
GUIDELINES FOR BUSSINESS INTELLIGENCE OF WOOD FUEL IN DISTRICT HEATING IN THE REGIONS OF ÖSTERGÖTLAND (SWEDEN), VIDZEME (LATVIA), SOUTH ESTONIA (ESTONIA)

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Introduction

This folder is a product of the systems analysis part of the EU financed Wood Energy project. The Wood Energy project (May 2010-December 2012) promotes wood as an energy source and improves knowledge about wood energy, eco-friendly techniques and clean technology. The project develops regional action plans and strategies on how to promote the effectiveness of wood energy. Case studies are carried out on investment calculations and procurements-related procedures in district heating.

Wood energy for use in district heat production is a strong combination for achieving sustainable heating of households and other buildings. Using wood fuel in district heating (DH) allows local utilization of the wood resources with high efficiency where the whole energy content of the wood fuel can be utilized. Moreover, wood energy based DH is not only carbon lean but also offers the opportunity to produce renewable electricity that can replace fossil fuel based electricity production. Hence, wood energy in DH can play an important role in a development towards a sustainable energy system, both locally and in a larger perspective, e.g. in a national and even in a European perspective.

For wood energy based district heating to grow, the technology must be competitive with other alternatives as well as profitable for the local energy companies. The competitiveness and profitability of this technology is very dependent on energy prices, especially wood fuel prices. Hence, an analysis of the (local) wood energy market is crucial for investors of this technology. The analysis of the wood fuel market can be supported by applying business intelligence (BI) methods, hereon referred to as business intelligence (BI) of wood fuel. The outcome of the BI is knowledge about the wood fuel market and possibly price prognosis, which is essential for decision making.

Performing a BI of wood energy for use in DH is a non-trivial task and a thorough methodology is essential for results of a high quality. This folder presents a guideline, or a check list, for performing a BI of wood fuel for DH. It illustrates what information is needed and how the information can be processed to give understanding of the market. The folder can be used for decision makers to understand the complexity of such a task, and also to check whether an expert's BI includes the essential parts. It can also be used as a support for anyone doing a BI of wood fuel. It should be noticed that here are many different ways of performing a BI of an energy carrier, and one general method is described here.

Bussiness intelligence-overview

Business intelligence (BI) mainly refers to computer-based techniques used in identifying, extracting and analysing business data, in order to support better business decision-making (definition of “Business intelligence” according to Wikipedia, November 2011).

The objective of the BI presented here is to get knowledge and an understanding of the (local) energy market to support strategic energy planning. One key issue for energy strategies are estimates on future energy prices. Even though making estimates on future prices is a non-trivial task, it can be facilitated by knowing historical and today’s prices and understanding the price mechanism as well as having access to an analysis tool bar. Hence, one approach for BI can be summarized by Figure 1 and the check list below. The guidelines for BI presented here, follows the structure presented in Figure 1 and the check list, with one section for each step.



Figure 1. General methodology for BI of an energy carrier.

BI - check list in brief

1. Price statistics
 - Historical and current prices as well as available futures
2. Price mechanisms
 - Factors influencing (local) supply and demand
3. Analysis and evaluation
 - Analysing gathered data

- Market function (Monopoly/oligopoly? Information spread? Etc.)
- Different energy market models
- Scenarios for possible price development

Wood energy is a local product

When it comes to wood energy, the local conditions are of great importance. The reason is that long transportation of wood fuel is relatively costly due to the relatively low energy density of wood fuel. The implication of this is that wood fuel is to a great extent a local product with a local market. This does not mean that wood energy is not transported; long distance transportation with boat is common, especially in the case of relatively high energy dense wood fuels such as wood pellets¹. However, it does mean that the price of wood energy is to a great extent set by local factors.

Local adaption

The below described methodology is supposed to be general from a North European perspective. However, for a BI of a local product such as wood fuel, local consideration is needed. Hence local adoption is needed. Examples of local adoptions for the countries participating in the *Wood Energy project* are presented in the guideline.

