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Deliverables

CONCERTO INITIATIVE
Sesac

Sustainable Energy Systems in Advanced Cities

Integrated Project, FP6 [6.1])

Period covered: 25.04.2008 – 24.04.2009
Start date of project: 25.05.2005

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Deliverable 2.1a How to create energy efficient behaviour in the city of Växjö

CONCERTO INITIATIVE
Sesac

Sustainable Energy Systems in Advanced Cities

Period covered: 25.10.07-25.10.08
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EXECUTIVE SUMMARY

Early results from a small scale Demand side management program used in Växjö resulted in interest about how energy efficiency by means of changed behaviour can be achieved all over Växjö. If this can be achieved in Växjö, it should also be able to be achieved all over Europe, where the same prerequisites can be found. By management concentrated on the people living in Växjö city, their energy awareness will change in a way which will create consumption patterns that lower electricity consumption. The aim of this required awareness is to decrease the total electricity consumption of all inhabitants of the city of Växjö by 5 %.

In order to create communication channels that cover the whole city, and to succeed with the members' environmental work, four different members are included in the Sams project. An important aspect of this is to make it possible to use four different channels of communication. Collaboration between the Energy Company and Housing Companies ensures that all inhabitants are included, both as tenants and as energy customers.

For creating the desired behaviour it is of great importance to understand the correlation between lifestyle and consumption patterns. The main goal with the strategy used is to get people to take an interest in and enjoy using energy in a sustainable way. When looking at energy saving and climate change issues, there tends to be a lack of interest. Instead, people feel forced to do something they do not know much about, or perhaps feel bad about not doing. EnergiKollen uses collected data from energy meters around Växjö and gives direct feedback to consumers via an Internet web site. EnergiKollen is a smart metering based feedback system that visualises energy usage in a pedagogical and interesting way to foster greater understanding by customers of their energy consumption. The logic behind the system is that when customers and other consumers see how easy it can be to understand their energy consumption, they will be encouraged to behave in a more energy efficient way.

Results come from analysed energy data in Veabs smart metering system and show a decrease in electricity consumption of 450 MWh/year. Notifications from customers and Sams members are mentioned and discussed, in order to give a holistic view of the difficulties and possibilities of a large scale energy efficiency project, through behavioural changes. Results show that electricity consumption has decreased by 0.97 % in apartments and by 0.19 % in private households. Changing behaviour in large scale projects does work and it is cost-effective, by comparison to other actions. People show very positive reactions to EnergiKollen and competitions for saving energy and would like to compete again against neighbours and friends.

Author: Deliverable 2.1 a - How to create energy efficient behaviour in the city of Växjö
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2008-10-31

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1. INTRODUCTION

The city of Växjö aims at becoming fossil fuels free and has since 1993 (up to 2007) reduced its fossil CO_2 emissions by 32%, down to a level of 3.13 tonnes per capita and year. The Concerto area connects the university to the city with new developments consisting of energy efficient dwellings and commercial buildings supplied by district heating from forestry waste materials. Within the Sesac project a Demand side management strategy has been developed in the WP 18 project[1] and this has shown that there is great potential for energy efficiency by changing people's behaviour.

This WP 2.1 aims at developing well-functioning energy management systems among the implementing partners. This is done by analysing the existing environmental management systems in Delft, Grenoble and Växjö and their strengths and weaknesses in energy management. Early results from the Demand side management program used in WP 18 resulted in interest about how energy efficiency by means of changed behaviour can be achieved all over Växjö. If this can be achieved in Växjö, it should also be able to work all over Europe, where the same prerequisites can be found. By management concentrated on the people living in Växjö city, their energy awareness will change in a way which will create consumption patterns that lower electricity consumption. The aim of this required awareness is to decrease the total electricity consumption of all inhabitants of the city of Växjö by 5 %. This will be a good example of saving a large amount of energy by making small changes in many places.

1.1 AIM OF THE REPORT

This report describes the first 12 moths of this project which will continue for 7 more months. Changing people's behaviour takes time, in most cases, one year is not enough time. This report explains the work with setting up a Demand side management programme in the city of Växjö, and the indications that can be seen from changed behaviour and efficient use of energy.

1.2 MEMBERS OF SAMS

In order to create communication channels that cover the whole city, and to succeed with the members' environmental work, four different members are included in the Sams project. An important aspect of this is to make it possible to use four different channels of communication. Collaboration between the Energy Company and Housing Companies ensures that all inhabitants are included, both as tenants and as energy customers.

1.2.1 VÄXJÖ ENERGI AB (VEAB)

Sweden's first municipal power station for street lighting and general distribution was opened in Växjö in 1887 - only five years after the first two power stations in the world had been brought into operation, one in London, the other in New York. Just over 90 years later, in 1980, Veab were once again the first in the country to convert from an oil-fired district heating plant to burning bio-fuels with extremely positive results. Nobody had carried out such a conversion before for the purposes of producing district heating. Three years later, in 1983, Veab did it again as they brought the first bio-fuel combined heat and power plant online. Thanks to large-scale investments in district heating, the air in Växjö has improved considerably and has come a long way in the battle for environmentally friendly heating. History shows that, since the beginning in 1887, Veab have succeeded with much more than many thought possible and are continuing to develop all the time - for the benefit of customers and society alike. In 2007 Veab was named as "The district heating company of Sweden" which was a great achievement.

[1] Deliverable 18a Description of the metering system and test results from the first metering stage.

1.2.2 Hyresbostäder i Växjö AB & Växjöhem AB (VKAB)

Hyresbostäder i Växjö AB and Växjöhem AB are two of three municipally owned housing companies in Växjö. Växjö Kommunföretag AB (VKAB) is the parent company. The two housing companies own and administer some 11,600 apartments within the urban district of Växjö and immediate surroundings. The housing companies have earlier been included in activities relating to behaviour and energy efficiency. High energy efficient buildings have, in recent years, been an important aspect of these activities, where a natural feature has been to offer tenants the opportunity of influencing their own energy costs.

1.2.3 Växjö kommun (The city of Växjö)

Växjö is an exciting combination of idyllic small town, university town and centre of entertainment with a population of some 80,000 - a strong regional centre in the middle of the south of Sweden. Business life is rich and diverse – 7,000 companies in a dynamic mixture of sizes and industries. Major international companies collaborate with smaller entrepreneurs. For many years now, Växjö has worked with environmental issues, the main vision being to make the city fossil fuel free. In 2007 Växjö won the "Sustainable energy Europe" prize, which was the trigger for being the Greenest city in Europe.

1.2.4 Sams partners

In order to cover more channels of communication and to create a stronger connection between Sams and end consumers, companies can also be members of Sams. If a company can be seen as valuable to Sams, it can become a partner. Valuable companies are those who contribute prizes to competitions and channels of communication. Companies that do this are then named as a Sams partner, and can use this for marketing themselves as companies working against climate changes.

1.3 Växjö - the greenest city in Europe

In autumn 2007 Växjö was named the Greenest City in Europe by the BBC, which was broadcast world wide. Växjö had previously been called the Greenest City in Europe in other international contexts. Växjö has received many awards for its work to limit climate changes. Växjö has the aim of being a fossil fuel free city, and this is the aim of climate activities in the city. When the BBC broadcasted their report about the Greenest City in Europe, the city of Växjö decided to use this designation for marketing the city. This shows that Växjö wants to be the cutting edge city when it comes to fighting climate changes.

When using this title as a brand name, it is of great importance to fulfil commitments and to show creativity in finding new solutions for fighting climate changes. It puts pressure onto the various parties in the city to do something extra. Within Sams is it important to get inhabitants involved, and Växjö uses the title of The Greenest City in Europe In order to make inhabitant feel proud to be a part of something positive.

1.4 Energy systems in the city of Växjö

The VEAB energy company provides the city with electricity and district heating. The grid is owned by VEAB and the inhabitants can chose to buy electricity from the open market for electricity. Most apartments have individual metering of electricity and heating is included in the rent. Växjö is known for its sustainable energy systems, where a district heating network supplies the city, using 95 % renewable sources of energy. The electricity produced in the co-generation plant corresponds to 35 % of the electricity used in the city.

1.4.1 Smart metering System

In Växjö a system with smart meters are used to collect the energy consumption data. Consumption data is transferred to Veab once a day, and later also sent back to the customers. The sent back data are presented in EnergiKollen which is a web based system for creating interest in energy awareness. The metering system creates new possibilities to include the inhabitants in the energy system. The transfer of data from customers to Veab and back again can be explained as in figure 1.1.

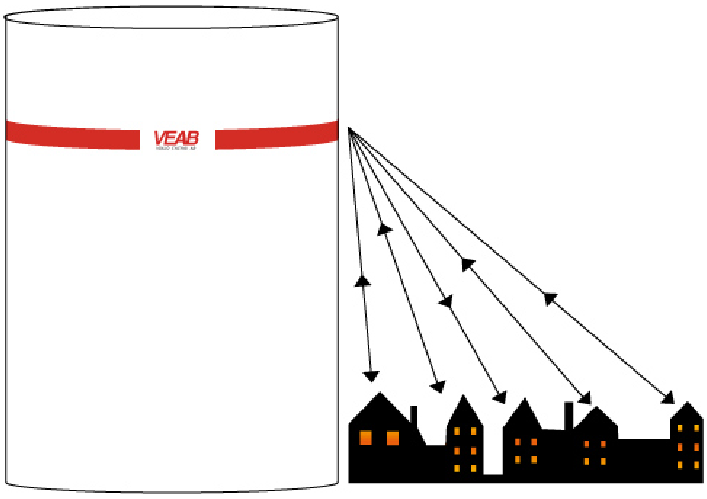

Figure 1.1 show the transportation of data from inhabitants to Veab, and back again where it is presented in EnergiKollen.

In Sweden the grid owner is the one who owns the consumption data from households. This means that independent of whatever energy trade company the inhabitants buy their electricity from, they are able to see their electricity consumption on EnergiKollen. In 2009 the regulations state that all electricity meters will be read once a moth. This will contribute to the possibility for other cities in Sweden to present energy statistics in new ways.

2. Description of work

When creating a sustainable energy system it is of great importance to understand the different parameters influence energy consumption. In this project there is a focus on human behaviour. The start and realisation of a large scale project for changing people's behaviour is explained, with a description of the strategy and its difficulties and possibilities. For creating the desired behaviour the points below have been used throughout the project, these points are always taken in account when creating activities.

- Help consumers to gain knowledge about efficient saving strategies
- Give consumers feedback from measures taken
- Help consumers to compare their consumption to others
- Provide more information about energy saving ideas for those who want them
- Show the possibilities/recommendations of purchasing energy efficiency applications
- Show successful measures in the bill
- Engage people in easier activities to achieve changes in attitudes
- People show more powerful reactions to losses than to gains
- The consumer wants to feel that there is a possibility to choose and to control

2.1 Strategy

Witin the Sesac project, a Demand Side Management (DSM) strategy was developed and this has been adapted for large scale use in the city of Växjö. For creating the desired behaviour it is of great importance to understand the correlation between lifestyle and consumption patterns. The main goal with this strategy is to get people to take an interest in and enjoy using energy in a sustainable way. When looking at energy saving and climate change issues, there tends to be a lack of interest. Instead, they feel forced to do something they do not know much about, or perhaps feel bad about not doing. The four different steps can be explained as the steps described below. These steps are used to describe why people do something, and why they do better in some situations. It can be used when explaining peoples behaviour relating to issues such as climate change and energy saving. The aim with the Sams strategy is to make people travel from “1” and “2” to level “3” and “4”.

Figure 2.1 shows the strategy used in Sams. This is how inhabitants should develop a more sustainable behaviour by changing from 1 and 2 to number 3 and 4.

1. External pressure

If people are forced to do something due to external pressure, they will not do it as well as possible. They do what they are forced to do, but they do not actually like it, and will therefore not do anything similar when they are not forced to do so. If you do not see any meaning with a specific action, and you do it only because someone has forced you to, the work will not be done well. There are many people who in terms of climate changes are to be found at step “1”. To make people act when it comes to climate changes, it is important that they do not feel forced.

2. Should

Have you ever felt bad about not giving enough money to charity? This is step “2” when it comes to changing peoples behaviour. People tend to have a bad conscience about not acting to climate changes. If people feel bad about consuming energy, it is not likely that they will change their behaviour. This occurs when actions are taken without their reasons being understood. This could well be connected to poor feedback. Many people know that negatively affecting the climate is bad, but they do not know what to do, and if they act in a different way and do not receive any feedback, why should they continue to behave in a different way?

3. Interested

When people act and are given feedback they are more likely to be interested in acting in the same way in the future too. They know that someone likes the things they do and show a reaction to the changed behaviour. This can be compared to workers who are interested in their work; they can also be seen as high performance workers. For creating this interest when it comes to climate changes, it is of great importance to give the right feedback from consumer’s consumption. The results of energy savings should be available to consumers who search for them. If energy saving tips are given too early this can be seen as something they “should” do and the intentions could have the opposite effect.

4. Joy

When people climb Mount Everest, they need to feel the joy in reaching the top. It is not about joy for one day, it’s about a lasting joy on a higher level. The process takes years to achieve and create this behaviour. If people feel joy in doing something about climate changes, this will be a great step forward in the work that needs to be done. When creating this feeling it is not only about giving feedback and showing possibilities. Here people need to find their own feeling for reaching the goal. This is more of an aim for creating sustainable behaviour than a goal that many people reach. People found at this level when talking about climate changes are real enthusiasts, some of them perhaps even try to live without electricity for some time.

2.1.1 Creating Sams

This project aims at reaching the inhabitants of an entire city and creating more energy efficient behaviour. This is done by first making them feel part of Växjö “The Greenest City in Europe”. This title was chosen as it was felt that it was something that that people would most likely want to be part of. It is also something that people can feel to be the right choice. Engaging people puts great importance on the value of what they get in return for being a part of something.

To make people feel part of Sams, it is of great importance to surprise them, to give them something that they did not expect. Within Sams this unexpected part consists of competitions in saving energy. The management of energy competitions is administered by EnergiKollen using data from smart meters. This is hoped to have the same effect as, for example, the world cup in soccer, or the Eurovision song contest, where the actual it is the competition that engages people. Competitions in saving energy are managed in EnergiKollen. These competitions can be on an individual basis or as team competitions where different areas compete against each other. The Swedish word Sams can be translated as “being in agreement” or “being friends”. The name was chosen due to its uniqueness and the possibility to use the different letters, as in the boxes used in the logotype. It was thought that a name with a more specific meaning could possibly "drown" in similarities to other projects aiming at saving energy. But Sams has a different strategy and is not a regular energy saving project at all. Sams does not show people what to do; it aims at making people make the right choice because they feel it is the right choice to make.

2.2 Activities

The steps explained below are all included in the strategy. These need to be done in order to create the interest that makes people change behaviour. In Sams there is collaboration between housing companies, the energy company and the municipality. This has been done in order to get as many of the inhabitants involved in Sams as possible.

2.2.1 Making people feel a part of the greenest city in Europe

When planning this project something that people would like to be a part of needed to be found. "The Greenest City in Europe" started to be mentioned some time before the project started, Sams therefore aims at making people feel that they are part of this. The important thing when starting this kind of project is to find something that most of the inhabitant would like to be a part of, in other cities this could be something completely different. Activities are listed below:

- Presentations of the member organisations leading Sams
- Posters at members offices, showing that everyone can make a difference
- Starting www.sams.se
- Direct marketing on radio, presenting Sams
- Direct marketing on local public transport presenting Sams

2.2.2 Make people feel in control

A common feature amongst people, when talking about energy consumption, is their lack of control. People tend not to know much about the electricity they pay for. Neither do they know much about what happens if they start consuming electricity in a different way. If we communicate to people they are given the opportunity to understand electricity consumption. The different activities aiming at creating the feeling of control are listed below:

- Using www.sams.se for the spreading of information
- Presenting EnergiKollen
- Presenting electricity consumption in different postal code areas
- Providing guidance for those searching for it

2.2.3 Engage people in easier activities

If people do something out of interest, they are more likely to also learn from it, by comparison to acting on a negative feeling. Within Sams the purpose of easier activities is to get people to feel that it is easy and fun to use electricity in a sustainable way. Easier activities are also used to make people feel more for Sams, and its goals. The activities used to engage people include:

- Giving packet of seeds to people (50,000 bags)
- Quizzes on www.sams.se
- Log on to EnergiKollen
- Competitions on EnergiKollen, about saving energy in real life

2.2.4 Giving people feedback from changed behaviour

When people change the way in which they use electricity they need to be given feedback about their new way of consuming electricity. If no feedback is given then there is a risk that people will not maintain this new behaviour. Feedback is given to both groups and to individuals. The different aspects of giving feedback include:

- Growing seeds, giving something to people who act
- EnergiKollen show people's electricity consumption
- EnergiKollen show changes in consumption patterns
- Prices for energy savers in EnergiKollen
- Engaging media in results from competitions
- Showing results from earlier projects about behaviour and energy efficiency

2.3 Marketing and Press

One of the keys to success with changed behaviour is to reach the end consumer. In Sams four different organisations collaborate, which makes it possible to reach a large number of consumers in a cost efficient way. The key to success is to use a mix of communication channels in a cost-effective way.

2.3.1 Existing marketing channels from Sams members

As explained in chapter 1.2 Sams consists of four different organisations, which cover the whole of Växjö. By using existing channels of communication and member's experiences Sams can be realised in a more cost-effective way than if it had been necessary to create new channels for all communication.

