Contract N°: IEE/11/946/SI2.615945

ECOINFLOW

Energy Control by Information Flow

Instrument: Intelligent Energy – Europe (IEE)

Deliverable D.2.2
Guide for defining zones and finding locations for energy meters

Due date of deliverable: 2013-05-01
Actual submission date: 2013-05-01

Start date of project: 2012-05-01

Duration: 12 months

Organisation name of lead contractor for this deliverable: SP

Type: Final

Project co-funded by the European Commission within Intelligent Energy – Europe (IEE)		
Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Preface

The main objective of *ECOINFLOW* is to reduce the annual energy consumption in the European sawmilling industry (SMI) sector by 1 TWh through international engagement, collaboration and knowledge transfer.

Some of the main barriers for energy savings in the SMI are lack of infrastructure and profitability with sale of surplus energy products, such as bark and chips, knowledge about optimal utilization of the energy input factors, and low awareness about the reduction potential.

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

ECOINFLOW will develop and implement Energy management systems, EMS, in small and medium sized sawmill enterprises to enable the control and the information flow.

Generally, there are only a few measurements of energy consumption on a regular basis for companies in the sawmilling industry sector, which can be an obstacle for the implementation of an EMS. The project participants will propose actions to find the most efficient way to install power and heat meters for monitoring of energy flows in the industry. Based on the monitoring of the energy utilization, the energy performance of the participating companies will be benchmarked to identify the best practice. The project will employ the standard ISO50001 for implementation of tailor-made EMS for the sawmilling business sector.

The annually energy consumption of the SMI in the participating countries is estimated to a total of 17 TWh, thus the energy saving target of the project corresponds to an average reduction of approximately 6 %. The IEE indicators as target within the action period is 159 000 toe/year in primary energy savings, compared to projections, and 238 000 t CO_2e/year in reduction of greenhouse gas emissions.

Implementation of EMS will enable more accurate analysis of energy saving measures. The motivation for the companies to participate as project partners are both better control of processes and resources, but also the economical benefits any energy saving measure gives.

The project will generate important inputs for the participating countries to be implemented in the national action plans to meet the binding targets of the 2020 European renewable energy policy. Energy savings in the sawmilling industry sector will lead to excess surplus of biomass, as the sawmills through the production of sawn timber also are large producers of biomass. Parts of this biomass can be utilized to replace fossil energy sources in Europe.

Participating companies in the project:
Norsk Treteknisk Institutt, Norway
SP Technical Research Institute of Sweden, Sweden
Thünen-Institute, Germany
L'Institut Technologique Forêt Cellulose Bois-construction Ameublement, France
The Norwegian Sawmill Industries Association, Norway
InnovaWood, Belgium
Bundesverband der Säge- und Holzindustrie Deutschland, Germany
Fédération Nationale du Bois, France
BSW Timber, United Kingdom
Mühlböck, Austria
Bergkvist-Insjön AB, Sweden
Amber Wood LTD, Latvia

Contents

1 Abstract

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, EMS.

In order to be able control the energy use and follow up the energy efficiency improvements it is necessary to group the energy users into manageable sizes with good enough resolution in size. For the total use, it is sufficient to have e.g. the bill from the electric company, and from the supplier of steam, and the amount of bio mass put into the boiler. If the aim is to know where the greatest saving potential is or if a change has had the foreseen impact, it is necessary to have smaller groups. The division into zones at the sawmill can most easily be made according to the production steps. What is important is that the zones are manageable and possible to measure. Before buying meters, it is necessary to consider the area of use. Make sure the meter is easy to use and is able to measure the interesting parameters. Also the ruggedness is important, like if the meter is waterproof, shockproof, battery life etc.

It is also essential that the data transfer to your EMS or other computer for further evaluation and storage is easy and fast, so that logging can continue almost uninterrupted when the logger is full and needs emptying. This goes of course also for the fixed installed meters. Make sure that the data format is usable in visualisation and calculation programs of your choice. The memory capacity of mobile meters is very varying between meters. Make sure it is possible to store enough data with enough resolution for your purpose.

The time between samplings as well as the time for measuring the production steps requires knowledge about both the process and the measuring device. The best is to measure during more than one whole cycle, e.g. more than one drying batch, more than one saw batch etc., with high resolution. It is always possible to aggregate measurements if there are much data, but difficult to separate them if there are too little data.