¹ Import of wood pellets from Canada to Sweden is one common example in the Swedish market.

Step 1: Price statistics

A convenient start for a BI of an energy carrier is to look at historic prices. By carefully analyse price statistics, a lot of information can often be revealed.

How to find price statistics

In most cases wood fuel is a local product and the price can vary within a nation. Hence, national/local price statistics are preferred before more chunked ones. Also prices in neighbouring countries can be of relevance, which calls for local statistics from other regions. Reliable local and official sources for price statistics on wood fuel for Sweden, Estonia and Latvia are presented below. On an international level, there are much less easily available price statistics for wood fuels than for fossil fuels such as coal, oil and natural gas. This is a challenge when import and export of wood fuels are considered. This is also the case regarding futures, where there are existing markets for fossil fuels and power, but not yet for wood fuel. However, as the importance of wood fuels grow (especially in the perspective of the increased use of renewable energy that is included in the EU climate and energy package), the demand for databases of international price statistics on wood fuels and futures markets for wood fuels will increase and are likely to emerge.

Sweden

One convenient source for price statistics on wood fuels is presented four times a year by the Swedish Energy Agency. This latest version (nr 3, 2011) can be found under <http://webbshop.cm.se/System/TemplateNavigate.aspx?p=Energimyndigheten&nc=Default&view=default&q=2327>.

Estonia

The main and most up to date source for price statistics is available in the website of private forestry webpage where price statistics of various wood products are available: www.eramets.ee. Additional information from national statistical database can be followed under the forestry chapter at: www.stat.ee

Latvia

Statistics on average prices of energy resources for final consumers are available in the database of Central Bureau of Statistics, available at: <http://data.csb.gov.lv/Dialog/varval.asp?ma=EN0260a&ti=ENG26%2E+AVERAGE+PRICE+S+OF+ENERGY+RESOURCES+FOR+FINAL+CONSUMERS+%28EXCLUDING+VAT%29&path=../DATABASEEN/vide/Annual%20statistical%20data/Energy/&lang=1>.

One disadvantage with these open sources is that often there is a considerable time delay, which means that the latest available prices are up to one year old (or even more), thus not reflecting current market prices. With a quickly changing market (wood fuel prices has increased rapidly in many places in Europe), these statistics can be out of date before they are published. One way to get more updated prices is to have direct contact with sellers and buyers of wood fuel. However, in some cases the contracts between these partners can obstruct them from revealing current prices.

An advantage with these open sources, is that they can show the long term development of the prices. This can be used in Step 3 (Analysis and evaluation) to identify price shifts and analyse the reasons behind them.

Check list for gathering price statistics

- ☐ Gather price statistics for different wood fuel categories, at least ten years back in time.
- ☐ If possible, distinguish prices for different regions to find any price regions.
- ☐ Also gather prices of other fuels to find out any covariance (e.g. that wood fuel price follows oil price).
- ☐ Include any taxes or subsidies to get the full picture.

Step 2: Price mechanism

As with all commodities on a free market, the price of wood energy is set by the supply and demand, see *Figure 2* below. Hence, one should investigate the (local) factors for supply and demand. In the bullet lists below factors that influence supply and demand, respectively, are presented. Below the lists, each factor is described in brief.

