sections, by providing input to the site in the form of relevant news items resulting from their own work and networks and by ensuring its widest possible visibility in their own regions/countries and networks.

In total, the main Ecoinflow website had 36,000 hits. It is expected that number of hits will continue to increase in the post project period due to possibility of downloading the project outcomes, such as SawEnMS Handbook, Night owl Walk guide, Defining zones for metering guide, report on Inter-European strategy for reduced energy use, etc. The website will remain active after project end and will continue to serve as one the main communication channels for project achievements.

Although the SawBenchmark website (www.sawbenchmark.com) was designed primarily as an online tool which offers the opportunity for companies to compare their own energy use to fifty European sawmills, the portal also indirectly contributed to the dissemination of the project overall concepts. It is expected that the full use of the Ecoinflow online tool will increase the number of users during the post project period in which an extensive tool promotion campaign will be carried out by the main author of the tool, FCBA.

5.2 Promotional material

The development of promotion materials by employing an attractive and recognisable project corporate identity was another important activity in meeting the project promotional dissemination needs. These materials were created from the start of the project and were based on common, compelling descriptions of the project main aspects available in different languages. All project partners provided feedback on the design and contributed to their distribution at relevant events, direct emailing, and face to face contacts. These materials were also available on project website.



Figure 30. Examples of different Project promotional materials.

5.3 Promotion at thematic events

By participating in numbers of the sector thematic events the consortium intended to increase awareness of the project outcomes and ideas, and to enlarge the potential recipients of the project message and increase the number of interested people. Presentations at relevant conferences, seminars, industry fairs and other events was managed and monitored to maximise the dissemination potential of these activities. All project partners contributed to this task by presenting Ecoinflow in relevant national and international events according to an agreed schedule as set out in the project dissemination plan. In addition to project presentations, the posters, brochures and project rollup were also presented and distributed to events participants. In particular, the sawmill industry events were visited such as the LIGNA industry fair in Hannover (Germany) and the Sawmill industry trade fair in Gothenburg (Sweden).



Figure 31. Ecoinflow at the Sawmill industry trade fair in Gothenburg (Sweden) and the LIGNA industry fair in Hannover (Germany).



The project partners also organised their own promotional workshops as a back to back activities or separate sessions in their other organised events (e.g. technical meetings, general assemblies, annual meetings, theses presentations etc.). The workshops mostly targeted sawmill managers and operators and aimed to promote the concepts of project clustering and sawmill networking. The sawmill network is one of the outcomes from the project which was initially used for the testing of the SawEnMS handbook. By joining the Ecoinflow network, sawmills got an opportunity to be actively involved in knowledge transfer and training activities related to energy efficiency in the sawmill industry, share their experiences with other European sawmills, build their networking capacities and participate in joint training events and initiatives. In order to assure the continuing project dissemination, each partner's sector contacts and sawmill network contacts were mined to create an expanded data resource of potentially interested organisations and individual.



Figure 32. Ecoinflow at events: the 9th International Softwood Conference (ISC, 16-17 October in Berlin), and a workshop at the County Administrative Board of Dalarna (Sweden).

5.4 Training workshops

The main objectives of the Ecoinflow training activities was the empowering of the sawmill industry stakeholders to improve their energy efficiency and to trigger management decisions which will lead to an implementation of an EnMS. Training was an important aspect in the knowledge transfer process to the main project target group (sawmill managers and operators). By organising national training sessions and workshops, the Ecoinflow consortium aimed to raise awareness among the sawmill managers and operators about the benefits that implementation of the energy efficiency measures could have in the production processes and savings that could be achieved.



Figure 33. The training material slides.

For the training sessions, the consortium produced a training material kit. It includes information on the potential of energy savings, best industry practices and examples of the benefits that EnMS implementation could bring for individual companies, including the ideas for energy saving measurements that should be considered for the existing production processes and in further investments. In total, four training workshops were held during the project period and more training sessions are planned after the project period.



Figure 34. The images from the training events.

In summary, the consortium reached the audience of more than 100,000 people by carrying on more than 60 different dissemination activities.

6 Activities and impact after the end of the project

The activities that the project consortium is going to pursue in the after project life will be essential for the project success. The project consortium will continue to:

- create awareness of the project results among the key target groups (sawmill managers and operators, policy makers, equipment manufacturers, sawmill industry associations, etc.),
- share the knowledge and experience gained during the project,
- enhance discussion and expertise on relevant issues related to energy efficiency amongst the key actors such as sawmill industry, national and EU policy makers.

To ensure that the post project life is successful, the consortium will continue some of the dissemination activities. For example will some training sessions be held with presentations of the project results to the industry associations. The energy efficiency networks and other entities involved in energy management will live on, and so will participation at events, face to face meetings in particular with representatives of the small and medium sawmill companies. The project websites will continue to have an important role in communication of the project results and findings.

The early stage of the post project period the consortium will focus on promotion of the main project outcomes to different target groups from sawmill businesses to policy makers and industry associations. The target groups will receive information on final project report and briefing on main project outcomes and how they could be accessible.

In particular, the stronger collaboration with industry associations will be foreseen expecting that they act as the multiplier for the further communication of the project results.

The industry associations will disseminate the project results by:

- Further promoting the tools developed during the project and dissemination of the success stories of implemented EnMSs and installation of energy efficient technologies.
- Influencing the politicians to improve the financing framework for information and investment support by showing them the energy efficiency potentials of the sawmill industry at national and EU level.
- Providing the platforms for energy efficiency networks to strengthen the communication between sawmills.