The meters should be placed and grouped so they measure the needed data and only the needed data. The grouping of energy users should be well thought of before installing fixed meters. Mobile meters can be positioned in different places, and tested where they are of most use.

2 Introduction

The main objectives of *ECOINFLOW* are to reduce the annually energy consumption of the European sawmilling industry (SMI) sector by 1 TWh, to contribute to the EU goal of 20 % reduction in fossil energy by 2020 and to increase biomass available for energy generation through international engagement, collaboration and knowledge transfer.

Generally, there are only a few measurements made of energy use on a regular basis for companies in the sawmilling industry sector. This can be an obstacle for the implementation of an energy management system, EMS. The project participants will propose actions to find the most efficient way to install power and heat meters for monitoring of energy flows in the industry. Based on the monitoring of the energy utilization, the energy performance of the participating companies will be benchmarked to identify the best practice.

The project aims at developing accurate methodology to find the most efficient way to install power and heat meters for monitoring of energy flows in the industry. The methodology will focus on sorting the different production processes into energy groups, to yield the measure of energy used for each step of the production process.

3 Division into sawmill zones

Sawmills use energy of three main categories: electricity, thermal energy and transport fuel. The thermal energy is provided by biofuels, oil or natural gas, but also by electricity. All of these types of energy should be measured to be able to map the energy use and find improvements for energy efficiency.

There are also mills that produce and sell electricity and thermal heat. These parts of the sawmill energy should also be included in the energy mapping. The sold biofuel, e.g. saw dust, bark and chips, is not included explicitly in this context if it is not included as an input.

In order to be able control the energy use and follow up the energy efficiency improvements at the sawmill, it is necessary to group the energy users into manageable sizes with good enough resolution in size. For the total use, it is sufficient to have e.g. the bill from the electric company, and from the supplier of steam, and the amount of bio mass put into the boiler. If the aim is to know where the greatest saving potential is, where a change has been made, or if a change has had the foreseen impact, it is necessary to have smaller groups. As a sawmill has hundreds of electrical motors, it is not possible to measure on each of them and they must be grouped.

The division into zones at the sawmill can most easily be made according to the production steps. One example can be seen in Figure 1. There are of course more ways to group energy users than this way. What is important is that the zones are manageable and possible to measure and that all energy users are included in a zone.

If you look at the kiln dryers in Figure 1, they are divided into “Batch kilns” and “Progressive kilns”. As there might be more than 40 batch kilns on a large sawmill they are most probably different in make, year of manufacture, isolation, energy use, productivity, size, heat recovery etc. so the real division should be in a finer net than exemplified in the figure. This goes for all groups where you want to control the energy usage.

In the example the chipper is found in the “Supportive processes”, but it can also be found in the “Saw house” or in “Bio fuel production”. It all depends on the layout of the company and how the processes are organised in other ways.

Many machines also have dust extracting devices, which are not mentioned in the zone plan. A very important thing to remember about them is that they extract a lot of indoor air, which in many cases has been heated first. The main energy loss from dust extraction is therefore not the fan motor, but the heated air that is extracted from the premises.

This is an example of how the division can be made. Other divisions are possible. Each sawmill must make their own division into zones, to fit their needs. The processes in the example can in turn be separated further. Sometimes it is desirable to measure the energy with higher resolution in machinery, e.g. sawing consists of many machine groups and, perhaps, 20 motors.

There is no use of dividing the energy users into too small units to begin with, as it is the largest users that must be found first, and too small zones makes it too tiresome to measure.

Log measuring station		
Log reception	Log sorting	Log yard

Saw house			
Debarker	Log intake	Sawing	Conveyors

Green sorter		
Green sorting	Cut saw/trimmer	Sticker stacker

Kiln dryers	
Batch kilns	Progressive kilns

Final sorter			
Destacker	Final sorting	Stacking	Packaging

Preservation plant			
Destacker	Impregnation	Stacking	Packaging

Planer				
Destacking	Planing	Rip saw	Stacking	Packaging

Other processes		
Finger joint	Painting	Biofuel production

Forklifts and tractors		
Log tractors	Forklift, green	Forklift, dry

Office		
Lighting	Heating	Car heaters

Warehouse	
Lighting	Heating

Boiler		
Fuel feeder	Pumps	Fans

Supportive processes			
Chipper	Ventilation	Pneumatics	Hydraulics

Figure 1. Example of energy zones.

4 Meters and data loggers

The meters and loggers mentioned below are examples and must not be seen as recommendations from the project participants. There are also other suppliers of both meters and loggers. The prices are very approximate from the spring 2013.