Växjö Energi AB (Veab)

Consumers of electricity in Växjö are customers of Veab (28,000). Veab have the knowledge and experience to communicate to customers about electricity consumption. The existing channels used are:

- Striping cars
- Customer magazines
- Flyers in bills and to new/moving customers
- www.veab.se, using links to www.sams.se and presenting news about Sams
- Exhibitions

Housing companies Hyresbostäder i Växjö AB and Växjöhem

These two housing companies communicate about energy saving in their every day work. They together have 11,600 rental apartments, and work with energy efficiency in their daily work. The existing channels used are:

- Striping cars
- Customer magazines
- Flyers in bills and to new/moving customers
- www.hyresbostaderivaxjo.se, www.vaxjohem.se using links to www.sams.se and presenting news about Sams
- Exhibitions
- Sams information within joint facilities

Municipality of Växjö

When Växjö chose to use the title of "The Greenest City in Europe", plans to spread this message were formulated at the same time that Sams was launched. The municipality works with the spreading of information to inhabitants. They have different magazines and also arrange days with special topics such as climate changes. Channels used by the municipality's every day routines are:

- Striping cars
- Information magazines
- Flyers to new inhabitants
- www.vaxjo.se using links to www.sams.se and presenting news about Sams
- Exhibitions and information meeting at the city

2.3.2 Other channels for Direct marketing

When building the communication strategy for Sams, the aim is to reach as many people as possible in the most cost effective way. Existing communication channels are supplemented with external communication channels, such as:

- Radio
- Newspapers
- Social magazines
- Videos at supermarkets
- Videos at cinemas, advertisements before film starts
- Striping local traffic busses
- Partner companies' communication channels

2.3.3 Press

When working towards a target such as an entire city, it is of great importance to be seen in the press. By getting the press to write about Sams, you attain a cost effective channel which reaches people, as well as a channel that creates greater confidence than direct marketing. The Sams project is unique and this creates opportunities for media time. Sams connects to "The Greenest City in Europe" which means that Sams also gets a lot of free attention in the media, which interests people. This becomes particularly clear when it comes to the title of "The Greenest City in Europe", which is built around action is taken by the media.

2.4 Internet-based system EnergiKollen[2]

This system uses collected data from energy meters around Växjö and gives direct feedback to consumers. The English translation of EnergiKollen is Energy Check, and aims at informing people how to take control of their energy consumption. EnergiKollen is a smart metering based feedback system that visualises energy usage in a pedagogical and interesting way to foster greater understanding by customers of their energy consumption. The logic behind the system is that when customers and other consumers see how easy it can be to understand their energy consumption, they will be encouraged to behave in a more energy efficient way. People in Växjö can follow their consumption day by day, see figure 2.1.

Figure 2.1 shows the electricity consumption for a month. In this view Veab customers can see their electricity consumption every day. They can also choose other time periods up to one year's consumption. In the same view they can also see cost, outside temperature and consumption as an average compared to neighbours. If they think the bills are hard to understand, they can chose to print a report which shows a years consumption in an easy understandable way.

Understanding electricity consumption is often difficult. People do not normally have the possibility to understand the connection between behaviour and electricity consumption, due to lack of feedback. In EnergiKollen people can obtain a visual picture if they change behaviour and consumption patterns. This is shown in figure 2.2.

[2] www.logica.com

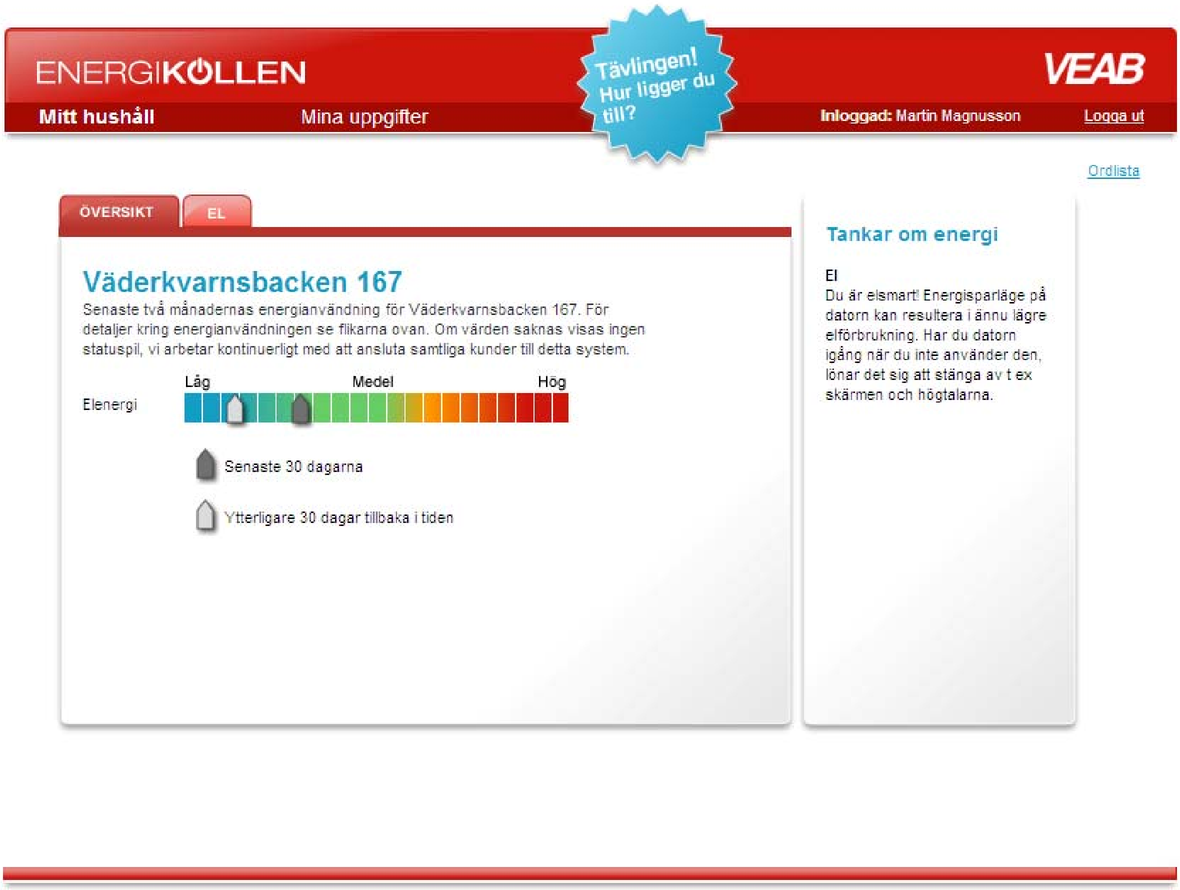

Figure 2.2 shows the first view consumers see when entering EnergiKollen. Here they are given a picture of using high or low amounts of energy, compared to an average consumer. The average consumer is the mean value from neighbours. The latest 30 days consumption is marked in the coloured scale together with the previous 30 days. This view is updated every day, and clearly shows the effects of people changing consumption patterns. In the example used, an increase in energy consumption can be seen. To the right in the "Tankar om energi" column, messages connected to peoples specific consumption are presented.

2.4.1 Competitions in Energy saving

In EnergiKollen competitions can be initiated by Veab. The competitions use data from consumers' energy meters. This is the same data as used when showing energy consumption day by day. Competitions are created to make

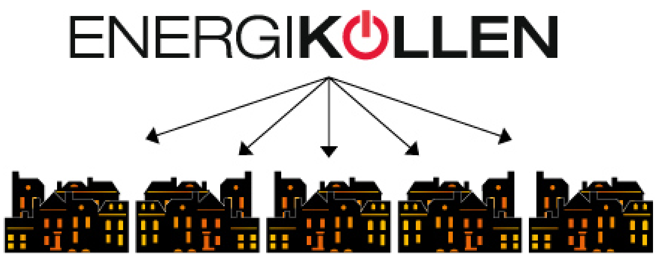

Figure 2.3 shows an example of competitions where inhabitants in different areas compete against each other. The competitions are managed in EnergiKollen which is the Internet-based system used by inhabitants.

people more interested in saving energy, and to give them feedback in a new different way. Prizes for the winners are donated by Sams partners. The results of competitions are presented when customers login to EnergiKollen. Here they can se the results, and also see how much energy has been saved, and how this corresponds to CO_2 emissions. Studies show that competitions in saving energy can be a good pedagogical way to foster new sustainable behaviour[3]. Two models of competitions can be used one where inhabitants compete against each other one by one, and team competitions, which are explained in figure 2.3.

2.5 WWW.SAMS.SE

The Sams web site is the main place for collecting information which could be of interest to customers, see figure 2.4. Here people also have the possibility to discuss energy and to read about Sams partners. The Web page should present information that makes people more interested in doing the right thing. In Sams, results from competitions are presented together with results from energy saved. This is aimed at giving positive feedback to people getting engaged in Sams.

Figure 2.4 show the Sams web site. Here people should be able to find the information needed to create sustainable behaviour. The web site also presents energy related topics with the aim of creating greater interest in energy savings. It also aims at getting more and more people to discuss energy saving.

2.6 METERING OF RESULTS

Results from energy saved come from data collected from households. 8,000 meters from apartments and 3,200 from people living in private houses are analysed. There is a total of 22,000 meters, and these are sorted out as explained chapter 2.6.1. To be able to make a comparison about reaching the 5 % goal, yearly consumption is compared to the time that the project started. Every household should reach 5 % and everyone

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[3] Om alla gör sin del... -En pedagogisk studie av ett kommunalt energiprojekt: Emilia Horner, Växjö universitet 2008.

makes the same difference, independent of the amount of energy consumed. The value of energy saved is calculated as a mean value from all households.

2.6.1 SORTING DATA

In order to make a comparison that eliminates erroneous data from energy consumption, certain different factors are used to indicate whether or not the data can be seen to be reliable. If such data is deemed to be unreliable, then it is deleted. The comparison is used between consumption data from the latest 12 moths, data that has been quality checked in the debiting system. Data that has not been collected by the smart metering system is deleted. The conditions that have to be fulfilled for data are explained in table 2.1 and 2.2 below.

Conditions Apartment		
Yearly consumption	> 700 kWh/year	< 10 000 kWh/year
Increased or decreased yearly consumption	Increased less than 50 %	Decreased less than 50 %
Increased or decreased monthly consumption	Last month's consumption should not exceed 50 % of yearly consumption	Last month's consumption should exceed 0.

Table 2.1 shows the conditions to be fulfilled for apartments.

Conditions Private houses		
Yearly consumption	> 1 500 kWh/year	< 15 000 kWh/year
Increased or decreased yearly consumption	Increased less than 50 %	Decreased less than 50 %
Increased or decreased monthly consumption	Last moth's consumption should not exceed 50 % of yearly consumption	Last month's consumption should exceed 0.

Table 2.2 shows the conditions to be fulfilled for private houses.

2.7 New ways of using smart metering

In order to create curiosity and discussion, measured data is used in new ways. Sams used collected consumption data to present electricity consumption in different postal areas. The aim of this is to make people question themselves and others as to why it looks like this. Two maps were used at www.sams.se and in customer magazines, see figures 2.5 and 2.6 below.

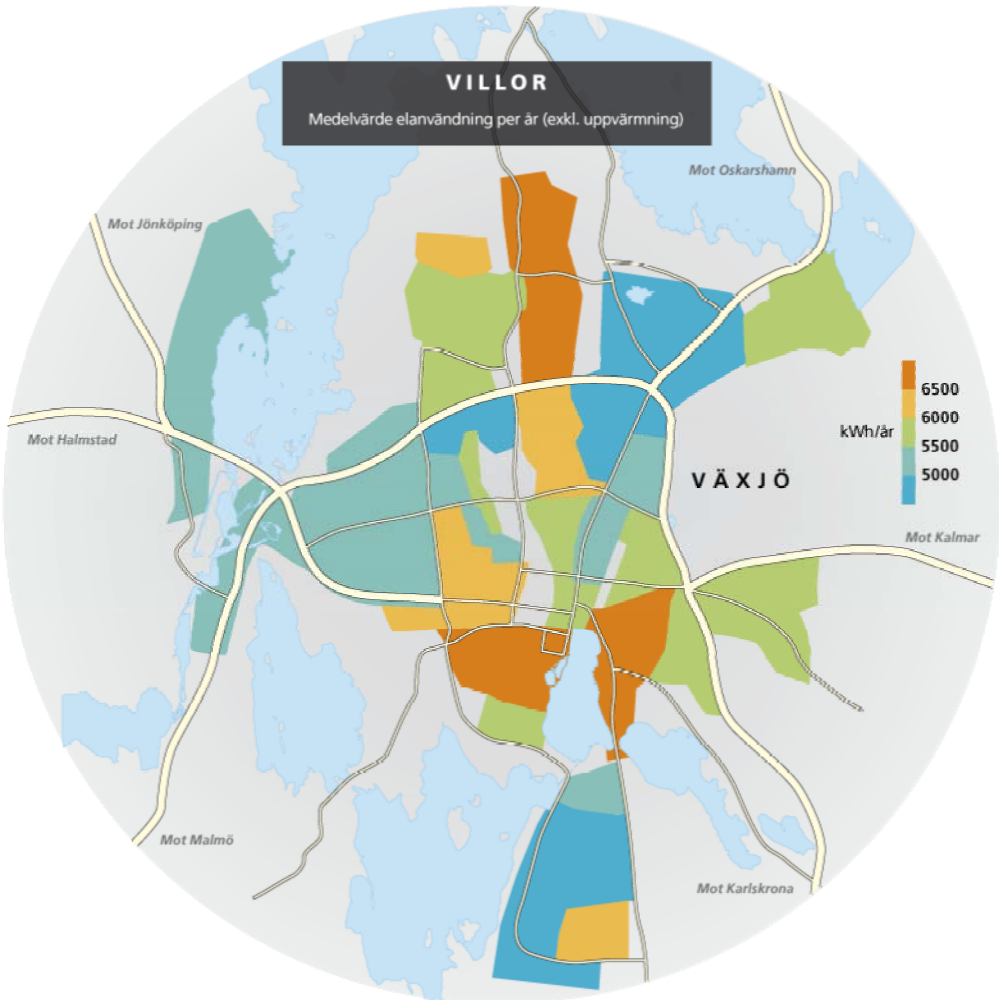

Figure 2.5 shows electricity consumption for private houses in Växjö. The map presents average yearly consumption. With this, people can see how old and new areas use different amounts of electricity. New areas use more energy, people can discuss whether this is the result of different types of houses, economy, family situations, etc.

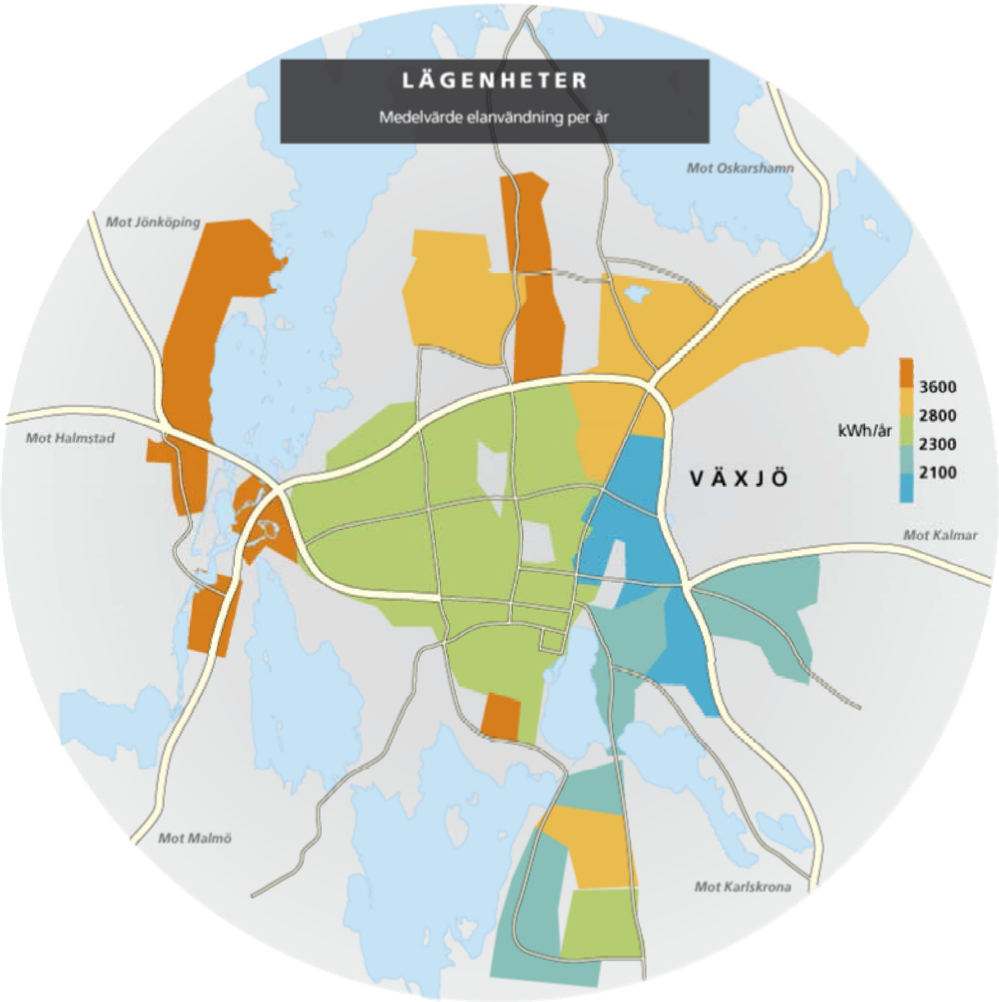

Figure 2.6 shows electricity consumption for apartments in Växjö. The map presents average yearly consumption. With this, people can see how old and new areas use different amounts of electricity. New areas use more energy, people can discuss whether this is the result of different types of buildings, economy, family situations, etc.

3. Results and Discussion

The results below come from analysed energy data in Veabs smart metering system. Notifications from customers and Sams members are mentioned and discussed, in order to give a holistic view of the difficulties and possibilities of a large scale energy efficiency project, through behavioural changes.

3.1 Saved energy

The results show that electricity consumption has decreased, see figure 3.1 and 3.2 below. 0.97 % and 0.19% saved energy can be seen as small amounts, but this is the result when looking at all inhabitants in Växjö (28,000 households). The amount of saved energy in apartments is 374 MWh/year and 76 MWh/year in private houses. During the first period of Sams, the major part of the work concentrated on getting people to feel part of The Greenest City in Europe and to make them feel that they have the possibility to influence the situation. This first period runs until the first of June. These first steps do not aim at making people use energy in a different way; it aims at making people ready for a change towards more sustainable behaviour, see figure 3.3. This can be one of the explanations for the increased energy consumption at the start of the project. There are also other factors that influence the results. We often talk about people's consumption increasing, but we do not know the figures for this increase, or if it actually decreases.