The networks of sawmills which was established during the project will continue to be in focus of consortium dissemination activities. In the short term, the project consortium expects that the continuation of promotion of the project outcomes through national sector federations and industry associations will increase the number of sawmills who will be interested in EnMS and will trigger the behaviour changes regarding energy saving. In the long term, it is expected that more political decision will be made in order to support and induce a policy framework that will assure the more efficient use of the energy in sawmill production processes.

7 Conclusions

Ecoinflow was a three-year project funded by the Intelligent Energy Europe II program in order to provide the sawmill industry knowledge and tools to make substantial energy savings. The project involved research institutes and industry partners from eight European countries, and substantial energy savings have already been achieved.

The main project outcomes are:

- [The SawEnMS handbook](#),
- [The SawBenchmark tool](#),
- [An Inter-European strategy for reduced energy use](#).

The SawEnMS handbook is a guide for sawmills on how to implement a practical EnMS. The handbook includes a number of complementary tools (for example tools for Life Cycle Cost Calculation and for supporting the Energy Review), which are available on request from the project partners. The benchmarking tool is an on-line tool for evaluation of energy performance in the sawmilling and wood manufacturing industries. If you wish to compare your energy performance, please visit www.sawbenchmark.com. The SawEnMS handbook and the SawBenchmark tool are available in six languages (English, French, German, Latvian, Norwegian and Swedish). More project results (e.g. Nigh Owl Walk guides, Defining zones for meter guide, Inter-European strategy for reduced energy use, etc.) can be downloaded from the project website www.ecoinflow.com.

The Inter-European strategy for reduced energy use includes recommendations for stakeholders in the sawmill industry.

The main recommendations for sawmills are:

- Start working with energy efficiency in a structured way, for example by implementing an EnMS according to the SawEnMS Handbook,
- Collect information on the financial support provided for energy efficiency networks, energy audits and investments into energy efficient technologies in your country,
- Focus on your drying process first, since 81 % of the available potentials on average are located here.

The main recommendations for policy makers are:

- Make sure that energy efficiency is an important topic in national and European research and development programs,
- Incentive programs for installing EnMSs should foresee a control loop to make sure that supported activities are not only documented on paper, but have been implemented and that the expected results are achieved,
- Urge associations to document progress achieved by their members and quantify the energy savings.

The project aimed at energy savings of 1 TWh, a number that the project group realised from the start was very ambitious. When summing up the results, estimated energy savings in the range of 190–490 GWh have been achieved during the project period. The project group is confident that even though the 1 TWh target was not reached within the three-year project period, the ground is set to reach the target within the next 3–4 years.

It should be noted that the decision period at sawmills can be long lasting, which makes it difficult to realise both the implementation of EnMSs and the post energy saving analyses of a large number of sawmills within a project period of three years. In addition, when companies have already set their investment budgets for the next year, any projects introduced at a later stage will be prioritized thereafter, and possibly postponed.

The SawEnMS Handbook and the established national networks are keys to achieve an energy saving of this magnitude in the coming years, and to continue the reduction in energy use in the industry towards 2020 and beyond. During the project period, 27 sawmills have started implementing an EnMS. This means that energy savings resulting from the project will be realised in the coming years and will continue for many years.

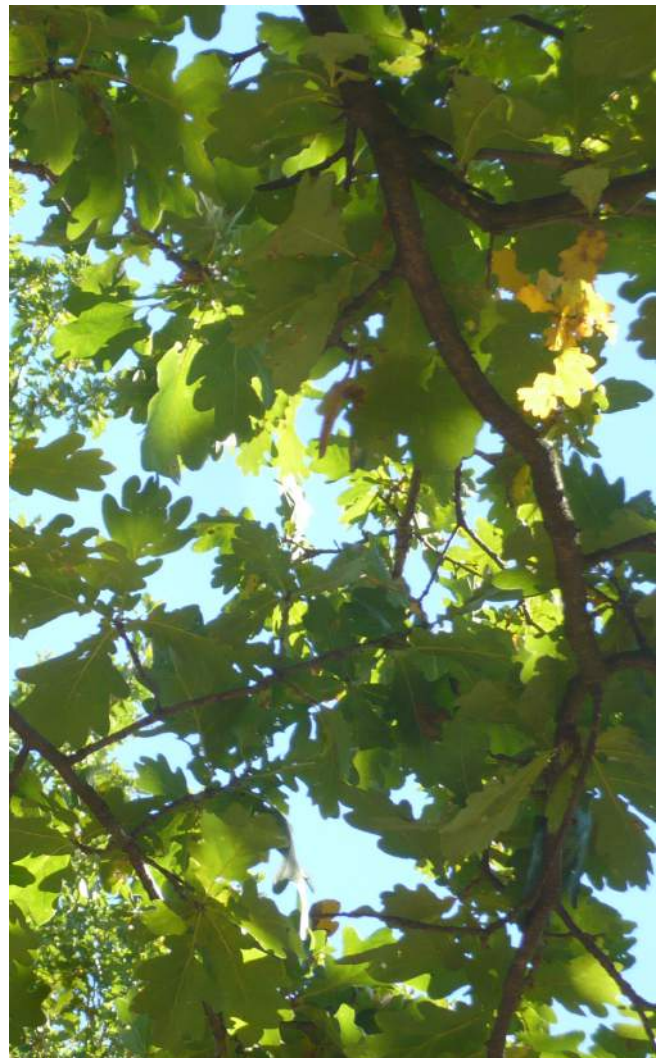


Illustration. Source InnovaWood.

To discuss how you could benefit from the ECOINFLOW project, please contact:

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www.ecoinflow.com