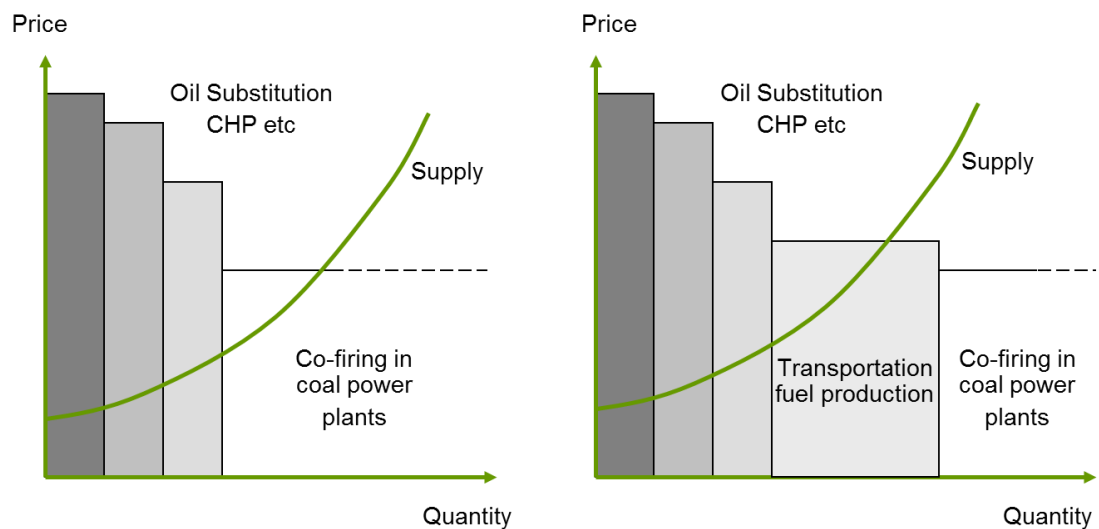


Figure 2. Supply and demand sets the price of wood fuel. A new player on the market with high willingness to pay for wood fuel (producer of transportation fuel in this example) can cause an increase in wood fuel prices, implying that some of the current users of wood fuel cannot afford it anymore (co-firing in coal power plants in this example).

<u>Factors that influence supply²</u>	<u>Factors that influence demand</u>
Current situation and plans for: • (Local) wood area and wood production • Harvesting companies • Wood fractions produced (stumps, residues etc.) • Activity in saw mills • Import possibilities	Current situation and plans for: • Export • Other users of wood fuel • Existing demand for wood fuel in the DH sector • Demand for district heating • Use of alternative fuel for DH production
Policy instruments and political goals	

² Regarding wood fuel supply, we are mainly referring to residues from wood production such as tops and branches, trees from early thinning, stumps and by-products (bark, saw dust, chips) at sawmills.

Factors that influence supply

Wood area and wood production

As already described above, wood energy is to a great extent local. Hence, the local production capacity is one of the key factors for the local wood energy price and knowledge about the local production potentials is of great importance for a BI of wood energy. In addition to local conditions, conditions in neighbouring regions can also be of importance, especially if the conditions differ. Although driving from one country to another the climate and forest conditions do not necessarily change considerably, but the regulations can change to a large extent.

Harvest companies

The local wood area can give an estimate on the production potentials, but there has to be harvest companies to bring the wood energy to the market. By contacting these companies, one can get a picture of the actual and the potential wood energy production in a region, e.g. concerning what is considered to be profitable to harvest at different market prices.

Wood fractions produced

One important factor influencing the amount of wood energy that can be harvested is what fractions or types of wood fuel that is produced, and what fractions are there still left in the forest. One relevant question is for instance, how much of the stumps as well as tops and branches are utilized. Is there potential for increased production of these fractions? Information about this can to some extent be found in statistics, but to get local precision, contact with local harvest companies and heat production companies is needed. Knowledge about the availability of different fractions is essential in the choice of combustion technology. The reason is that each type of wood fuel has its own characteristics and is more or less suitable for different types of plant configurations (e.g. fluidized beds or grate firing? Heat-only-boiler or combined heat and power plant working at different temperature and steam pressure conditions?).

Activity in saw mills

Residues from the saw mills can be used for energy purposes. Hence, current production and plans for saw mills can have a great impact on the supply. Regarding future plans, one should also consider the possibility that the market situation changes so that the local saw mills relocate or close down.