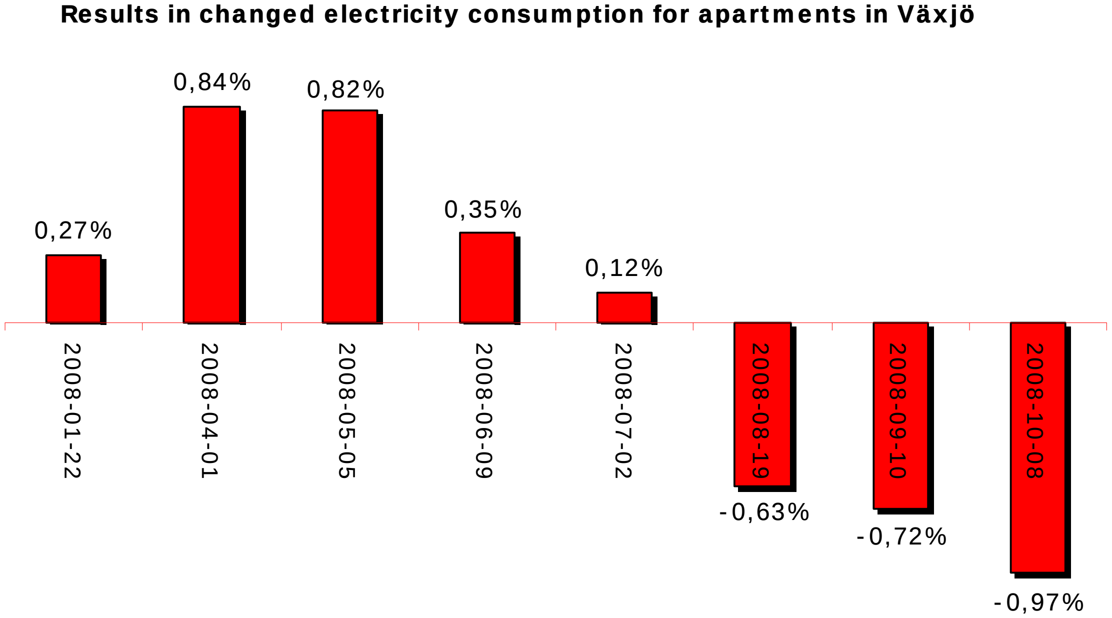

Figure 3.1 shows the results of changed electricity consumption in apartments. It can be seen that electricity consumption has decreased by 0,97% (374 MWh/year) up to the first of October.

Discussion about people's influence on climate change have increased, and people are given more and more information. This information is, for example, shown in newspapers, magazines, TV and radio. This influences some people to act in a different way, and this is also one of the ideas with Sams - to prepare people to be interested in doing the things mentioned in the media. Sams does is not aimed at telling people what to do; it aims at making people interested in doing those things shown in other media.

The climate, in terms of temperature, should not affect the result presented. The analysed data comes from those who do not use electricity for heating. Though there could be a smaller proportion who use electricity as a complementary heating form, under-floor heating in bathrooms, for example. The climate could influence people's way of using lighting, due to variations in numbers of daylight hours.

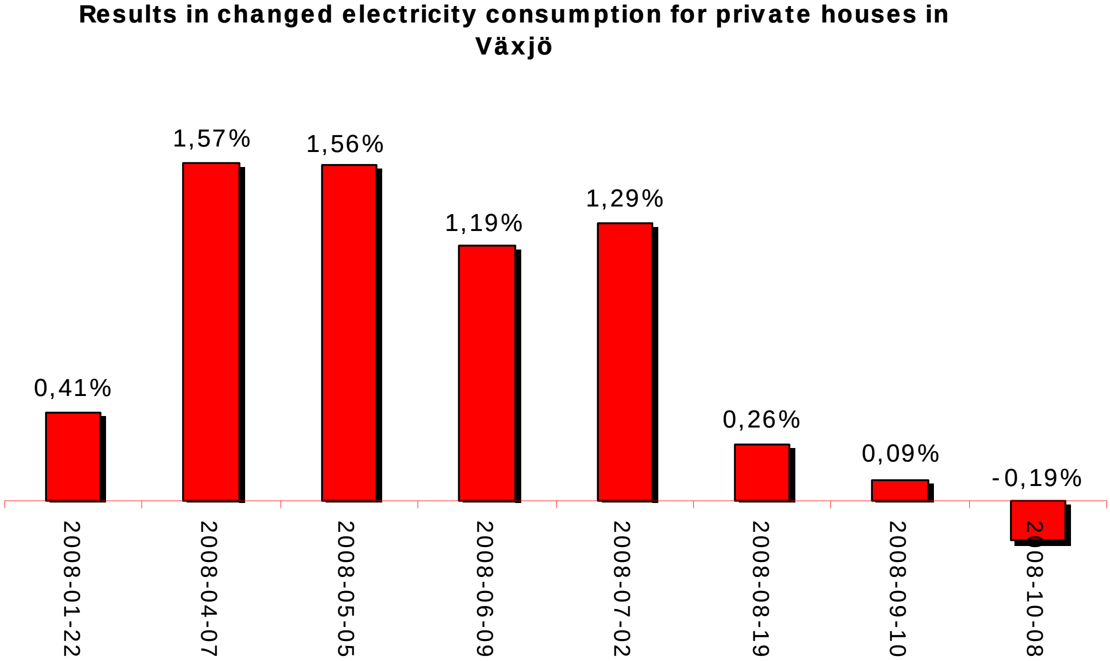

Figure 3.2 shows the results from changed electricity consumption in private houses. It can be seen that electricity consumption has decreased by 0,19% (74 MWh/year) up to the first of October.

The planned energy savings from the start of the project can be explained by figure 3.3 below, which is the theoretical model used. Here we can see how the saved energy rose from the start of the project. The reason for the much higher increase at the end is due to the fact that it takes time to change peoples behaviour. When people change their behaviour they are more interested in energy saving strategies, which enables them to learn more easily at the end of the project.

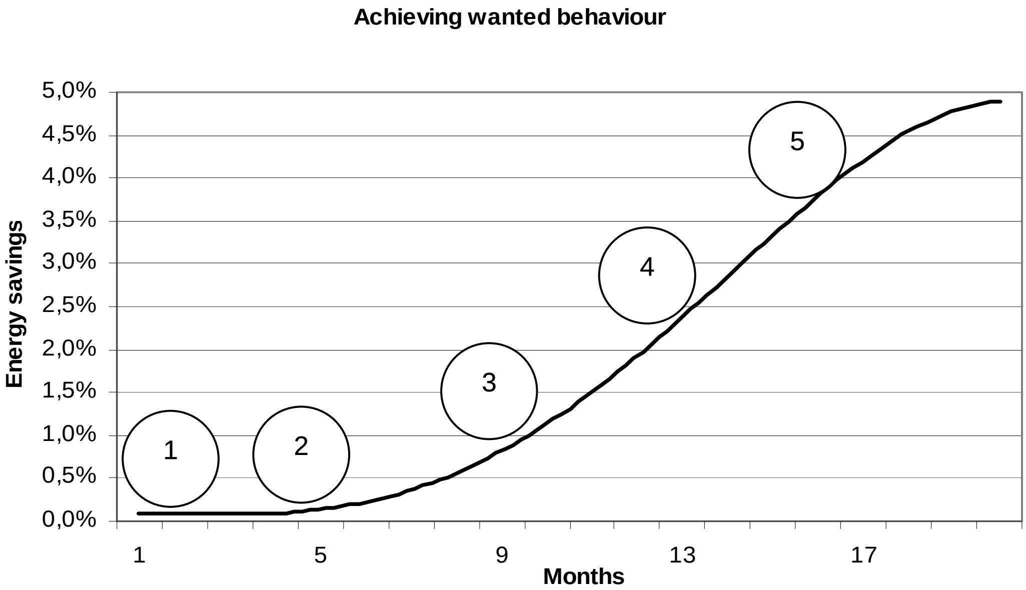

Figure 3.3 shows the theoretical model used to explain how the five percentage goal should be achieved. The numbers indicates different steps which should transfer people to a changed behaviour where they learn more about energy saving strategies.

3.2 Difficulties and Possibilities

The Sams project uses a strategy for changed behaviour developed at an earlier stage. The strategy has previously been tested in smaller projects. This is the first time that it has been tested on a large scale. Difficulties and possibilities are therefore mentioned below. These are lessons learned from large scale energy efficiency projects based on behavioural changes.

3.2.1 The Name "Sams"

The name Sams does not tell people anything about what it is. At times, this has been seen as a weakness, but it could also be a strength, due to its uniqueness. The problem as to the meanings of the name and its significance need to be studied further later in the project.

3.2.2 Sams strategy in other similar situations

Questions concerning behaviour and climate changes tend to grow as more information is collected from different projects. When looking at the strategy used in Sams, it is can be seen hat there is a possibility for using this for similar issues. Discussions have shown that it could also be used in areas such as waste treatment and transportation. When discussing these other matters it can be seen that feedback leads to a change in behaviour. Giving car drivers feedback, makes eco-driving more interesting. There could be greater possibilities for waste treatment if waste was measured, and prices set in accordance with the weight of the waste.

3.2.3 Sams strategy as a part of every day work

Getting more positive feedback at the same time that the energy bill is sent to customers can be complex, as there is already too much information on the bill. The housing companies have used flyers, in conjunction with their bills and it has become a regular occurrence that energy issues are communicated to consumers, though it has not been in the form of feedback. Some people need the information, but feedback would have a stronger impact. This is a cost effective way to spread information but how such information is received is harder to tell.

Companies need to strengthen activities towards younger people. This would be possible if Sams members could visit and inform schools more. Competitions would be an excellent way to start with children in schools; it would also be a good way of influencing their families. Using more positive and interesting ways of communication about energy consumption would be a good way of making people think in new ways in terms of energy.

3.2.4 EnergiKollen

This Internet-based system is an important part of the work towards the stated goal. It is a new tool which has been developed and something people are not used to using. Activities to make people log on to EnergiKollen have been difficult. When logging on, people need their customer number and code from Veab. These can be read from their bills, but seems to be something that makes people not log on. Discussion regarding new ways of logging onto the system are in progress. The system where launched in May 2008, until October 2008 have there been 1 200 unique users logged in to the system.

When people have logged on to EnergiKollen, Veab has tried to get in touch with the customers, and customers have also contacted Veab with information about their new way of thinking in terms of electricity consumption. Some problems with the system have confused certain customers, particularly when those in private houses with district heating, saw the district energy consumption in the wrong units. The first view where they can see if they use more or less energy than average has made certain people feel comfortable, now they can easily see if they change their behaviour. People now show positive reactions to the possibility of seeing energy consumption day by day. They are now better able to understand what happens if they change their behaviour or if they invite friends for a three-course dinner. The reactions from users are very positive, which indicates great potential for the future of EnergiKollen. In the Sams strategy the highest lever is “Joy” and this has been achieved. One customer e-mailed us and told us – “I really love EnergiKollen”.

3.2.5 Collaboration between Sams members

The mix of members from the energy company, the housing companies and the municipality makes the holistic view possible. Members of Sams have learnt about our different everyday work, where the inhabitants are the winners. Similarities can be seen if you now see an energy customer as one of your own tenants, as well as a member of the city you manage! Members have expressed interest in being able to also collaborate between cities, where cities challenge each other.

These results have lead to closer collaboration between housing companies and the energy company. Tests are being carried out where the energy company plays the same role as the housing company when signing contracts with tenants. Now they can also be shown EnergiKollen at the same time as they see their new apartment.

3.3 Competitions in EnergiKollen

Two different types of competitions have been tested. This first period can be seen as a test period for the competitions managed in EnergiKollen. Lessons learned from these competitions are that it is difficult to get the information out to people and to get them to log on to EnergiKollen and enter the competitions. That people’s energy meter can be read automatically every day is something new and this makes it hard for people to understand how the competition works.

3.3.1 Individual competitions

Four different individual competitions have been held. 77 people took part and contributed to the result. The reason for this small number of competitors is that the level of marketing was kept at a very low level in order to learn more about competitions for saving energy. It is also clear that competing in energy could be seen as less interesting than other competitions available in people's lives. For taking part in the competition people need to log onto EnergiKollen on the Internet. In the competitions people have saved energy, the results for the top five people in each competition have varied from 45 % to 10 % of saved energy.

Competitors responded well to participation. After each competition a questionnaire has been sent to those who took part. The results of the questionnaires showed that reaching the result were easy, and those who took part in one competition would gladly take part in more competitions and would also like to compete against neighbours and friends. The measures taken by people are often small measures such as less lighting, smart usage of computers and trying to be more aware of electricity consumption. Many of the competitors showed a lack of knowledge in the different between electricity and energy for district heating.

3.3.2 Team competitions

This model of competition is arranged by Veab, who decide the people to be included in the different teams. Only one competition in this form has been held. The competition was between members of Sams and politicians in Växjö. Each member put together a team consisting of employees living in Växjö. Five teams with 9-15 employees took part; each team had a leader to coach them. The project leader of Sams also coached and encouraged members to do as well as possible, in order to fulfil the aim of being "The Greenest City in Europe".

Figure 3.4 Show the results presented in EnergiKollen. Here competitors could see the results from the teams that participated.

The results surpassed all expectations, and showed that members of Sams were the right ones to demonstrate how such savings could be made. The winning team from Växjöhem with 9 people lowered their electricity consumption by 47,4%, see figure 3.4. The Other teams also showed great savings. This saving is compared to a reference period. This also makes the results dependent on earlier consumption. The team leader of the winning team focused on individual talks with all competitors, in order to create interest, curiosity and the feeling of control. This competition was an excellent example of what individuals can achieve together, if they are given the right means towards sustainable behaviour.

The competitions are a different method for creating energy efficiency. They did not only involve the competitors, the rest of the families were also involved. The competitors were motivated by their team leader, as well as by the rest of the family. Many of those who achieved greater results had children, who were engaged, and were lead into the competition as something exciting. In some cases friends of family members were also engaged. This proved that competitions engage people, and also spread discussions about energy between people. However, you need to make it interesting and fun!

3.4 ECONOMICS AND EFFICIENCY

When comparing this project to others, there is great interest to see the energy saved in proportion to investments. This does not say anything about how good the investment is, but gives a view of the efficiency of the investments. Results presented are only from the first part of the project, and will have the largest impact at a later stage. The proportion at this moment is 190 €/MWh. This must be studied further, due to a lack of knowledge about behavioural changes and how they continue over time.

The fact that the results show 0.97% and 0.19 % energy saved, can bee seen as a small saving by comparison other similar actions such as people buying low-energy lamps, which has an efficiency of 180 €/MWh. Discussion about people buying low-energy lamps can be compared to starting energy efficiency programs, such as Sams. Sams has shown that it will probably show a better result, in terms of economic efficiency than trying to make people buy low-energy lamps.

4. Conclusions

Working with a large scale energy efficiency program aimed at changing behaviour works and is economic efficient. The aim with Sams is to save 5 %, and the project has progressed towards the goal as planned. Collaboration between the Energy Company, Housing companies and the municipality provides the necessary holistic view.

People become more aware during the Sams project and they show very positive reactions to competitions and the possibility of following their electricity consumption on EnergiKollen. The difficulty with EnergiKollen is to get people to log onto the system. Once they are logged on, they become interested. People show very positive reactions to competitions for saving energy and would like to compete again against neighbours and friends.

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Project Acronym: SESAC REF EC: (Project Number) REF (project coordinator org.): DOCUMENT: Deliverable D4b REF.:

Project Coordinator: Torun Israelsson Project coordination org.: Växjö kommun Date: 2008-11-28 Revision: 1

Deliverable 4b Purchasing summary report

CONCERTO INITIATIVE
Sesac

Sustainable Energy Systems in Advanced Cities

Integrated Project
Thematic Priority 6-1

Period covered: 25.05.05-28.11.08
Start date of project: 25.05.05

Date of preparation: 2008-11-28
Duration: 58 months

CONCERTO is co-funded by the European Commission

1. Executive summary

The intermediate purchasing summary report from the participating cities and their demonstration projects shows that changing the current way of launching tenders, negotiation with potential contractors and entering into more incentive based contracts, is a truly challenging task.

Each of the cities has addressed their challenges, and also made progress, even though the full impact of their activities can't be determined until the end of the project, and in some cases even further in the future.

- In the city of Växjö has the Sesac Demonstration building projects, paved the way for a new type of tendering and negotiation process, leaving the municipality with less risk and having the building contractors more incentive based in their approach for fulfilment of energy- and technological performance.
- In the city of Grenoble has the Sesac Demonstration building and energy projects paved the way for a new procurement and contracting procedure towards the private developers actually executing the projects. Furthermore has the contractual demands implied by Grenoble within Sesac contributed to an improved national "standard"
- In the city of Delft has the Sesac Demonstration building and energy projects aimed at linking public and private funding together by introduction of energy efficiency ESCO concepts. Legal hindrances as well as financial challenges have resulted in a somewhat revised structure, due to limitations in what Social housing companies can do businesswise and caped rent for tenants. The new heat distribution system will be managed through co-owned and newly established PPP.

During this reporting period has the actual Management work within WP4 been limited to intermediate follow up as the different projects proceed forward. However, during the next reporting period will the work be intensified with "on-site" follow up meetings in each of the cities.

2. Table of contents

3. Introduction

The basic role of WP 4 has been to support the demonstration projects in developing contractual, financial and more incentive based implementation structures. This has been done in order to enabling the usage of this large-scale project to develop cost-cutting, risk sharing and more incentive based approaches for the final implementation of the demonstration projects.

4. Description of work

The level of WP 4 work during the period since D4a has varied between the partners due to time schedules and structural delays in some of the demonstration projects. This also means that the WP-management work of summarising the experiences into D4b also has been somewhat delayed.

The practical procurement and contractual work in the cities has been quite intense.