There are meters for fixed installation as well as mobile units.

Before buying meters, it is necessary to consider the area of use. Make sure the meter is easy to use and is able to measure the interesting parameters. Some meters are very powerful, and can measure and calculate a lot more parameters than needed. They are often too complicated to use, so the measurement is more of a burden than a help. Also the ruggedness is important like if the meter is waterproof, shockproof, battery life etc?

It is also essential that the data transfer to your EMS or other computer for further evaluation and storage is easy and fast, so that logging can continue almost uninterrupted when the logger is full and needs emptying. This goes of course also for the fixed installed meters. Make sure you are able to reach all data you need in a convenient way. Make sure that the data format is usable in visualisation and calculation programs of your choice.

The memory capacity of mobile meters is very varying between meters. Make sure it is possible to store enough data with enough resolution for your purpose. As the memory is limited to a fixed number of measurements there is a balance between sampling interval and resolution.

One example of mobile heat meter is the TransPort PT878 from GE Sensing. It is a portable ultrasonic liquid flow meter that measures the flow and temperature in a pipe from the outside of the pipe, without interrupting the flow, see Figure 2. The price is in the area of €7000-8000.

Figure 2. Example of mounting a mobile ultrasonic flow and heat meter.

Examples of mobile units for measuring electric energy are Fluke 435, Fluke 1735 and Chauvin Arnoux CA8332B. They have many similar, but also different, features and have also different prices. The prices for these meters are in the area of €4500-5000, €2500-3000 and €1500-2000 respectively. They measure the energy on 1 to 3 phases, and are able to store a large number of samples.

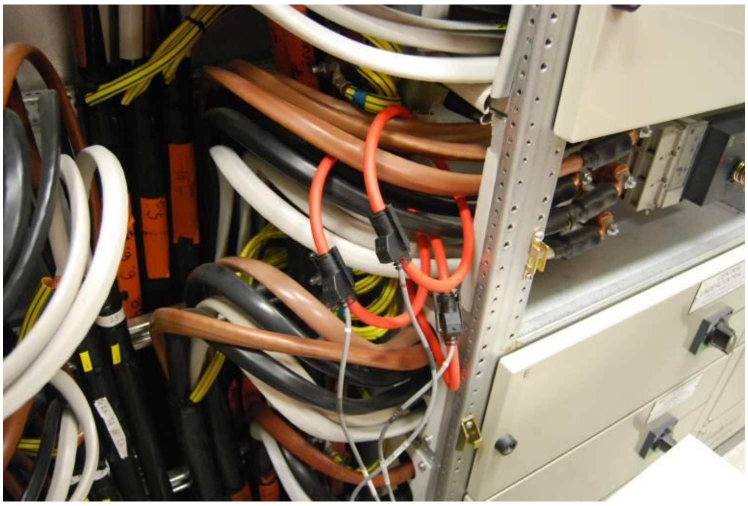

Figure 3. Mounting of current probes of a mobile meter in the electric central signal box.

Figure 4. Mounting of voltage probes of a mobile meter in the electric central signal box.

Examples of stationary meters:

- Electricity meter: Kamstrup 382, one unit per phase.
- Hardware for collecting the data and send it to a database: EMS10, also from Kamstrup.
- Heat meter: Multical 801, also from Kamstrup.

Approximal price for one kiln, without installation, is €2000-2500.

Example of visualization software:

- Labview
- Qlikview
- Tableau
- Excel

There are other suppliers, the meters mentioned above are examples used in other projects.

5 Sample time

The time between samplings as well as the time for measuring the production steps requires knowledge about both the process and the measuring device. It is the best to perform measurements during more than one whole cycle (e.g. more than one drying batch or saw batch) with high resolution. This makes it possible to get data from variations in the process, in the raw material and the environment. With high resolution in the sampling time it is possible to see peaks and other events. It is always possible to aggregate measurements if there are much data, but difficult to separate them if there are too little data. Some meters have the feature to log both the average and the min/max values during the sample interval. With this feature it is possible to see approximately where in the process the extreme values occur without logging the exact time and later measure only the interesting part of the process with higher resolution in time.

The electric metering for saws must have a much faster response time than the heat metering for kilns. The kiln measurement, though, is ongoing for many days without break, while the sawing usually stops for breaks and shifting of tools. This makes it possible to calculate needed memory and sampling interval.