Import possibilities

The supply of wood energy is also influenced by import possibilities. The price in the exporting country must be low enough to handle the extra transport costs compared to local wood energy supply. One important factor for import is the access to appropriate harbours nearby, which facilitates long distance transportation. Medium long transports can also be facilitated by railway. Hence, the availability of this alternative should also be considered. From a cost perspective, it is very important to minimize the number of loading and unloading operations.

Policy instruments and political goals

The political agenda can have great impact on the supply, concerning e.g. the opportunities to improve growth of wood energy (by using fertilizers and/or fast growing new species) and conservation and sustainable use of Europe's nature and biodiversity. In this context one should consider goals and policy instruments at different levels, e.g. regional, national and municipality goals.

Factors that influence demand

Export

Once a solid picture of current and future supply is established, one has to establish a similar picture for the demand. A first step could be to investigate how much is exported and if there are any plans for changes in export. This could be quite a challenging task, since data are not likely to be easily available. Contacts with harvest companies (see above), however, could possibly give input on this matter.

Other users of wood fuel

The fraction that is not exported is used locally. Other users of wood fuel, besides the DH sector, are for instance pulp mills, board production and transport fuel production. Facilities under construction and planned facilities should also be considered in this step.

Existing demand for wood fuel in the DH sector

The next step in mapping the demand is to investigate the current demand of wood fuel for district heating and combined heat and power production. Regional, national and neighbouring facilities under construction and planned facilities should also be considered in this step.

Demand for district heating

The demand of wood energy for district heating can be greatly influenced by the demand for district heating, especially if wood energy plays a major role in the fuel use for district heating production. Again both current situation and future expectations are of importance. Moreover both local demand and demand in municipalities nearby should be considered.

Alternative fuels

The demand of district heating can also be supplied by other fuels and other technologies, for instance waste fuel and natural gas. Hence, a picture of current and future fuel supply in the DH systems nearby can be important information for a BI of wood fuel.

Policy instruments and political goals

As with supply, also demand can be heavily influenced by the political agenda. For instance, there can be different kinds of support for using wood energy in order to reach renewable

targets. Hence, it is important to get a clear picture of the policy systems and be alert to any coming changes of the system.

Other factors and aspects

Analyse the whole value chain

There are many different wood products, e.g. forest residues, pellets, sawed timber. These products all have their own market, but to some extent they are related. Hence, to get a complete picture of the wood energy market, one can consider the factors described above for all relevant wood products, including all the different parts of the value change from harvesting to use.

Impact of climate change

The anthropogenic global warming can have both positive and negative impact of supply. One positive impact is that the growth in the forests can increase, since the growing season will be longer. On the other hand, a warm and moist climate also brings increased risk for damage, e.g. from storm-felling, insects and pathogens. The net consequence of climate change also depends on how well the management of the forests is adopted to the changes. Looking at the demand side, a warmer climate can imply decreased demand for heat in the long run.

Social aspects

Social aspects of wood areas should also be considered, for instance plans and political goals concerning wood area as recreation and conservation of species. This mainly affect the supply side, but could also have an effect on demand side, e.g. if wood use for some reason would be considered as “bad” by the public (c.f. the debate regarding ethanol production leading to less land for food production and increased GHG emissions).

Check list for price mechanisms

- ☐ Check local production of wood fuel as well as production potentials.
- ☐ Contact harvest companies to get a picture of the supply curve, including supply and price for different fractions.
- ☐ Check (potential for) import and export of wood energy (distinguish between different fractions and qualities)
- ☐ Map current production and use of wood fuel (for different fractions and qualities), e.g. including current production and plans for saw mills and pulp industry. Detailed mapping of wood fuel in district heating is required, including coming and planned facilities.
- ☐ Check demand for DH, both current and expected development.
- ☐ Check fuel use in DH, both current and expected development.