Delft has focused on how to deal with legal constrains regarding Escos and caped rents in social housing apartment, while at the same time establishing a new heating supply PPP with energy utilities and housing companies, and furthermore managed to complete procurement contracts with real estate developers having them "absorbing" Sesac prerequisites as a new contractual base.

In Grenoble has the work mostly been focusing promotion, procurement and contractual capacity building, meaning the collection of experiences and the development of guidance structures to strengthen the house owners in setting firm and contractually valid energy performance demands on developers, architects and consultants. Furthermore has the RES-conversion in Viscose been highlighted on a national level, paving the way for a very cost efficient working model.

The city of Växjö has moved further in their building projects an also using the results and experiences made by KFAB/VKAB regarding public procurement and negotiated processes from D4a, to serve as "backbone" when entering new contracts for premises and schools. Växjö is also striving to work out a model enabling to give CO2 capturing wooden constructions, an economically and environmentally favourable evaluation advantage, when procuring projects in the real estate sector

The management work carried out has been focused on an on-going dialogue with partners, partly linked to the PMC-meetings, and partly as separate processes containing telephone, email and the project web-site, WP-Management has manly been focusing on collection of tendering, procurement and contractual experiences from the participants.

The dialogue has partly taken place directly with the individual contractors and partly within the framework of their local city coordination work.

From a WP-Management point of view there has been a need balancing available time and financial resources, towards the needs deriving from the more dynamic approach that was selected to better match the somewhat delayed and time wise distribution of demonstration projects. As given account for under 5.2.4 the work has been in a an intermediate and less intensive phase since D4a, but the balancing and careful use of resources, put Management and partners in reasonable good position to reach its objectives.

5. Conclusions

5.1 Introduction and general findings

A main component in supporting the overall objectives, and paving the way for the final Implementation Report D4c, is the successively capturing of experiences and evaluation of results. This Purchasing Experience Summary is therefore not focused on the technological development, but on the early results in terms of purchasing, contractual and financial aspects of the demonstration projects.

The work so far shows that changing the current way of launching tenders, negotiating with potential contractors and entering into more incentive based contracts, is a truly challenging task.

In order to secure that experiences from demonstration projects actually contributing to a change in standard and enhancement of state-of-art among the contractor's organisations, it's seems to be necessary to involve a broader variety of staff than initially anticipated. The individual WP-managers and Local coordinators needs to have some type of "take-up" responsible on management level among the participating bodies.

5.2 Content and structure

This deliverable contains early results and reflections from the project partners as well as examples of strategic, procurement and contractual practises that has developed and changed within the partner's organisations as a result of this project. The final outcome will be given account for in the final Implementation Report D4c.

The structure and content of this deliverable is divided into three sections, one for each Sesac city. Depending on available experiences and feedback, information will include both generic and more project specific conclusions.

In addition to the partner feedback and findings, has a final headline focusing how to work forward to prepare for the final Implementation Report D4c, been included.

5.2.1 Conclusions and findings in Växjö

In the city of Växjö has one of the main ambitions been the change in state-of art in the Eco building segment, by moving away from carrying out different "pilot project", and instead bring in energy performance ratios and building contractor incentives directly in the tendering and contracting procedures.

The work carried out has so far paved the way for a new type of tendering and negotiation process, leaving the municipal housing companies with less risk and the building contractors with more incentives in their approach for fulfilment of energy- and technological performance.

One of the most clear breakthroughs in terms of changes business as usual has been the introduction of an, until now, relatively unknown part of the Public Procurement Act, namely the Negotiated Processes. Without coming in conflict with the procurement act has the municipality and VKAB succeeded in both bringing in the energy performance indicators directly in the permitting process, and through direct negotiations closing far more secure and incentive based contracts with the building contractors, than ever before.

Within the framework of the municipality and VKAB has movement towards a new way of economically measuring the value of the carbon reduction/capture of different building materials and techniques started. The aim is to launch large scale wooden construction systems as a cost efficient way of both erecting buildings and simultaneously capture carbon dioxides. This work has not yet been finished, and the current focus is to interact with already on-going studies and to launch own new studies to determine the industrial as well as environmental value of wooden constructions, and to make housing companies aware of this when setting evaluation criteria's in their tendering processes.

5.2.2 CONCLUSION AND FINDINGS IN GRENOBLE

Since the city of Grenoble and their housing company Opac 38 aren't erecting their projects and buildings themselves, has one of the main ambitions been the development of a tendering, procurement and contracting structure, enabling the ability to uphold energy and environmental goals, even through multiple levels of developers and building contractors.

In this strive has Opac 38 focused a lot on information and meetings in order to actually get the message through, since several of the developers simply didn't respond in line with the tendering requirements. Even though substantial amounts of work have been carried out in this aspect, has not yet any "total" contractual approach been able to develop. The multi-level stakeholder structure has also significantly hampered the cost-cutting ambitions.

However, the city of Grenoble and Opac 38 has dealt with the challenges, by themselves establishing a new role of a Holistic Energy- and Environmental Performance Coordinator. This coordinator has by linking WP3 and WP4 work still managed to reach the majority of the objectives.

In terms of actually change in state-of art in the Eco building segment. Grenoble needs to adapt another strategy than initially anticipated. The current situation with the city and Opac 38, entering into contracts with different developers, that themselves entering into contracts with multiple levels of contractors and sub-contractors, simply make the "one contract model" impossible.

Proposed ways forward is to form a type of procurement and project follow up guideline stage-by-stage ensuring that project objectives are being achieved without the additional contractual follow-up role being applied in this project. Furthermore is an even broader internal dissemination and training effort needed to really anchor this new way of work.

However, despite some contractual and coordination issues, the results in terms of a new baseline for energy performance in buildings has been very successful. The work carried out by Grenoble within Sesac and the De Bonne areas, has substantially interacted with national guidelines and having the national BBC Granelle 2000, absorbing the Sesac goals and indices for energy efficiency. Now other municipalities can tender and contract in line with Sesac requirements, just by referring to the BBC-documentation.

5.2.3 CONCLUSION AND FINDINGS IN DELFT

In order to provide substantial refurbishment of apartment blocks in social housing areas, and at the same time implement energy efficiency measures to cut the total cost, lease, heating and electricity. To achieve this in a cost efficient and incentive based contractual structure, the city of Delft and it's social housing companies aimed at pairing their own resources with an private ESCO, and jointly forming Public Private Partnership.

Within the framework the Delft team and WP4 coordination, an innovative structure enabling implementation of energy efficiency measures without increasing the tenants total cost for the apartments, lease, heating and electricity, was laid out. However, even though substantial efforts have been made to proceed with this innovative approach, the efforts have so far been hindered.

One of the main hurdles remaining is the housing allowances that several of the tenants in the social housing area receiving from the social welfare systems. These allowances and subsidies are not linked to the total cost of the apartment, but to a maximum lease, excluding energy and electricity. This system with caped rents for tenants, halting the full implementation, since the social housing company can't recover their costs and the tenants in need of subsidies can't stay in the buildings if this strategy is applied. The contra productivity of the current structure of housing allowances is currently being discussed at the Ministry of Spatial Planning and Housing.

The city of Delft has also put a lot of efforts in tendering and negotiations an establishment of a low temp district heating system. However the proposed structure with one energy utility doing the grid and a consortium doing the production facility in the end didn't result in a feasible business case. In order to still reach the objectives did the city of Delft together with the Energy Utility and four housing corporations jointly formed the Public Private Partnership ENECO Delft BV, that with a limited public shareholding still will be able to realise the project. Final decisions for the private partners and the City Council was taken December 2008.

6. Priorities and strategies

6.1 PRIORITIES AND STRATEGIES FOR FINALISING WP-4

Within the respective cities and their local partnerships will the main priority for the remaining period be a systematic documentation and evaluation of what new procurement, contracting and partnership models that actually been established as a result of the Sesac project. Furthermore will emphasis be made on describing how these new structures can be more anchored within the participating organisations, and also present and explain this to the associated cities, in order to have them finding short cuts in the implementation of more innovative procurement, contractual and partnership models.

From a WP-Management perspective, the evaluation of the existing work indicate, that after the first period of very intense work, the following period "intermediate phase" with lower management activity, resulted a somewhat weaker momentum. However through a stringent plan including a new set of "on-site" follow up meetings in each of the cities, the momentum will be regained.

The final deliverable D4c will capture the experiences from all participants, analysing them and present them in form of a final Implementation Report. An important part of the report will be chairing of knowledge and best practice transfer to the Associated Cities.

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Project Coordinator: Torun Israelsson
Project coordination org.:
Växjö kommun
Date: 20 May 2009
Revision: 0

Deliverable 7.2 Establishment document of the District Heating Company Delft

CONCERTO INITIATIVE
Sesac

Sustainable Energy Systems in Advanced Cities

Integrated Project
Thematic Priority 6-1

Period covered:
25.05.05 – 01.05.09
Start date of project: 25.05.05

Date of preparation:01.05.09

CONCERTO is co-funded by the European Commission

1. Executive summary

The deliverable is characterized as the Establishment document of the District Heating Company (DHC) Delft. As such it describes very short the activities that led to the establishment of the DHC and the organizational aspects and the steering principles of the DHC. The establishment documents of the DHC are the Statutes and the Shareholder agreement between the shareholders: two Municipalities (Delft and Midden-Delfland), three Housing Associations (DuWo, Vidomes and Woonbron) and the energy utility Eneco New Energy. These documents are in Dutch language only and for that reason shortly explained.
The District Heating Company will provide about 20.000 dwellings in Delft and Midden-Delfland with heat, partly supplied by heat-pumps and partly by combined heat and power generation.

2. Table of contents

3. Introduction

This deliverable is part of the work package 7: the realisation of a Low temperature based district heating in Delft (NL). Work package 7.1 is the demonstration part and work package 7.2 is the innovation part of WP 7. The deliverable 7.2 is the only deliverable for the work package 7.2. The deliverable is characterized as the Establishment document of the District Heating Company Delft. It describes the chain of activities to come to the district heating company and the underlying documents.

Work package 7.2 describes technical, legal and economical strategies for realization of a low temperature based district heating infrastructure and its connections to building sites distribution systems. A major milestone is the establishment of the District Heating Company Delft. The City of Delft is responsible for work package 7. The District Heating Company Delft will be responsible for the actual realization of the district heating system. The district heating system will include the heat supply system and the transport and distribution part of the heat-chain, from the heat source to the end-user. The City will participate in a public-private-partnership with the energy company ENECO and housing associations to realize the whole heat-chain together. This may include temporary heat sources in some locations.

The other research in the work package 7.2 is on integration of low temperature district heating in Dutch building regulation and CO2 emission trading.

4. Description of work

4.1. Chain of activities

The Establishment document of the District Heating Company (DHC) Delft is the end-result of a long chain of activities. They can be described by all the decisions the City Council of Delft has taken before the final approval of the establishment of the DHC. See table below.

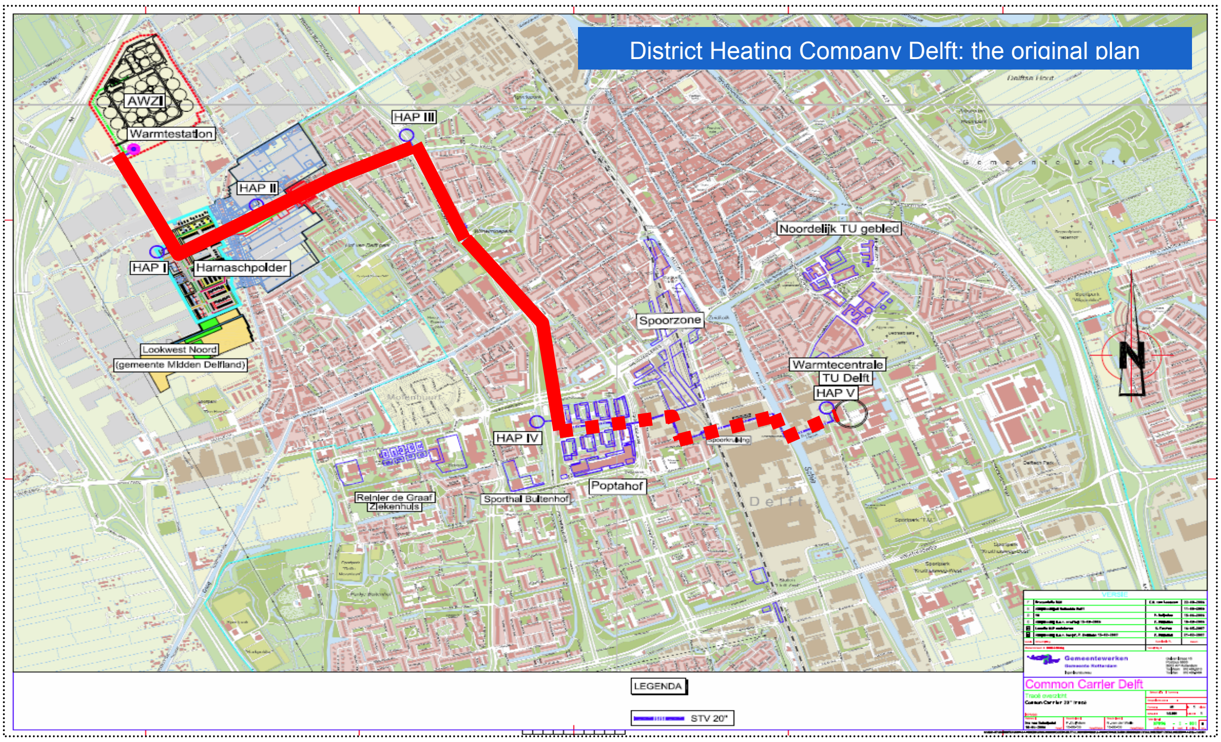
Date	Content
Apr 2003	3E: Delft Climate Policy Plan 2003-2012 approved by the City Council
Feb 2005	City Council decision on the participation in a regional district heating company (to be established in Rotterdam); decision on the participation in SESAC.
Nov 2005	City Council decision, based on a preliminary business case, on: - Feasibility of a district heating supply company; - Start of the negotiation with the future Regional District Heating Company about participation - Tendering of the right to design, construct and exploit a district heating distribution grid in Delft - Obligation to connect to the grid, unless technical or financial impossible - A preparatory budget of € 150.000,-
Feb 2006	City Council decision on: - A supplementary preparatory budget of € 1,092 mln. - Main issues of a "heating supply contract" and a "agreement on participation in a regional district heating company"
Apr 2007	Status reports to the City Council
Nov 2007	
Feb 2008	
Mrt 2008	City Council decision on: - a "go" for an integrated District Heating Company

	- development of other technical and organizational solutions for this DHC than elaborated thusfar (that had shown to e not feasible) - proposal about the preparatory costs thusfar - a new preparatory budget of € 330.000,-
Jul 2008	Status report to the City Council
Nov 2008	City Council decision on: - approval of the establishment of a District Heating Company (as described in paragraph 2.2.)

This table shows a long process from an original idea to the final decision by the responsible authority. After this final decision the implementation should take place. The process thusfar can be described in short as follows:

The Municipality of Delft figured out that a system of collective heat provision (district heating), sourced by the residual heat from industry, would greatly contribute to the climate goals. This was described in the Climate Policy Plan.
As there were no companies interested in the development of district heating systems those days, the Municipality initiated a feasibility study itself, strongly assisted by the experience from the City of Rotterdam (that was developing a similar plan that time).

The first outlines of a district heating system in Delft were based upon the distinction between a "heat producing" company and a "heat distributing" company; the latter supplied by the producing company and delivering heat to the end-user. That's why in an early stage the distribution grid was tendered. Besides that, a preliminary design was made for the heat production units and the main transport line. Based on a comparative study, a technical concept was chosen with large electrical heat pumps, electrical fed by generators driven by large gas-engines. Technical support for the design and feasibility of this system was gathered by a study-visit to Göteburg, sponsored by SESAC and organized by the Technical Coordinator of SESAC.
The heat pumps were fed by the low temperature of the effluent of a large waste water treatment plant, near the newly build district Harnaschpolder. The heat pumps and all other necessary equipment, as boilers and a buffer, (the heat station) fed a large 20 inch double pipeline through the City (the common carrier), finally connected to the heat station from the University of Technology as a back-up facility.
The figure gives an impression of the original plan.



After the designing process of the district heating (supply) system, a tender document has been developed and the construction of the system has been tendered.
After long negotiations with the tendered Consortium, the system appeared to be too expensive to build. It was impossible to develop a suitable business case for the district heating supply system. In other words: the cost of the supplied heat to the distribution firm was too high for the normal Dutch situation ("normal levels" characterized by the branch-union of district heating companies in the Netherlands).

That led the City (Council) to the conclusion that a cheaper system should be developed. One of the possibilities to cut costs in the system was to integrate the heat supply and the heat distribution in one company instead of in two separated companies.
The City (Council) also decided not to be the only partner bearing all the risks of the large investments needed to develop and implement the district heating system. That's why the selected distribution company, Eneco, offered the City also to develop the heat production units.
To be sure that the most important future clients of the district heating system should commit themselves to the system, the City negotiated with the four Housing Associations in the City to become partners in the district heating company.

Together with Eneco, the Housing Associations and a neighbouring Municipality, the City finally developed a new technical concept, with smaller and more conventional natural gas driven CHP-units as a heat source feeding two smaller parts of the city (instead of the city as a whole), and the new organizational concept for an integrated district heating company with more shareholders, as described below.