It is not possible to say that “1 hour of measuring is enough” or that “5 days is too short”. It all depends on what parameters are measured, what process is measured and where during the process, and what measurement interval is used. This is specific for all measurements, not only energy at sawmills. In Figure 5 it is possible to see the energy use, with rather low resolution in time. The interesting part, 10 kW during the night, is very visible anyway.

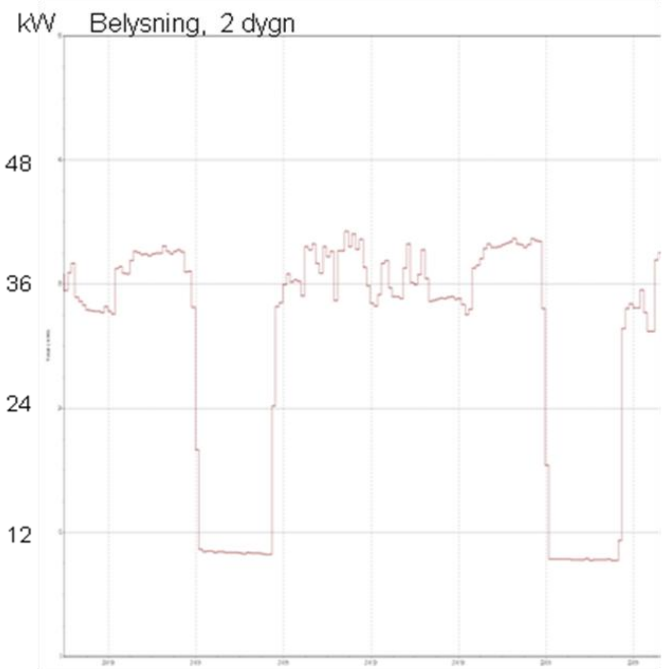

Figure 5. Energy used for lighting during 48 hours.

In Figure 6, the electricity use of a compressor during two weeks is shown. In the figure it is possible to see the idle power, approximately 65 kW, during nights and weekends, as well as the peak power, approximately 85 kW.

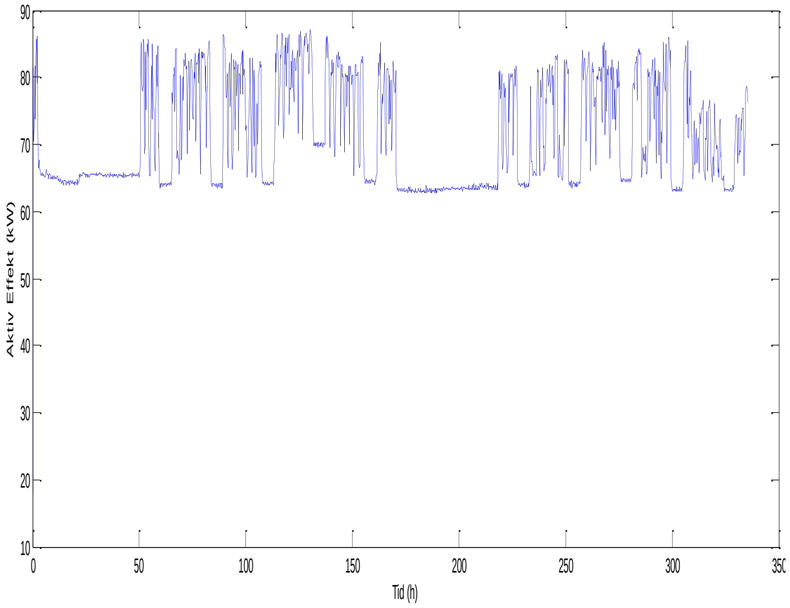

Figure 6. Energy used by a pneumatic compressor during 2 weeks.

To get started, it is better to do something than to do nothing. As long as the first collected energy values are considered as a snapshot and not as the whole truth, the values are a starting point for further measuring.

6 Positioning of meters

The meters should be placed and grouped so they measure the needed data and only the needed data. Too large groups make it hard to define how much energy each user use. The grouping of energy users should be well thought of before installing fixed meters. Mobile meters can be positioned in different places, and tested where they are of most use.

When buying new equipment, remember to include the energy metering in the installations.

Thermal meters should preferably be placed so it is possible to measure each kiln separately. Only in lack of alternatives should the main pipe be the only measurement point.

The electric meters can nowadays be included in the frequency converter and comparatively cheap and easy be connected to a logging system.