- Check for policy instruments than influence supply (e.g. fertilize use and goals for biodiversity) and demand (renewable goals and support schemes).

Step 3: Analysis and evaluation

In the first two steps data is gathered; price data in step 1 and data about factors influencing supply and demand in step 2. Although some immediate analysis is made while gathering the information, a proper BI should include a structured analysis. Guidelines for a structured analysis are presented below.

Analysing price statistics

In order to get a picture of the local wood fuel market, there are some special aspects that can be considered when analysing the price statistics, as summarized below:

- General trends and price shifts
- Regional differences
- Covariance with other energy carriers

To identify price shifts and try to understand the reasons behind them can be a very important step for making prognoses of future prices. To take the analysis one step further, one has to include the supply and demand factors.

Analysing the supply and demand factors

Analysing of the price statistics alone can give some understanding of the wood energy market. However, the analysis can also raise more questions than can be answered by prices statistics alone. In order to answer these questions and get a deeper understanding, the information gathered about the factors influencing supply and demand has to be included. Below, three examples of findings that can be made when combining price statistics and information about the important players in the market are presented.

Example 1, decreased demand:

A sudden decrease in prices in a certain region can be explained by the closing of a pulp mill, which used a significant part of the available wood energy supply.

Example 2, delay in harvest investments:

Increasing prices to a peak followed by declining prices in a certain region can be explained by first lack of harvest capacity resulting in high prices, which in turn gave incentives for investment in harvest capacity, which in the end hampered further price increase.

Example 3, impact of policy instruments:

A new trend with higher prices starting a certain year can be explained by introduction of policy instruments which support use of wood energy, hence giving higher demand as well as willingness to pay for wood energy.

The third example was very clear in Sweden when certificates for renewable electricity production were introduced in 2003. This new policy instrument resulted in a large shift towards building CHP plants based on wood fuels, which in turn increased the demand and the price for wood fuels. In the next years to come, however, several old CHP plants will be phased out of the certificate system, which in turn might lower the demand for wood fuels.

Analysis of the market function

Another important aspect to analyse is the market function in the region. Questions that can be answered in this part are:

- Is the market a monopoly, oligopoly or is there a perfect competition resulting in correct prices according to the supply and demand?
- How is the information spread? Are the buyers and sellers on an equal playing field when negotiating about prices, or do for example sellers have more information, leading to higher prices?
- Is the market entry for new players easy or difficult?

Regarding market entry for new players, aspects as high initial costs, strategic pricing from existing players, transport limitations and similar can be considered.

Energy market models

In this analysis and evaluation step, one can also utilize different energy market models as support. An overview of different models and how they can be used are presented here. Electricity market models e.g. MARKAL-Nordic (Loulou et al., 2004; Unger 2003), district heating models, e.g. Martes (Sjödén and Henning, 2004) and scenario models, e.g. ENPAC (Axelsson and Harvey, 2011) can be used to support the analysis step. The first two types of models are especially useful in exploring the effect from changes in fuel prices, policy instruments and demand (e.g. heat and electricity demand). Furthermore, these models give insights on long-term developments, e.g. concerning the phase out of fossil fuels and replacement with renewable alternatives. These models, however, should not be seen as prognosis models, since they normally operate on a scale too wide and too aggregate for the local wood market. Their main benefits are to give insights on what parameters are important and in what time perspective.

With a scenario model one can produce energy price scenarios that can be used for evaluating different investment options. By using a number of different scenarios that outline possible cornerstones, robust investment options can be identified. To obtain reliable results, it is important that the energy market parameters within a scenario are consistent. Consistent scenarios can be achieved by using a tool where the energy-market parameters (e.g. energy prices and energy conversion technologies) are related to each other. ENPAC developed at Chalmers University of Technology is an example of such a tool.

Developing price prognoses

The first step in developing price prognoses is to set the time period. One should keep in mind that the longer the time period, the larger the uncertainties towards the end of the period.