4.2. The result: establishment document of the DHC

The District Heating Company (Warmtebedrijf Eneco Delft B.V.) is a special purpose company from the Dutch Energy Utility Company "Eneco New Energy".
Eneco has 98 % of the shares in the DHC. The municipalities of Delft and Midden-Delfland own together 1 % of the shares and three housing associations own also 1 % of the shares together.
So the municipalities and the housing associations have little influence in the day-to-day operation of the company. But the three parties (Eneco, municipalities and housing associations) agreed to have the same influence on and control over six important items:

- new or substitutive production units
- tariffs
- increase of serviced area
- service levels
- climate change goals
-"super" return on investments

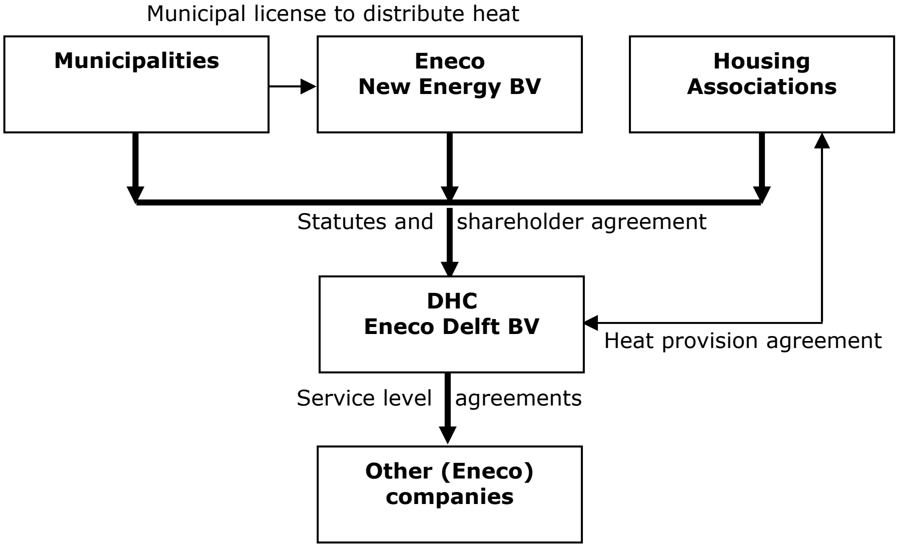
That's why the shares are called "priority shares". The shareholders meet each other several times a year, discussing the reports and proposals the staff of the DHC will bring in. Reporting on the status of the climate goals is one of the items; this will be the basis for the monitoring of the results of the DHC.

The agreement on the DHC is described into several formal documents with annexes. The main documents are: The shareholder agreement and the Statutes of the DHC. These documents are signed by all the participants early 2009.
The main annexes are: the Businesscase of the DHC, the Demand side register (both not publicly available), the Memoranda on the tariffs, the Client satisfaction criteria.
Besides these documents on the agreement between the six partners, there is a second basic document. This is the license provided by the City of Delft to Eneco, that gives Eneco the exclusive right, but also the obligation, to distribute heat in the city of Delft. This right is given under certain conditions. So the Municipality controls the DHC by the

"priority shares" and by the terms and conditions of the distribution license.

All documents are formal Dutch texts; they are presented to the City Council and as such publicly available, unless otherwise noted.

Figure of the contractual relations between the participants



5. Conclusions: lessons learned

- The realisation of a District Heating Company for the whole City of Delft appeared to be a very complex project, with many stakeholders and high investments involved. Many contractual relations between the City of Delft and these stakeholders have been developed and many technical and economical aspects solved before construction can take place.
- It is advisable to let the main stakeholders become financial shareholders at an early stage in the process. This will speed up the forming of contractual relationships.

- Close cooperation with an experienced and reliable energy-company is needed to implement a district heating system on this scale. The Municipality lacks the skills and experience to set up its own district heating company.

- Never start to build the infrastructural elements of a district heating system before a substantial part of the total amount of paying clients has been identified and contracted.

Project Acronym: SESAC TREN/05/FP6EN/S07.43335/006183 REF: KTH DOCUMENT: Deliverable 21a REF.:Thomas Sandberg

Project Coordinator: Julia Ahlrot Project coordination org.: Växjö kommun Date: 2009-04-24 Revision: 4

Deliverable 21a A first outline of monitoring structures

CONCERTO INITIATIVE
Sesac

Sustainable Energy Systems in Advanced Cities

Integrated Project
Thematic Priority 6-1

Period covered: 2005-05-25 – 2010-05-24
Start date of project: 25.05.05

Date of preparation: 2006-01-15
Duration: 8 months

CONCERTO is co-funded by the European Commission

EXECUTIVE SUMMARY

Deliverable 21a is a report on the work during the first eight months towards joint monitoring and analysing structures within the Sesac project. The work has primarily been done by KTH.

The report will be discussed with the aim of presenting a proposal at the annual meeting in May 2006 when a decision on the definitive structure is to be taken. Earlier drafts have been presented and discussed in project meetings.

This working report is, firstly, an overview and summary of the monitoring and analysing obligations of the Sesac project and, secondly, a theoretical/conceptual discussion of what is to be monitored and analysed. In parallel we have also investigated the access to different data and the possibilities and limitations to monitor the demonstration projects.

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1. INTRODUCTION

1.1 OVERALL OBJECTIVES OF SESAC AND OF WP 21

According to the project plan, the overall objective of Sesac is "To show how sustainable energy systems can be achieved by a combination of good governance, innovative co-operation and concrete measures in Delft, Grenoble and Växjö and to transfer the knowledge and experiences to others."

For WP 21 the overall objective is to monitor and analyse. Firstly, it will monitor and analyse the sustainability contribution of the individual concrete measures in each city (in close co-operation with WP 3, WP 4 and of course all the demonstration projects) and, secondly, the sustainability development of the energy system of the participating cities (in close co-operation with WP 2).

1.2 OBLIGATIONS AND RESOURCES OF WP 21 PARTNERS

Monitoring, analysis and reporting are tasks for every Sesac partner. Each and every demo project must "Report on energy performance of the project, in close co-operation with WP 21."

KTH has a developing, coordinating, implementing and analysing role. KTH will work closely with WP 3 and 4 as well as WP 2. Of 89 months in WP 21, the three main cities get 50, the observer cities 15 and KTH 24

1.3 AIM AND CONTENT OF THIS REPORT

The aim of this report is to summarise the work during the first eight months on developing common monitoring and analysing structures for the Sesac project. It is the result of KTH work and a number of project meetings where a first version was discussed in a joint WP 2 and WP 21 meeting, a second one in meetings with the WPs and local project management in Delft, Grenoble respectively Växjö.

In the next step this report will be the base for further development work by KTH and discussions among the partners. In the annual meeting in May 2006, a decision on the definitive structure is to be taken.

In the second section, a basic model of an energy process is introduced as well as a discussion of the actors in the process. Sections 3 (demo projects) and 4 (city energy balances) respectively contain basic theoretical and conceptual discussions of what is to be monitored and analysed. The last section is an overview of the tasks and times we have to face.

In parallel to the so far more theoretical and conceptual work, we have also investigated the access to different data and the possibilities and limitations to monitor the demonstration projects. Obviously there are huge differences between the cities depending both on the presence/absence of relevant statistics and the possibilities to get data from (private) energy companies.

2. SUSTAINABLE ENERGY DEVELOPMENT

According to the Sesac project plan in Annex 1, sustainable energy development can be achieved by "… good governance, innovative co-operation and concrete measures …".

With help of an energy system model (cf 4.2), this section elaborates some alternatives ways. The key concept is *energy process*.

In the first dimension the energy process is specified in terms of the activities constituting the process: extraction, transformation, distribution, storing, consumption. The second dimension contains equipment, energy sources and carriers, actors and institutions.

The energy process often has a very low overall efficiency. One alternative then is to develop one or more of the separate activities, another to change the overall process design radically.

Without changing the energy process, sustainability can be increased by changing the energy sources and/or energy carriers. Sometimes it is possible to use waste energy sources. An important type of change is from high to low quality energy sources (to save exergy).

Regardless of which alternative to improve the sustainability of an energy system, choice and change must be performed by one or more actors. The actors can be "owners" of the energy process and/or they can be performing the activities in the processes (producers, consumers …). The actors can be characterised according to:
• Interests: Is energy a core business? Ownership? Policy and strategy?
• Competencies: Promoting internal, buying external, branch organisations?
• Resources: Size, mother and/or sister organisations, branch organisations?

The actors have to take into account the importance of the surrounding institutional settings:
• Local, regional and national energy policy
• Local, regional and national authorities
• Laws, branch agreements, traditions and other norms.

3. WHAT TO MONITOR, ANALYSE AND REPORT IN DEMO PROJECTS

Before starting monitoring, analysing and reporting, we must answer the following three basic questions:
• What aspects are to be included?
• What objects/levels are to be included?
• Who is to do the job?

We must have a common model for measures, analysis and reports but at the same time we must also consider the unique capabilities of each city and partner.

3.1 WHAT ASPECTS TO INCLUDE

In a broad perspective, there are lots of aspects that are more or less relevant as conditions and/or consequences in connection with a sustainable development of an energy system. Those are perhaps the most evident:
• Energy
• Environment
• Economy
• Employment
• Business
• Users
• Institutions
• Implementation.

As the main focus must be the energy system itself, it is necessary to specify the energy aspects more in detail:
• Changes in supply and transformation of energy sources
• Changes in distribution and storage of energy
• Changes in use of energy
• Changes in energy quality, reliability/security.

In the project plan some energy aspects are especially mentioned:
• Primary energy use (amount and source)
• Overall electricity consumption, as well as peak-hour demand
• Changes in daily and seasonal demand
• Local emissions (e g NOX, SOX, PAH)
• Cost of energy measures.

To those aspects, another set can be added as also playing crucial roles:
• Security of energy supply
• Price and availability of new renewable energy sources
• Local employment
• (New) actors in the energy chain, their driving motives
• Consumer demands
• New technology in old infrastructure.

3.2 WHAT OBJECTS/LEVELS TO INCLUDE

The energy system analysis can be applied on all system levels: Demo project, Concerto area, city/municipality area:
• Demo projects are monitored and analysed
• Concerto area is estimated both from the demo projects and different statistical sources
• City is estimated both from the Concerto area and different statistical sources.

3.3 WHO IS TO MONITOR ETC

For each level, one specific actor has the responsibility for the monitoring, analysing and reporting.
• For demo projects: every WP (the WP leader and its partners). Data and reports from the WPs are input for WP 2-4, cities and KTH.

• For Concerto area: cities (and WPs). The cities should also process data and reports for the Concerto areas.

• For community level: cities. They should also process data and reports from the demo projects and the Concerto area(s)

• KTH has an overall responsibility for the development and implementation of measures, analysis and reports. KTH will actively support the monitoring, analysing and reporting activities of all WPs and cities in a close dialogue.

4. ENERGY SYSTEM ANALYSIS

4.1 AIM OF THE ENERGY SYSTEM ANALYSIS

The energy system analysis should in principle be applied on the city (or municipal) level. Due to primarily statistical reasons it may be necessary to choose another geographical entity, e g a metropolitan area. On the city level, the aim is to get a view of the main characteristics, not the details.

The aim of the energy system analysis in order to develop a more sustainable energy system is to get a picture of:

- The primary energy sources, their transformation to different energy carriers and how those are used
- The actors involved in the energy process
- The institutions influencing the actors.

4.2 A SOCIO-TECHNICAL MODEL OF AN ENERGY SYSTEM

Every system analysis must build on a model of the energy system. The basic model chosen here is a socio-technical one emphasising five aspects.

4.2.1 ENERGY PROCESS

The first aspect is the *energy process*, which can be understood as a map of the energy flows, from the primary energies over transformation to the final use. It is a physical process to which information and financial processes are linked. It is a complex structure of big and small processes with interrelations between many processes. Important characteristics are the dependencies within and between the sub-processes, the degree of centralisation or concentration, high vs low quality (exergy) and so on.

Energy processes can be classified according to

- Primary energy sources
- Functions like heat, power, fuel
- Sectors like households, industry, service.

Already a first, very short look on the six cities shows, that their energy systems have very different characteristics.

4.2.2 EQUIPMENT

A second aspect is the *equipment* used in the energy process, an aspect which is of minor importance in the Sesac project. Aspects that nevertheless might be of interest is the size of the equipment and if it permits polygeneration or not.

4.2.3 ENERGY SOURCES AND CARRIERS

Energy sources and carriers are the third aspect and an important (physical) one. The energy processes should be mapped from the primary to the final energy. To what extent is exergy wasted? How local/regional are the primary energy sources? Are there local/regional energy sources not used so far?

4.2.4 ACTORS

Actors are the fourth aspect. Choices and changes must be carried through by one or more actors (firms, families, cooperatives, authorities …). Actors can be the owners of the energy process and/or performing the activities in the processes (producers, distributors consumers …). Important characteristics are the relations between the actors and how the actor network is related to the energy process (and other processes related to that). Important questions about actors are, firstly, their *interests:* Is energy a core business? Ownership? Policy and strategy? Also their *competencies* must be taken into account: Are they promoting the internal ones or buying external? Do they belong to branch organisation and, in that case, do they draw on that competence? Thirdly, *resources* must be studied: size, mother and/or sister organisations, branch organisations?

4.2.5 INSTITUTIONS

The fifth aspect is *institutions*, the wider environment around the actors to a large extent setting the conditions for them:
• Policy instruments like taxes, market instruments, legal regulations
• Local, regional and national energy policy
• Local, regional and national authorities
• Laws, branch agreements, traditions and other norms.

4.3 THE SANKEY DIAGRAM AS A MODEL OF AN ENERGY SYSTEM

To get an overall picture of a energy system on an aggregated, e g city, level, a Sankey diagram is a powerful tool. Basically it shows the energy sources to the left and the energy uses to the right. In between it can be more or less elaborated showing (part of) the transformation from primary energy to final use. As the city of Växjö is using a Sankey diagram as a way to present its energy balance in a quite sophisticated way, this approach will probably be used in the whole Sesac project.

5. WORK TO BE DONE

5.1 DELIVERABLES

The project plan specifies nine deliverables, where the last five are to be seen as "result reports":
• D21a (Month 8): Definition of baseline data for key energy indicators in the respective SESAC cities.
• D21b (Month 12): Description of monitoring structures
• D21c (Month 18): Energy balances/ plans for all cities
• D21d (Month 24): Energy flow data base
• D21e (Month 48): Large scale implementation forecast
• D21f-h (Month 55): Energy performance report for demonstration projects in Delft, Grenoble and Växjö
• D21i (Month 58): Reports on the benefits distributed electricity generation, local production of bio fuels and wastes, and use of solar and local geothermal resources for heating and cooling.

5.2 MILESTONES

The two milestones are to be seen as the start and end of the monitoring activities:
• M21a (Month 2) Begin monitoring in each city by responsible parties in each city.
• M21b (Month 48): Completion of measuring and evaluation – workshop on large implementation.

5.3 WORK PLAN

• Proposal for monitoring structure (January 2006; KTH)
• Agreement on monitoring structure (May 2006; All)

- Energy balances (November 2006; Six cities; KTH)
- Energy flow database (May 2007; KTH)
- Annual or biannual workshops on monitoring, analysis and reporting of demo projects in Delft, Grenoble and Växjö, all in close co-operation with WP 3
- Annual workshop on energy balances with all six cities, all in close co-operation with WP 2
- When a demo project gets into operation, start of monitoring, analysing and reporting
- In many of the cities development of energy statistics as a base for the energy balance and energy plan work.

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Deliverable 21b Monitoring structures

CONCERTO INITIATIVE
Sesac

Sustainable Energy Systems in Advanced Cities

Integrated Project
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EXECUTIVE SUMMARY

Starting from the SESAC overall objective, the overall objective for WP 21 is to monitor and analyse, firstly, the *sustainability contribution of the individual concrete measures* in each city, and, secondly, the *sustainability development of the energy system of the participating cities*. Applying a socio-technical perspective not only technical but also ecological, economic and social aspects are included.

After some introductory remarks (section 1) and an overview of the goal structure (2), the paper presents step-by-step procedures to monitor and analyse the outcome of the individual demonstration projects (3) respectively the development in the cities (4).

This paper was finally presented at the SESAC General Assembly in Grenoble May 2006. Before that earlier drafts had been worked on during the first year. A first version was discussed in a joint WP 2 and WP 21 meeting, a second one in meetings with the WPs and local project management in Delft, Grenoble respectively Växjö.

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1. INTRODUCTION

1.1 AIM OF WP 21 ANALYSIS AND MONITORING

Starting from the SESAC overall objective, the overall objective for WP 21 is to monitor and analyse, firstly, the *sustainability contribution of the individual concrete measures* in each city, and, secondly, the *sustainability development of the energy system of the participating cities*. Applying a socio-technical perspective not only technical but also ecological, economic and social aspects are included.

Through the monitoring and analysis activities, new knowledge will be obtained on the potential benefits of large-scale implementation of RES technologies within SESAC. Examples of such benefits are: GHG reduction, improved local environment, and security of energy supply. Socio-economic aspects, like end-user issues and opportunities for employment, will also be evaluated. The various demonstration projects within SESAC will be monitored using suitable monitoring structures that take into account each SESAC community's unique measuring capabilities. This will enable proper energy benchmarking. The WP contains city-individual and common activities on analysis and monitoring.

Within this WP, the participation of observer cities will ensure that these communities gain knowledge and thus enable best practice transfer, and facilitate future development in line with the Concerto objectives.

1.2 EVALUATION AS THE WP 21 TASK

The task of WP21 within the SESAC project is monitoring and analysis, which also can be termed evaluation. Evaluation of public programmes and projects like EUs framework programmes and the SESAC project has gradually attracted more and more attention not only within the funding bodies. The social sciences, especially policy studies, have developed a huge repertoire of theoretical and methodological approaches to manage evaluations in a systematic way.

Common for most evaluation approaches is to focus on the goals that can be specified, the results achieved and the relation between those results and the resources implemented. Taking into account not only the EU Work Programme "Sustainable energy systems", the Concerto initiative but also the EU energy targets and directives, the task of WP21 will be to answer the following three basic questions.

1. To what extent have the SESAC sustainability goals been achieved?
2. How efficient have the resources been used to reach the sustainability goals?
3. What have been the promoting respectively hindering economic, social and political conditions in the change process to reach the goals and that in an efficient way, and what are the economic, social and political consequences of the change process?

1.3 WHAT LEVELS TO EVALUATE

In the SESAC project, evaluations should be performed on three different but interrelated levels.

1. Individual demonstration project. Concerning evaluation, this level causes no principal problems and the practical ones seem to be limited.

2. Concerto area. This level gives rise to at least two problems. Firstly, in all three cities it is very difficult to get data about the energy system in the Concerto area, which makes it not so easy to generalise the results to the whole city. Secondly, the Concerto areas are to some extent "artificial" areas due to their very special geographical shape. A third

problem is valid for Växjö where all houses will be new making the generalisation to the whole city very special.