The electric measurements must in many cases be made on each motor separately, which makes it hard to measure a complete sawing operation, as many, maybe up to 6 or 8, motors are engaged at the same time. The easiest way might be to measure in the central signal box.

In Figure 7, an example of how to divide the measuring of energy in a sawmill is shown.

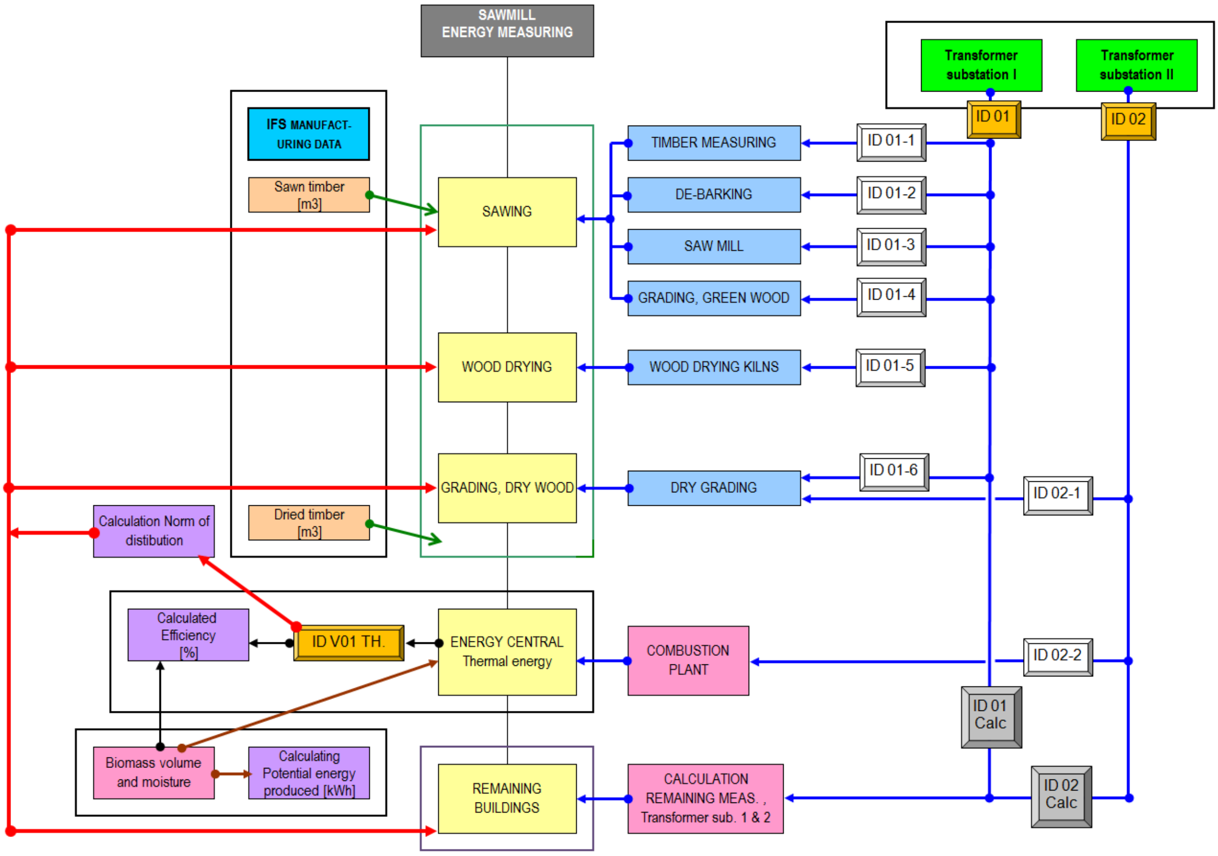

Figure 7. Example of divisions and positioning of meters for electrical and thermal energy.

Each example is simplified and only made to illustrate the complexity in the problem. In the figure above, Figure 7, only one kiln is shown. In reality many kilns of different kinds are in use.

7 Conclusion

An EMS needs energy data as input, to see if improvements are made in due time. Meters can be either mobile or fixed, or a combination thereof. There is much to gain if energy meters are installed and used in a carefully prepared way. The energy zones must also be chosen in a carefully prepared way, so the measurements can be used for improvements.

Before a sawmill industry invests in meters, it might be a good thing to ask a consultant or a research institute for advice on suitable meters and positioning of the meters.