After that, it can be valuable to compile all factors leading to increased and decreased prices respectively, how much these factors can affect the price and how much they can change given the chosen time period. Input to this step should be available from the analysis step presented above. This step can be used to evaluate the boundaries for reasonable price changes given the chosen time period.

Next, the likelihood for different changes in these factors must be evaluated in order to narrow down the outcome of each factor, see *Figure 3*. This is a subjective task, where it can be valuable to have a discussion in an analysis group, exploring the reasons for narrowing down the possible outcome of each factor to certain values. Previous experience in evaluating the likelihood is very useful in this step.

Finally, these factors should be put together in a number of reasonable combinations to evaluate the future price. Exactly how this is done depends on the timespan and the nature of the factors that are identified as relevant. For instance, with a short time perspectives (e.g. 1 year), only the most likely changes might be reasonable, resulting in a narrow span for the future price, see *Figure 3*. For longer time periods (5-10-20 years), a scenario approach for reasonable combinations is probably more useful, narrowing down a potential price span for the future price.

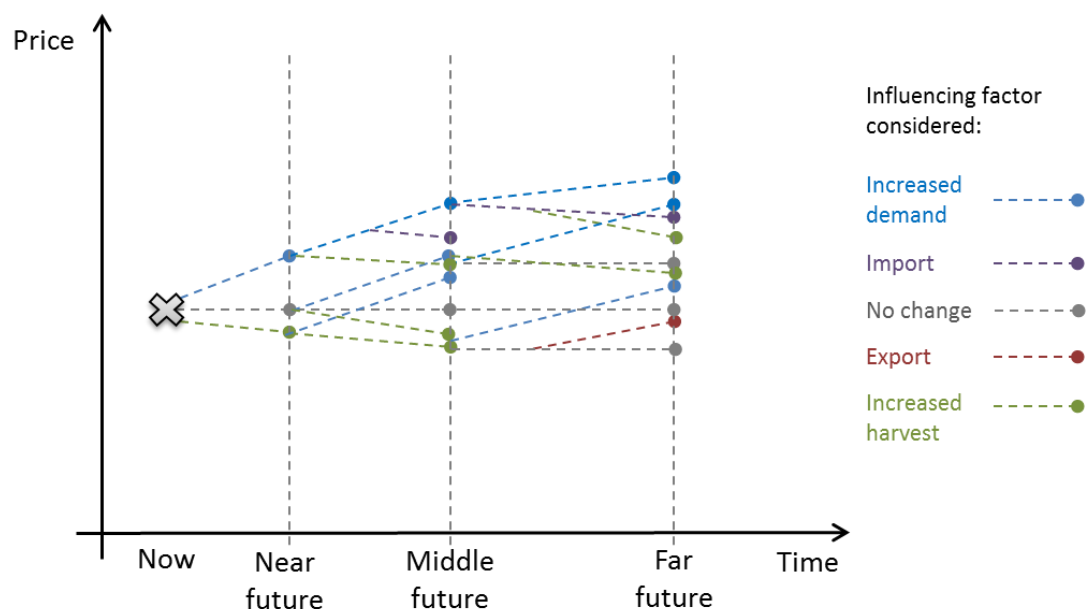


Figure 3. Principle for developing price prognoses. Starting from today's prices, the most probable changes gives near time prices. In a longer time perspective, more factors are included and triggered, resulting in a wider price span.

Check list for analysis and evaluation

- ☐ Analyse price statistics, e.g. trends, regional differences, covariance with other fuels.
- ☐ Analyse supply and demand factors. Try to understand price changes by including the gathered knowledge about the dominating price mechanisms
- ☐ Analyse the market function (monopoly/oligopoly, information spread, possibility for new player)
- ☐ Utilize energy market models to get a deeper understanding of the market and to construct price scenarios.
- ☐ Develop a price prognosis based on the above analysis and all information mentioned above.

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