3. The whole city (community, municipality). Delft, Grenoble and Växjö are very different concerning their (geographical) borders. Växjö municipality includes not only the city but also a number of smaller towns and the rural surroundings. Delft municipality is just the city with some parts of its border going through densely populated areas. One of the big Delft demonstration projects is even located in an area, which now lies in another municipality but will be transferred to Delft. Grenoble municipality is part of a metropolitan area and has its borders going through the urban settlements. In some of the Grenoble demonstration project also another municipality is involved. Basic energy statistics is no problem for Växjö. For Delft very little seems to be available. Moreover, much of what may be found belongs to private companies that may not be willing to share it for competition reasons. For Grenoble most of the energy statistics refers not to Grenoble municipality but to the metropolitan area. Thus earlier meetings have decided to base the energy system analysis on Delft and Växjö municipalities but the Grenoble metropolitan area.

1.4 OVERALL ORGANISATION OF THE WP

Even if the Concerto area level must not be neglected, the two main levels are the demonstration projects and the cities. This is the reason why the overall objective of the WP is formulated as an evaluation of the increase of sustainability in the demonstration projects respectively the cities. Thus the three basic questions – sustainability, efficiency and change process – will be applied both to each demonstration project in Delft, Grenoble and Växjö as well as to the energy system in each of the six participating cities.

The overall work of WP 21 will to a large extent be divided in two parts corresponding to those two levels. At the same time, and especially in the last phase of the project, it is necessary to observe and analyse the interplay between the two levels.

KTH has a developing, coordinating and implementing role for the whole WP as well as for the two parts. Then monitoring, analysis and reporting is a task for each demonstration project respectively each city.

1.5 WP START AND WP END

WP 21 has in accordance to the project plan started in month 1 of the SESAC project, i e June 2005, and is planned to end in month 58, i e March 2010.

2. GOALS AS STARTING POINTS

Earlier has been stated that common for most evaluation approaches is to focus on the goals that can be specified, the results achieved and the relation between those results and the resources implemented. Thus an important task for WP 21 is to specify the relevant goals. The SESAC project plan is full of goals of many different kinds and scope. To systematise them it is useful to start with the EU Work Programme "Sustainable Energy Systems" and the Concerto initiative, which are treated in the next section. After that the SESAC goal structure is discussed in two sections.

2.1 GOALS FOR THE "SUSTAINABLE ENERGY SYSTEM" WORK PROGRAMME AND THE CONCERTO INITIATIVE

Within in the "Sustainable Energy Systems", the main goal is to " achieve a truly sustainable energy system". The strategic and policy objectives include (p 2)
1. Improving energy efficiency.
2. Increasing the use of renewable instead of conventional energy.
3. Increasing the security of energy supply.
4. Reducing greenhouse gases and pollutant emissions.
5. Enhancing the competitiveness of European industry.
6. Improving quality of life.

"In the short to medium term, the goal is to pave the way for the introduction of innovative and cost competitive renewable and energy efficiency technologies into the market as quickly as possible through demonstration and other research actions aiming at the market…" (p 2)

As a part of the "Sustainable energy systems" programme, the main aim of the Concerto initiative is to improve the sustainability of energy systems, i e an emphasis on the first two of the goals above. The strategic and policy objectives of Concerto can be summarised as (p 10 - 11)
1. Applying highly efficient energy saving measures.
2. Increasing significantly the percentage of renewable energy supplies.
3. Integrating the self supply of renewables and polygeneration into eco-buildings.
4. Demonstrating the high potential for sustainable energy systems with a fully integrated approach in high performance communities.
5. Supporting the future development and implementation of energy policy by providing well documented field experience.

2.2. SESAC PROJECT GOAL, CRITERIA AND INDICATORS

In accordance with the two goal lists above, the overall SESAC objective is "to show how sustainable energy systems can be achieved by a combination of good governance, innovative co-operation and concrete measures in Delft, Grenoble and Växjö and to transfer the knowledge and experiences to others." (p 7)

This very general formulation is complemented by a lot of criteria and indicators on different pages in the project plan. One important group of criteria is found in the BEST tables for the three cities (pp 27 – 34, 40 – 43 and 50 - 63). On the input side they specify the U values that should be reached in the construction of new and refurbished buildings and on the output side the energy consumption per m2 and year that must be achieved. Another group is the list of indicators on pp 18 – 19 with the purpose to give an overall picture of the project achievement and even named "Measures of success".

"To enable a comprehensive and coherent follow up and evaluation of the individual demonstrations and the results of the overall project, there will be a set of success indicators integrated in the continuous follow up and reports. These indicators will be used adaptively due to their relevance in respective demonstration and city.

1. increase in % of renewable energy in electricity consumption in the Concerto community
2. increase in % of renewable energy in heating / cooling consumption in the Concerto community
3. reduction in energy consumption per m^2 of each building type (efficiency measures)
4. overall reduction in conventional energy consumption in the Concerto community (sum of efficiency gains and renewables supply)

5. m^2 of new high-performing eco-buildings constructed (with signed certificate)
6. m^2 of refurbished high-performing eco-buildings constructed (with signed certificate)
7. MW of new renewable electricity generators commissioned (with signed certificate).
8. MW of new renewable heating / cooling commissioned (with signed certificate).
9. quantitative data on RES and RUE policy implementation by local authority administrations in the Concerto community
10. quantitative data on householders with changed attitudes towards RES and RUE
11. project specific deliverables (eg numbers and types of persons trained or influenced)
12. other results of analyses and monitoring, which indicate the success of the innovations implemented in the project
13. details of long term Concerto community energy management and monitoring systems, which will continue to operate after the end of the project"

2.3 SESAC GOAL STRUCTURE

As SESAC is a huge and complex project and as there are a great number of criteria and indicators that should be monitored, it is necessary to systematise the operational goals. In the matrix on the next side, the first dimension (row) contains the strategic and policy objectives of the Concerto initiative. The second dimension (row) is the three types of evaluation questions.

The first three rows deal with the demonstration projects and the goals relevant for them. Row 4 is especially about the city (community, municipality) level but also the Concerto area level, row 5 the city level.

In the column named Sustainability goals are listed in the first two cells overall characteristics of the demonstration project together with more specific indicators. Cells 4 and 5 are as mentioned related to the city and overall changes in the energy balance respectively energy policy.

The purpose of the column "Efficiency in the use of resources to reach the goals" is to evaluate to what extent the WPs have used their (economic) resources efficiently in relation to their sustainability goal achievements.

The purpose of the last column goes beyond merely describing the sustainability and efficiency results and aims at explaining the varying success in fulfilling the goals. The change process in a WP, the actors involved in the process, the physical structures and the institutional conditions are important.

In the cells have shortly been listed indicators relevant for the different goals. The indicators listed above ("Measures of success) are then classified with bold figures. With indicator 10 as the only exception, they all belong to the sustainability goals. The indicators for the efficiency and process goals are found on other places in the project plan.

Also the demonstration projects have been classified; they all have to answer the three basic questions about sustainability, efficiency and process.

	1. Sustainability goals	2. Efficiency in the use of resources to reach the goals	3. Change process; economic, social, political conditions and consequences
1. Rational use of energy	New and refurbished eco-buildings; m2. **Ind 5, 6.** Reduced (non-sustainable) energy consumption; %, kWh/m2.year, U-values. **Ind 3.** **WP 5, 6.1, 9.1, 10, 16.**	Cost efficiency; €/m2, €/person **WP 5, 6.1, 9.1, 10, 16.**	Change process, chronology and content. Actors, characteristics and relations. **Ind 10** Structures: institutional, political, social, economic conditions and consequences. **WP 5, 6.1, 9.1, 10, 16.**
2. Renewable energy supply	Increased production of PV, hydro, CHP; %, MW, MWh. **Ind 1, 7** **WP 11, 12, 14, 15, 17.** Increased use of waste heat, organic waste, bio-based cooling; %, MW, MWh. **Ind 2, 8** **WP 9.1, 9.2, 17, 19.**	Cost efficiency; €/MW, €/MWh **WP 11, 12, 14, 15, 17.** **WP 9.1, 9.2, 17, 19.**	See above **WP 11, 12, 14, 15, 17.** **WP 9.1, 9.2, 17, 19.**
3. Renewable self-supply in eco-buildings	Combination of measures and indicators from the first two goals.	Cost efficiency; indica-tors as for the first two goals	See above
4. Sustainable energy system in the city	Actual and potential sustainability of the energy system; %. **Ind 4.** Changes in the energy balance; %. Local/regional self-supply; %. **WP 6.2, 7.1, 7.2, 13.**	Cost efficiency; indica-tors as for the first two goals **WP 6.2, 7.1, 7.2, 13.**	See above **WP 6.2, 7.1, 7.2, 13.**
5. Development of new energy policy	Better energy policy. **Ind 9, 13.** Energy management training. **Ind 11.** **WP 2**	 **WP 2**	See above **WP 2**

3. MONITORING AND ANALYSIS OF DEMONSTRATION PROJECTS

3.1 INTRODUCTORY REMARKS

The monitoring and analysis of a demonstration projects is to *apply the relevant indicators listed in the goal structure* above. This causes few and small principal problems, also the practical problems are quite easy to handle. Many of them deal with system limits: which parts of buildings should be included and which should not, which energy consumption should be included and which should not, which energy production should be included and which not. Another issue is to decide the borders or interface between different actors operating different parts of one and the same network, regardless whether it is power, heat or cold. The implications of all those decisions are where to put the meters.

The monitoring and analysis of the demonstration projects is primarily the obligation of each demo WP. As demonstrated in the goal structure, for most of the demonstration projects it is primarily the cells 1:1, 1:2, 2:1 and 2:2 that are relevant. Also parts of 1:3 and 2.3 (the change process) apply. Four of the demonstration projects more relate to the Concerto area and city levels and thus cells 4:1 and 4.2. The indicators on the sustainability and efficiency goals are straightforward to apply, the indicators on the process goals need to be far more elaborated (which is a KTH task, cf the first attempt in 3.2).

The KTH coordination of the work is managed in several ways: joint WP 3, 4 and 21 meetings in the cities, KTH participation in city working meetings, direct and indirect contacts between the WPs and KTH. A new interesting possibility may be exchange-of-experience-meetings organised by Concerto+.

The direct contacts between KTH and demonstration projects must primarily be internet and telephone contacts but also some visits. Those contacts are discussions over project plans, maps, drawings, other documents and site visits with the aim to install the relevant meters and develop the data handling. As more demonstration projects successively have come into the construction and operation phases, their planning and operation of monitoring will also be scrutinised by KTH.

The demonstration projects have different start and end months ranging from month 1 to month 60. This and their different character makes individual work and time plans necessary. Nevertheless some common features are necessary to follow.

3.2 STEP 1: DESIGN OF THE ENERGY AND ECONOMY MONITORING STRUCTURES

The first step naturally starts with the definition and delimitation of the system that is to be monitored. This will define both the energy flows that are to be monitored as well as the system the cost of which also is to be monitored. Next is to decide where to put the meters respectively how to organise the accounting to keep track of the costs. Those tasks are done in collaboration with KTH; also the involvement of WP 3 and 4 is essential.

From the very beginning of a demonstration project, it is necessary to keep some kind of diary or log-book to keep track of the activities, what is done and by whom (individuals, households, companies, authorities and other actors), the arguments for and against decisions and actions.

3.3: REGISTRATION AND DOCUMENTATION

As soon as the first activities of a demonstration project causes costs (and sometimes revenues), those must be registered properly. When the demonstration project starts to operate in the planned way, also the energy parameters must be registered properly.

As the projects will last between three and five years, the continuous registration and documentation must be organised in a consistent way over the years. This is to be designed in collaboration with KTH. Also here the saying of WP 3 and 4 is important.

3.4: ANALYSIS AND EVALUATION

After one year, a first analysis and evaluation of the achievements will be made. Depending on the length of the project, such an analysis and evaluation will be done at least once more before the final analysis and evaluation at the end of the whole SESAC project. This is to be done in collaboration with KTH. Once again the interplay with WP 3 and 4 is important.

4. ENERGY BALANCE AND ENERGY SYSTEMS ANALYSIS IN THE CITIES

4.1 INTRODUCTORY REMARKS

As stated in the introduction, the second overall objective for WP 21 is to monitor and analyse the sustainability development of the energy system of the participating six cities. The instruments for this task will be the *energy balance* and the *energy system analysis*. Parts of those two instruments are part of the *energy management system*, which is a major instrument in WP 2. In the SESAC management cycle in the energy management inventory template in WP 2, energy balance is found in elements 2, 6 and partly in 7 and 8. Those four elements are in turn vital parts of an energy system analysis. These relations explain the close cooperation between WP 21 and WP 2.

The focus of energy management system is *policy and management*, the planning, implementation and evaluation of measures to increase the sustainability of the energy system. Its basic model is the enlarged Deming or management cycle with its centre and surrounding seven steps. Those eight elements make the structure of the WP 2 inventory of the city energy management systems (cf the WP 2 Implementation plan and the WP 2 inventory template).

The focus of energy system analysis is the *energy system* itself with its energy sources, flows, processes, carriers, actors and institutions. Important are the physical and actor networks. Its basic model is a socio-technical one starting with the energy value chain and adding the other aspects mentioned (cf the figure in section 4.3).

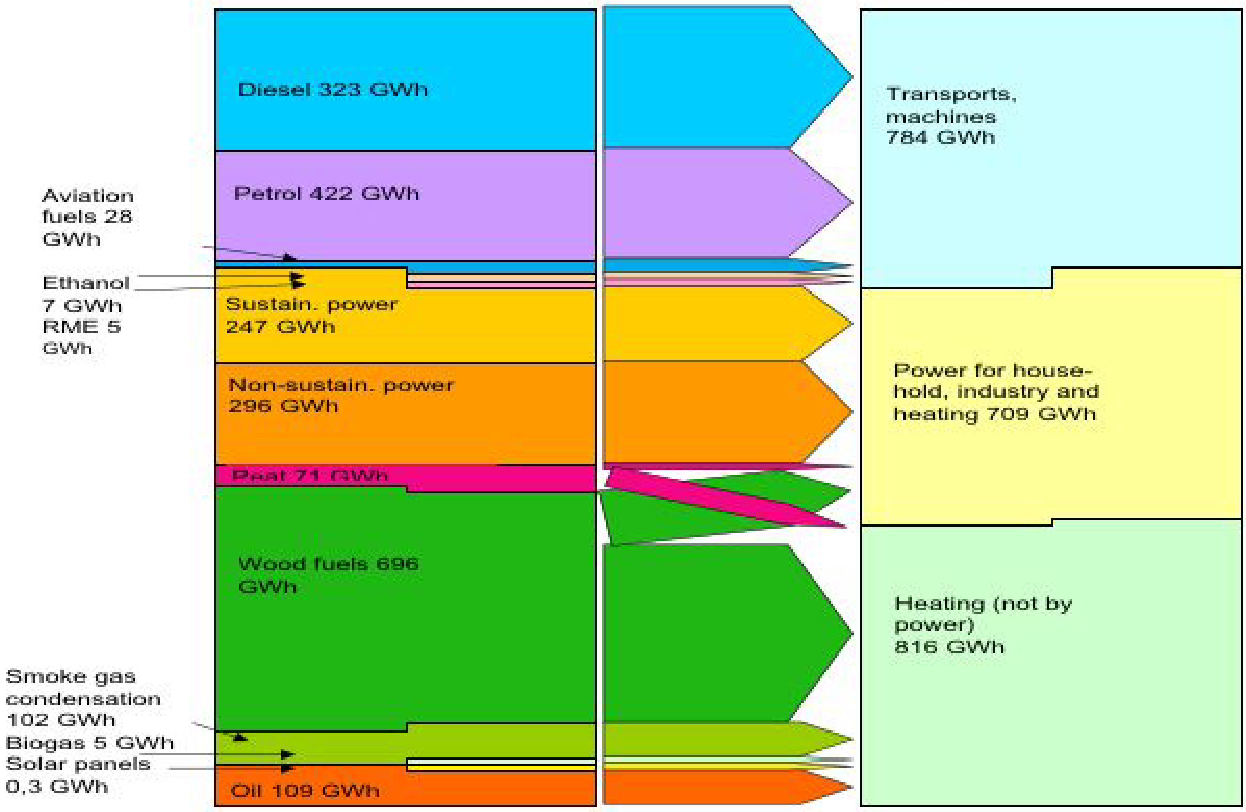
4.2 ENERGY BALANCE

The starting point of an energy system analysis can preferably be a conventional energy balance (cf the picture below). This gives an overall view of the energy sources, transformations and use. According to deliverable 21c all six participating cities are obliged to deliver *at least* one such an energy balance by November 2006.

As has been mentioned in section 1.3, the access to statistics differs considerably between the six cities. For Grenoble, Miskolc and Växjö there are only minor problems. For Delft the situation is the opposite; at the same time it would be possible to use older surveys and ask the Delft Energy Agency for help. For Kaunas and Vastseliina there is no information about energy statistics.

As Växjö has the most elaborated model and also the necessary software, they are kindly offering the other cities to use this tool. Henrik Johansson is the contact person in Växjö.

Energy balace Växjö municipality 2003 (by Henrik Johansson/TS)



Not available: Transmission and other losses; heat energy from the air, ground and water through heat pumps.

The present Växjö energy balance is not without its principal and practical problems. One is how to treat the power supply. Växjö has chosen to use the national average, another solution would be to first take what is physically produced in the city and for the rest use the national average. The root for this problem is that power is treated different physically and administratively. Another problem is that some (minor) energy sources are not traded over a market and thus not included in any statistics.

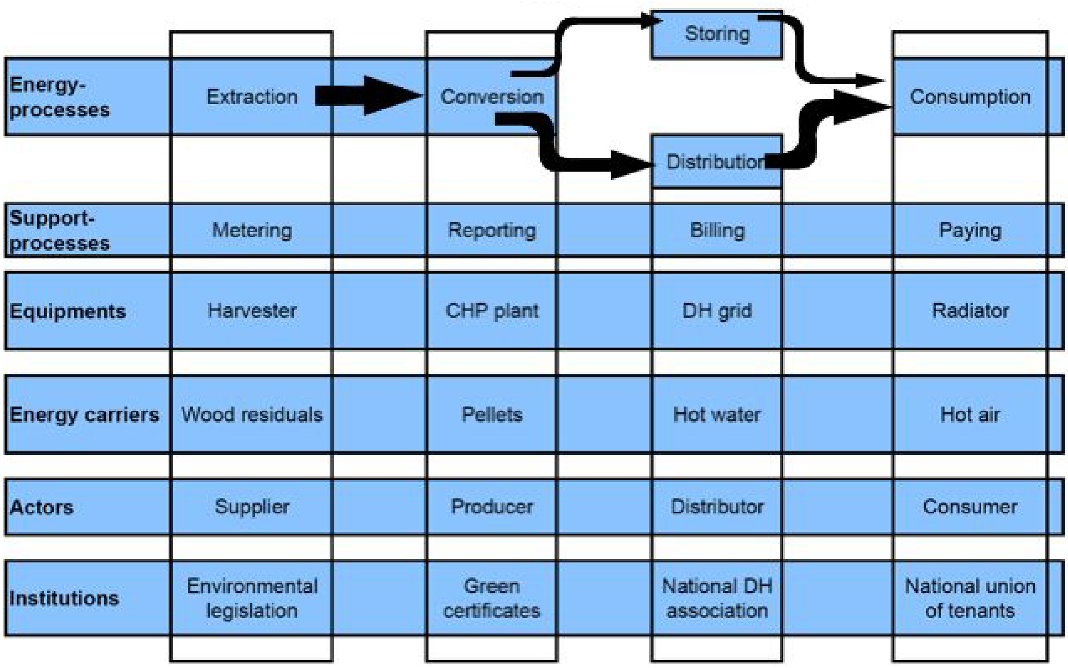
In order to make the energy balance a stronger tool, Henrik Johansson and Thomas Sandberg have agreed to develop the energy balance one step further. Unfortunately we have to wait until June for the model and software containing the new features. On the input side the following new points are agreed:
1. As the figure is two years old, already today, heat energy from the air, ground and water through heat pumps is included.
2. Of the primary energy in the present figure, especially the wood fuels will be more specified.
3. The primary energy will in a new and first step be specified on suppliers, this in order to judge the self-supply and energy security as well as the consequences for business and employment.

On the output side of the energy balance, another three new points are agreed.
4. A new step will be added, the sectors using the different kinds of energy carriers. This is a conventional part of an energy balance, the question is which sectors to include. International statistics mostly use industry, transport, households and service, sometimes the last two make one category. If possible it would be nice to discern also agriculture, public and private service and perhaps some more category.
5. Within the sectors it would be interesting to point out at least the biggest energy users. Some are easy (hopefully): the city itself, big hospitals and industries and what may be specific for a certain city.

This development of the energy balance model should be seen as a step towards a more ambitious energy system analysis. We are not obliged to do that per se – but the WP 2 energy management system inventory will anyhow bring big parts of the energy system analysis.

4.3 ENERGY SYSTEM ANALYSIS

As stated earlier the focus of an energy system analysis is the energy system itself with its energy sources, flows, processes, carriers, actors and institutions. The core is the physical and technical aspects, the energy sources, flows, processes and carriers. This is very much the same as the energy balance. It can also be modelled as an energy value chain as in the socio-technical model below and preferably extended to a physical network.



But to talk about an energy system analysis, one must also include the social aspects. It is the actors behind the activities, trading the energy, investing in the production and distribution equipment, operating the processes and flows and so on. It is the actor characteristics like their interests, resources, knowledge, their relations with other actors in actor networks. It is the institutions influencing the actors, the laws, taxes, administrative procedures and other political instruments, rules, norms, values, authorities and so on.

As stated, rather big parts of the energy system analysis is covered by the WP 2 energy management system inventory. In order not to duplicate this work, the results from the inventory must be taken into consideration before a similar template is developed and where parts can simply be imported from the WP 2 inventory. This is a KTH task.

The rest of the work is still fairly extensive and can preferably be done as master theses by students at the respective city universities. Students can also go abroad to cover more than one city. Another possibility is to involve the local/regional energy agencies.

4.4 STEP 1: DESIGN OF AN ENERGY BALANCE

The first step has been to decide the structure of the energy balance. The Växjö model is a conventional one and has not caused even minor objections; it also has the advantage of the accompanying software.

4.5 STEP 2: MAKING THE ENERGY BALANCE

As stated earlier, this is the obligation of each of the participating six cities and must be reported not later than November 25th 2006. In section 4.2 has been remarked that this will not cause any problems in Grenoble, Miskolc and Växjö. Delft has to take an overall decision on how to handle this task; KTH is willing to assist where necessay. Kaunas and Vastseliina have expressed an interest in a visit from KTH.

KTH will develop an energy flow data base, which shall be ready in May 2007, and where the energy balances will be registered. Hopefully also the cities that today do not make an energy balance will incorporate this among its routines so that the energy flow data base can be used to study the advancement of sustainability in the cities.

4.6 STEP 3: ENERGY SYSTEMS ANALYSIS

This is not an obligatory task (but big parts are within WP 2). We need more discussion about the ambitions of the cities, how they view the possibilities to get help from students and/or other partners. Also a time plan must be discussed, we could for example let this task last over year 2 and 3 in the project.

5. CONCLUSIONS

The overall conclusion is an easy one to draw. The SESAC project is a very big and very complex one making the monitoring and analysis a very big and very complex task. We have the demonstration project level, we have the city level and the intermediary Concerto area level. We have the rational use of energy and the renewable energy supply; in some demonstration projects we have both. We have the sustainability goals and we have the efficiency goals. The matrix on p 7 may look complicated but the reality it is meant to be a model of is even more complicated.

The organisation of the monitoring and analysis is also rather complex as it involves all the demonstration projects, all the cities and then the SESAC project as a whole where KTH has a developing, coordinating, implementing and analysing role. Delays in the demonstration projects will cause delays for the cities and for the whole SESAC project.

In the demonstration projects we have more or less a total access to the data we need, we "only" have to create them primarily by metering but also by other methods. For the Concerto area and city levels this is certainly not the case. The access to public local statistics on energy supply, transformation and use is quite restricted in most of the cities. In some cases there may be company=private local energy statistics; the access to those data can not be taken for granted.

With due respect to all kinds of "internal" problems that may complicate the monitoring and analysis, the major problems with the evaluation of the SESAC project will be "external". Over the five years the project will last, many circumstances will change and some of them even dramatically and in a way that will have a strong impact on the project. A new and better technology can be announced and may seem worth to wait for. The economic condition for the building projects may change. A new government can change the institutional settings influencing the energy supply mix. New city councils can change the involvement in the project, still within the limits of the contract.

Project Acronym: SESAC TREN/05/FP6EN/S07.43335/006183 REF: KTH DOCUMENT: Deliverable 21c REF.: Thomas Sandberg

Project Coordinator: Julia Ahlrot Project coordination org.: Växjö municipality Date: 2009-05-27 Revision: 3

Deliverable 21c Energy balances

CONCERTO INITIATIVE
Sesac

Sustainable Energy Systems in Advanced Cities

Integrated Project
Thematic Priority 6-1

Period covered: 2005-05-25 – 2010-05-24
Start date of project: 25.05.05

Date of preparation: 2006-11-25
Duration: 18 months

CONCERTO is co-funded by the European Commission

EXECUTIVE SUMMARY

One of the overall objectives for WP 21 is to monitor and analyse the sustainability development of the energy system of the participating cities. Applying a socio-technical perspective not only technical but also ecological, economic and social aspects are included.

After some introductory remarks follows an overview of the goals of importance (section 1). In the second section two approaches to an analysis of a city energy system are presented with an emphasis on the Sankey model as a way to picture the energy balance of a city. Applying an energy balance inevitably gets you in a number of big and small theoretical and methodological challenges; some of those are discussed in section 3. In section 4 characteristics of and comparisons between the energy systems of the cities are presented.

As the lack of energy statistics or other information on the energy system is conspicuous for most of the cities, the work so far has been twofold. Firstly, to develop the theoretical and methodological bases for the energy balances and, secondly, to make an inventory of what energy information that is available.

The result is this report where the first, mostly preliminary balances are attached as appendices. The work with the energy balances will continue, both in the cities and jointly, with the intention to later on present more developed and correct energy balances. Then is the time for more definite conclusions and even recommendations.

Those first results show very big differences between the cities where Vasteliina and Växjö have around 50 % renewable energy supply and the other less than 10 %, Delft only 1 %. Generally the same is true for energy security in terms of local supply.

When we specify the energy balances in the three sectors heating, power and transport, the situation is more heterogeneous. The exception is the transport sector where all cities are totally depending on fossil fuels. Concerning heating Vastseliina and Växjö rely to a large extent on biomass, Grenoble on a mixture between biomass and fossil fuels and the others nearly totally on fossil fuels (mostly gas). The power supply is based on renewables to 35 % in Kaunas (hydropower) and Växjö (biomass-CHP), 8 % I Grenoble and near 0 % in Delft and Vastseliina.

The "easiest" way to increase the share of renewable energy supply is to change the DH systems from fossil fuels to biomass and waste. To some extent the DH systems can be further developed to include CHP and to be geographically enlarged. And the city without DH – Delft – has to take the very first steps.

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1. INTRODUCTION

1.1 AN INTERMEDIARY REPORT

Deliverable 21 c is formulated as "Energy balances/ plans for all cities". After starting the SESAC project, it gradually turned out that the participating six cities had very different bases for delivering complete and detailed as well as theoretically and methodologically sound energy balances in due time. The six cities ranged from making an annual energy balance as an administrative routine to having not any energy statistics at all.

Thus this is an intermediary report mirroring the short-term aims of this part of WP 21. Firstly, to develop the existing energy balances to more powerful tools in the energy policies and, secondly, to help the cities without energy balances to take the first steps. The more long-term aim of this part of WP 21 is that all cities should have implemented more advanced energy balances as part of their energy management systems (which are developed within WP 2).

The emphasis of the report is firstly to introduce and develop the concepts and models that are a necessary ground. Secondly, focus is on the theoretical and methodological issues that must be dealt with in order to get valid and reliable energy balances. Thirdly, some comments are made on the mostly very preliminary energy balances that are included as appendices.

1.2 ENERGY BALANCE: A SHORT DEFINITION

An energy balance is a model over the supply, transformation and use of energy within a system. It can be used as a tool to plan, implement and evaluate changes in the system, in our case changes towards increased sustainability. To use an energy balance, you must decide which energy sources and carriers that should be included, where to draw the system borders, how detailed the information should be etc.

The answers to those and other questions differ between different applications of the energy balance concept. In our case, the energy balance concept and the city energy balances must be based on the goals of respectively the EU Work Programme "Sustainable Energy Systems", the Concerto initiative and the SESAC project. The next section contains a short summary of those goals; a fuller account is given in Deliverable 21 b Monitoring structures sections 1 and 2.

1.3 PROJECT GOALS RELEVANT FOR THE ENERGY BALANCES

Within in the "Sustainable Energy Systems", the main goal is to "achieve a truly sustainable energy system". The strategic and policy objectives most relevant for the energy balance task are improving energy efficiency, increasing the use of renewable instead of conventional energy and increasing the security of energy supply. (Sustainable Energy Systems, programme plan, p 2)

As a part of the "Sustainable Energy Systems" programme, the main aim of the Concerto initiative is to improve the sustainability of energy systems, i e an emphasis on the first two of the three goals above. The strategic and policy objectives of Concerto can be summarised as (Concerto programme plan, p 10 - 11):

1. Applying highly efficient energy saving measures.

2. Increasing significantly the percentage of renewable energy supplies.

3. Integrating the self supply of renewables and polygeneration into eco-buildings.

4. Demonstrating the high potential for sustainable energy systems with a fully integrated approach in high performance communities.

5. Supporting the future development and implementation of energy policy by providing well documented field experience.

In accordance with the two goal lists above, the overall SESAC objective is "to show how sustainable energy systems can be achieved by a combination of good governance, innovative co-operation and concrete measures in Delft, Grenoble and Växjö and to transfer the knowledge and experiences to others" (SESAC contract annex I, p 7).

This very general formulation is complemented by a lot of criteria and indicators on different pages in the project plan. One group is the list of indicators with the purpose to give an overall picture of the project achievement and even named "Measures of success" (SESAC contract annex I, pp 18 – 19):

1. Increase in % of renewable energy in electricity consumption in the Concerto community.

2. Increase in % of renewable energy in heating / cooling consumption in the Concerto community.

3. Reduction in energy consumption per m^2 of each building type (efficiency measures).

4. Overall reduction in conventional energy consumption in the Concerto community (sum of efficiency gains and renewables supply).

5. M^2 of new high-performing eco-buildings constructed (with signed certificate)

6. M^2 of refurbished high-performing eco-buildings constructed (with signed certificate)

7. MW of new renewable electricity generators commissioned (with signed certificate).

8. MW of new renewable heating / cooling commissioned (with signed certificate).

9. Quantitative data on RES and RUE policy implementation by local authority administrations in the Concerto community

10. Quantitative data on householders with changed attitudes towards RES and RUE

11. Project specific deliverables (eg numbers and types of persons trained or influenced)

12. Other results of analyses and monitoring, which indicate the success of the innovations implemented in the project

13. Details of long term Concerto community energy management and monitoring systems, which will continue to operate after the end of the project"

1.4 ENERGY BALANCE AS AN EVALUATION TOOL

Starting from the SESAC overall objective, the overall objective for WP 21 is to monitor and analyse, firstly, the sustainability contribution of the individual concrete measures in each city, and, secondly, the *sustainability development of the energy system of the participating cities*. Applying a socio-technical perspective not only technical but also ecological, economic and social aspects are included.

Within WP 21, the participation of observer cities will ensure that these communities gain knowledge and thus enable best practice transfer, and facilitate future development in line with the Concerto objectives.

Even if an energy balance can be used as a planning and implementing device (which it is in WP 2), in line with the WP 21 task we focus primarily on the use of the energy balance as an evaluation tool. Common for most evaluation approaches is to focus on the goals that can be specified, the results achieved and the relation between those results and the resources implemented. Taking into account not only the EU Work Programme "Sustainable Energy Systems", the Concerto initiative but also the EU energy targets and directives, the task of WP 21 will be to answer the following three basic questions:

1. To what extent have the SESAC sustainability goals been achieved?

2. How efficient have the resources been used to reach the sustainability goals?

3. What have been the promoting respectively hindering economic, social and political conditions in the change process to reach the goals and that in an efficient way, and what are the economic, social and political consequences of the change process?

1.5 OVERALL ORGANISATION OF THE ENERGY BALANCE WORK

The overall work of WP 21 will to a large extent be divided in two parts corresponding to the demonstration projects respectively the energy balances. At the same time, and especially in the last phase of the project, it is necessary to observe and analyse the interplay between these two parts.

KTH has a developing, coordinating and implementing role for the whole WP as well as for the energy balance work. Then monitoring, analysis and reporting is a task for each demonstration project respectively each city.

WP 21 has, in accordance to the project plan, started in month 1 of the SESAC project, i e June 2005, and is planned to end in month 58, i e March 2010.

So far, the first step has been to decide the structure of the energy balance (cf section 2.3). In parallel the cities have made their best to overcome the theoretical and methodological problem (section 3) and come up with first and preliminary energy balances, which are appended to this report. The WP leader has visited Kaunas and Vastseliina in order to help them getting started with the energy balance work.

The broader energy system analysis is not an obligatory task (but big parts are within WP 2). We need more discussion about the ambitions of the cities, how they view the possibilities to get help from students and/or other partners. Also a time plan must be discussed, we could for example let this task last over year 2 and 3 in the project.

2. ENERGY SYSTEM ANALYSIS AND ENERGY BALANCES

2.1 TWO APPROACHES

As stated in the introduction, the second overall objective for WP 21 is to monitor and analyse the sustainability development of the energy system of the participating six cities. The instruments for this task will be the *energy balance* and the *energy system analysis*. Parts of those two instruments are part of the *energy management system*, which is a major instrument in WP 2. In the SESAC management cycle in the energy management inventory template in WP 2, energy balance is found in elements 2, 6 and partly in 7 and 8. Those four elements are in turn vital parts of an energy system analysis. These relations explain the close cooperation between WP 21 and WP 2.

The focus of energy management system is *policy and management*, the planning, implementation and evaluation of measures to increase the sustainability of the energy system. Its basic model is the enlarged Deming or management cycle with its centre and surrounding seven steps. Those eight elements make the structure of the WP 2 inventory of the city energy management systems (cf the WP 2 Implementation plan and the WP 2 inventory template).

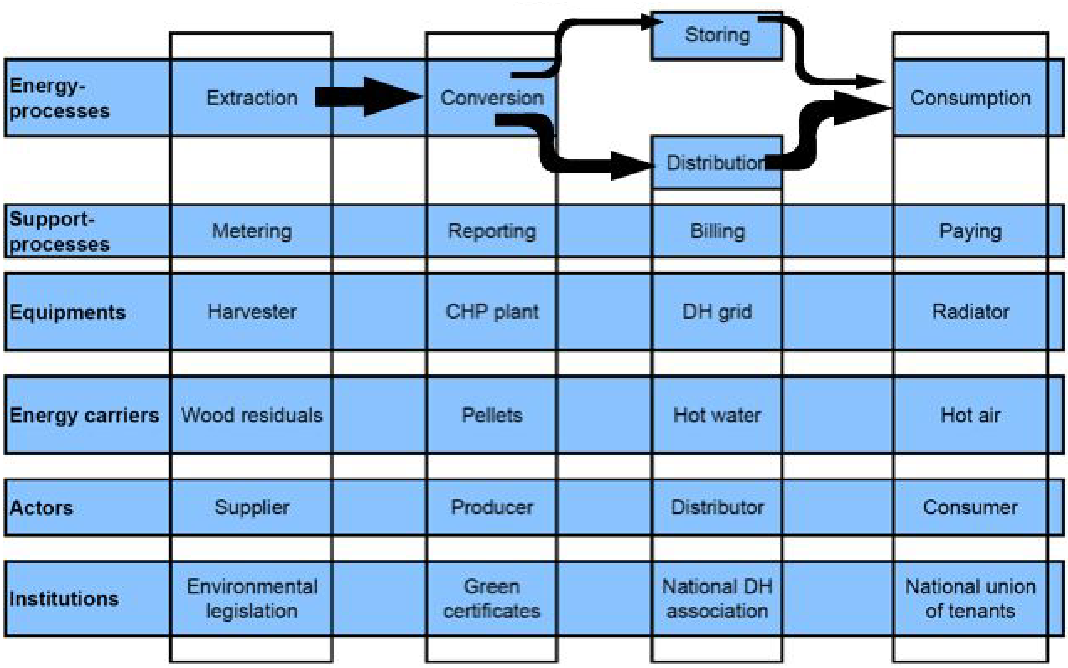
The focus of an *energy balance* is the physical aspects of an energy system: supply, transformation and use. We can also talk about energy sources, flows, processes, and carriers. An *energy system analysis* is a socio-technical approach also including social aspects like actors and institutions. Important are the physical and actor networks. Its basic model is a socio-technical one starting with the energy value chain and adding the other aspects mentioned (cf the figure in section 2.2).

2.2 ENERGY SYSTEM ANALYSIS

As stated earlier the focus of an energy system analysis is the energy system itself with its energy sources, flows, processes, carriers, actors and institutions. The core is the physical and technical aspects, the energy sources, flows, processes and carriers. This is very much the same as the energy balance. It can also be modelled as an energy value chain as in the socio-technical model below and preferably extended to a physical network.

But to talk about an energy system analysis, one must also include the social aspects. It is the actors behind the activities, trading the energy, investing in the production and distribution equipment, operating the processes and flows and so on. It is the actor characteristics like their interests, resources, knowledge, their relations with other actors in actor networks. It is the institutions influencing the actors, the laws, taxes, administrative procedures and other political instruments, rules, norms, values, authorities and so on.

As stated, rather big parts of the energy system analysis is covered by the WP 2 energy management system inventory. In order not to duplicate this work, the results from the inventory must be taken into consideration before a similar template is developed and where parts can simply be imported from the WP 2 inventory. This is a KTH task.



The rest of the work is still fairly extensive and can preferably be done as master theses by students at the respective city universities. Students can also go abroad to cover more than one city. Another possibility is to involve the local/regional energy agencies.

2.3 ENERGY BALANCE

The starting point of an energy system analysis can preferably be a conventional energy balance (cf the figure below). This is the very common Sankey diagram giving an overall view of the energy sources, flows, transformations and use. The Sankey diagram can then be complemented with other diagrams highlighting supply respectively use.

As Växjö already is using a Sankey model for its energy balance and has also the necessary software, they are kindly offering the other cities to use this tool. Henrik Johansson is the contact person in Växjö.

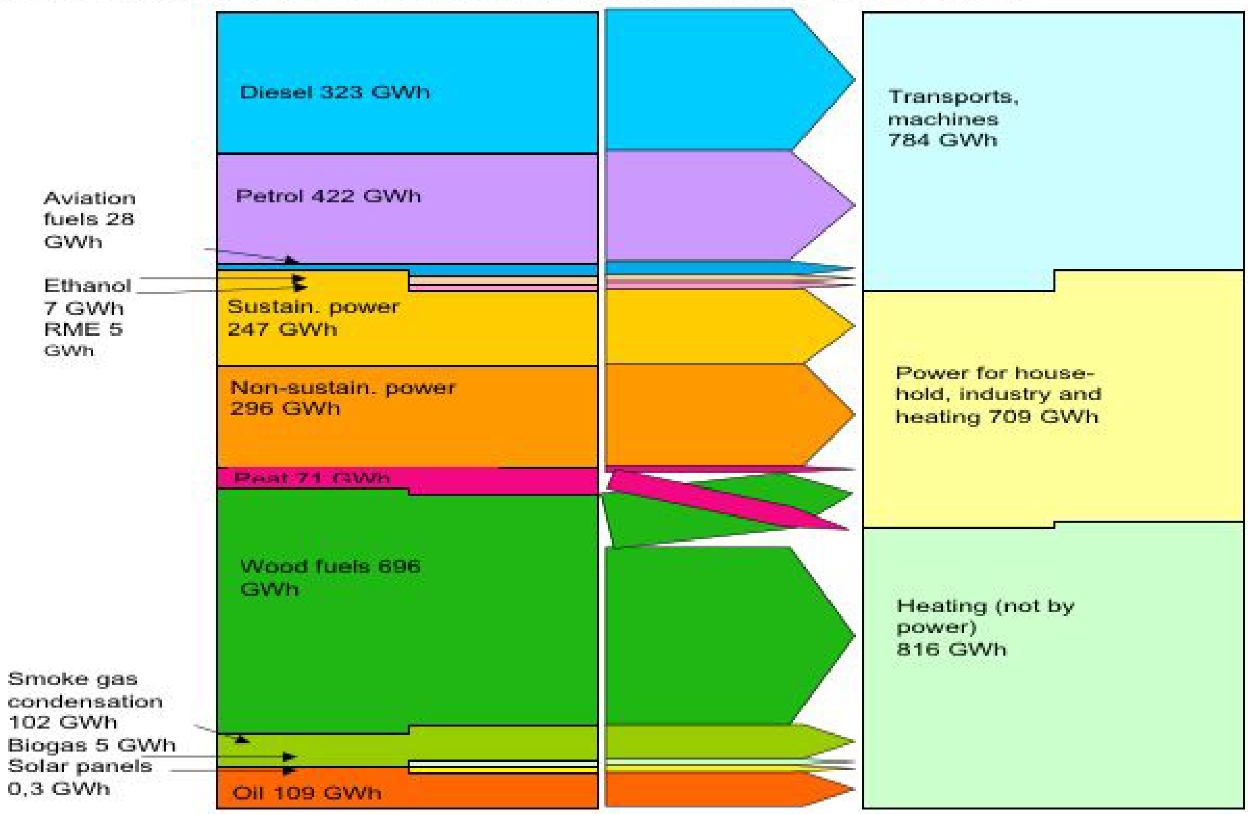
As all energy balances, the present Växjö energy balance is not without its principal and practical problems. Those issues are dealt with in section 3, here we will focus on the possibilities to develop the Sankey model towards more of an energy system analysis including actors.

On the input side, the primary energy will be preceded by a new and first step specifing the suppliers, this in order to judge the self-supply and energy security as well as the consequences for business and employment.

The transformation step in the middle will be specified with the "energy plants" where the transformation from one energy carrier to another takes place.

On the output side of the energy balance, two new points are agreed. Firstly, a new step will be added, showing the sectors using the different kinds of energy carriers. This is a conventional part of an energy balance, the question is which sectors to include. International statistics mostly use industry, transport, households and service, sometimes the last two make one category. If possible it would be nice to discern also agriculture, public and private service and perhaps some more category.

Energy balace Växjö municipality 2003 (by Henrik Johansson/TS)



Not available: Transmission and other losses; heat energy from the air, ground and water through heat pumps.

Secondly, within the sectors it would be interesting to point out at least the biggest energy users. Some are easy (hopefully): the city itself, big hospitals and industries and what may be specific for a certain city.

This development of the energy balance model should be seen as a step towards a more ambitious energy system analysis. We are not obliged to do that per se – but the WP 2 energy management system inventory will anyhow bring big parts of the energy system analysis.

3. THEORETICAL AND METHODOLOGICAL ISSUES

3.1 THEORETICAL CHALLENGES

The participating six cities are very different concerning their (geographical) borders. Delft municipality is just the city with some parts of its border going through densely populated areas. One of the big Delft demonstration projects is even located in an area, which now lies in another municipality but will be transferred to Delft. Grenoble municipality is part of a metropolitan area and has its borders going through the urban settlements. In some of the Grenoble demonstration project also another municipality is involved. Växjö municipality includes not only the city but also a number of smaller towns and the rural surroundings. Of the observer cities, Kaunas and Miskolc are big cities with minor rural parts. Vastseliina is the exact opposite as a rural municipality with only some thousand inhabitants.

That the empirical manifestations of the municipality concept are so heterogeneous of course have far-going consequences for the application of an energy balance model, regardless which. Even if the geographical conditions and the "physical arrangements" are similar for two cities, the different ways to draw the administrative borders can result in very different energy balances.

So the major theoretical question is as always the system limits, in our case the administrative borders. In modern societies, energy is only to some extent "consumed" in the same area as it is "produced" and vice versa. Especially in urban areas energy is to a very large extent exported and/or imported over the city/municipality borders. Especially the non-stationary transportation sector causes problems as nearly all energy first is imported to the city, then distributed and to some extent used outside the city. Similarly some energy used in a city is brought in cars and trucks that have bought the fuel somewhere else. To get hold of those flows statistically is really a challenge.

Another major problem is how to treat the relation between primary and final energy. Here the six countries have different routines in their energy statistics. The reason is the very different energy supply profiles in the six countries. In Sweden the primary energy is not a big issue as very little of the power is produced in condense plants with low coefficient of performance; the exception being the whole nuclear sector.

A third problem is the "free" energy, which is not traded over a market and thus not included in the ordinary energy statistics. Primarily it is heat (and cold) energy from the air, ground and water through heat pumps as well as heat from the sun through solar panels. Some years ago those energy sources were of minor importance but now they are growing fast and of course especially interesting in a sustainability project.

A fourth problem is how to treat the power supply. One can choose to use the national average, another solution would be to first take what is physically produced in the city and for the rest use the national average. The root for this problem is that power is treated different physically and administratively.

3.2 METHODOLOGICAL CHALLENGES

The major methodological problem is the lack of statistical information about energy supply and use on a local level. For Delft very little seems to be available. Moreover, much of what may be found belongs to private companies that may not be willing to share it for competition reasons. It might be possible to use older surveys and ask the Delft Energy Agency for help. For Grenoble most of the energy statistics refers not to Grenoble municipality but to the metropolitan area. Thus earlier meetings have decided to base the energy system analysis on Delft and Växjö municipalities but the Grenoble metropolitan area. Contrary to Delft and Grenoble, basic energy statistics is no problem for Växjö. In the observer cities, Kaunas and Vastseliina do not seem to have any energy statistics while the situation in Miskolc is somewhat unclear.

Due to the theoretical problems discussed in the previous section, many minor statistical problems will need creative solutions like translating national averages in an intelligent way, using other types of surveys, approaching big suppliers/users, making deals with private companies etc.

4. SOME COMMENTS ON THE FIRST ENERGY BALANCES

4.1 METHODOLOGICAL CHARACTERISTICS

As the first energy balances presented earlier this month for most of the cities were very preliminary, it is not so meaningful to go into a deeper analysis. Moreover, there is not time for this.

Basically the cities have had the Sankey diagram in mind as the model for the energy balance. A couple of them have not succeeded in putting together the data in the overall model, instead supply and use are presented separately. Also the design of the Sankey model varies a lot.

The problems with the lack of relevant energy statistics in most of the cities are obvious and further discussed in some of the appendices. The general comment must be that the cities have handled a difficult situation with creativity.

The energy balance of Miskolc is missing due to a combination of data and linguistic problems.

4.2 RESULTS IN A NUTSHELL

The energy intensity or energy consumption per inhabitant and year varies a lot from Växjö with more than 30 MWh/cap.year over Delft and Grenoble with somewhat more than 20 to Kaunas and Vastseliina with a little bit more than 10 MWh/cap.year.

Interestingly it is the two extremes concerning energy intensity that have the by far highest share of renewable energy supply, Vastseliina with 48 and Växjö 53 %. The main explanation is that they both rely on biomass for heating. Grenoble has 9 % renewable energy supply (hydropower, biomass and waste), Kaunas 8 % (mostly hydropower but also some biomass), Delft only 1 % (some biogas and solar energy).

The energy security in terms of local supply is not so easy to judge but shows the same pattern as renewable supply. Vastseliina can be a bit over 40 %, Växjö 40 %, Grenoble and Kaunas around 7 % and Delft 1 %.

Energy for transports is easy to summarise for all cities, it is fossil fuels 100 % with a few microscopic exceptions.

The power supply is a more heterogeneous picture. Delft and probably also Vastselinna have nearly no renewable power supply, Grenoble has 8 % (hydropower and some biomass-based CHP), Kaunas and Växjö around 35 % (hydropower respectively biomass-based CHP).

Heating is also a mixed picture. Delft is totally relying on fossil fuels, mostly gas, and has no DH. Kaunas is also totally depending on fossil gas for heating, however the city has DH and CHP. Grenoble is mostly using fossil fuels but also some biomass and waste for heating, this city also has DH and CHP. Both Vastseliina and Växjö have a heating sector nearly totally using biomass. Vastseliina has two small DH systems, Växjö a big one with CHP.

4.3 SOME CONCLUSIONS

The main challenge is the transports, which are totally relying on fossil fuels in all cities. The main policy instrument for the cities is to promote busses and trams, also biking and walking of course. Moreover the municipalities can change their bus and car fleets to sustainable alternatives like biogas.

For a Swede DH with CHP is a obvious and necessary base for heating but also power production. Also cooling can be produced at the same time. Thus Delft should fulfil its plan to introduce DH (WP 7, even if it is without CHP). The other cities should continue to enlarge the DH grid and increase the connections to the DH. All cities should get in as much waste heat as possible (cf WP 7 in Delft). Kaunas has the physical conditions for using more biomass in the CHP, the problem is that the owner Gasprom wants to sell its fossil gas. Grenoble could also use more biomass.

A lot of "new" sustainable energy supply alternatives can be found in the six cities but they all play a very minor role. Especially convenient for cities are biogas, organic waste, photavoltaic, solar panels and perhaps urban windpower.

Memo

To : Thomas Sandberg
From : Marc Schouten
Date : 9 november 2006
Subject : SESAC, Energy Balance city of Delft, first version

Delft Energy Agency Mijnbouwplein11 2628 RT Delft +31 15 2852860 m.schouten@delftenergy.nl

1. Introduction

The most recent available publication on the energy situation in the city of Delft, other than policy documents, is "Sustainable Energy in Delft" by CEA (1999). The starting point for constructing the energy balance for the city of Delft, required in the SESAC project, were some statistics from the CEA report, shown in figure 1 and table 1.

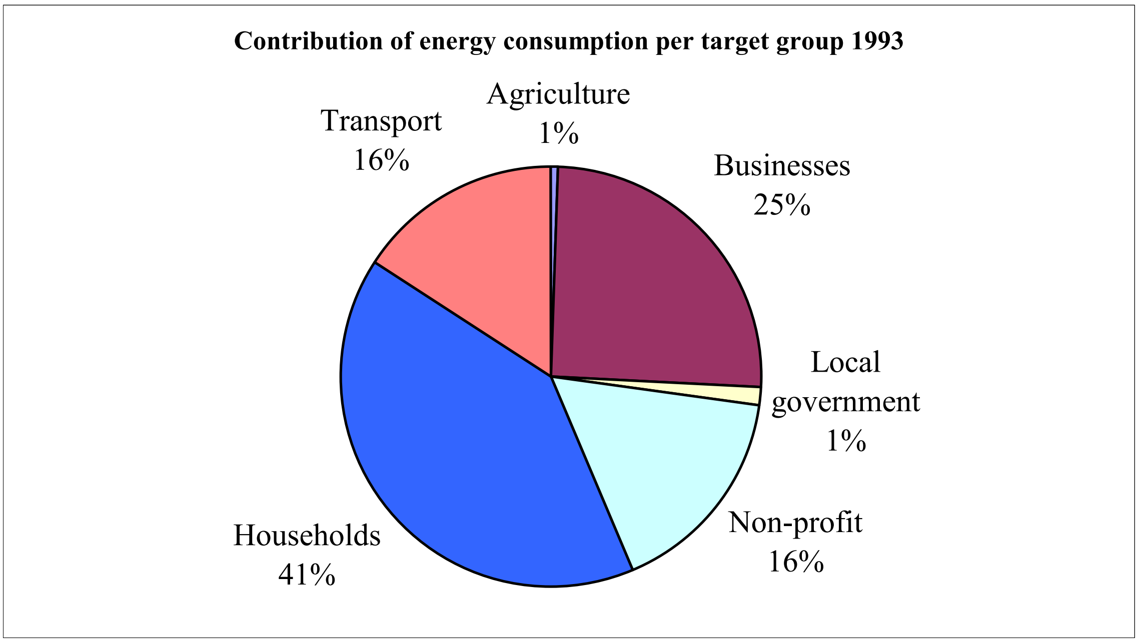


Figure 1

Consumption (GJ)	1993
Electricity	2.346.138
Gas	3.610.018
Transport	1.182.128
Total	7.138.284

Table 1

It was decided to use these numbers as a basis and extrapolate and expand them using national statistics. A description of the method follows.

2. Method

The process that was agreed upon during the last SESAC meeting in Delft can be summarized as follows:

1. Gather national consumption data for various categories for 1993 and 2005
2. Determine relative change in consumption for each of these categories
3. Apply this percentage change to the Delft-93 situation to obtain the Delft-05 situation
4. Expand on the result from step 3 with known data from the Delft-05 situation

The first obstacle was to determine which national data to gather. Since the available data from the CEA report on the demand side is more detailed than the data on the supply side, it was deemed most opportune to extrapolate on the demand side. For the total energy consumption the total amount from table 1 was used. From the table it is not readily apparent that this total is in fact the total energy consumed in 1993 in Delft, but it is stated in the report that this is the case.

The main source of national data is the Central Bureau of Statistics (CBS). Upon perusing the available data the first problem presented itself: CBS does not use the same categories as the ones used in figure 1. It does have information on energy consumption for households and transport, but the remainder is categorized by economic sector. It was not possible to make a one-on-one translation from the CBS categories to the CEA categories.

It was therefore decided to work with three catories: “households”, “transport” and “other”.

2.1. Households

2.1.1. Demand side

CBS has statistics on national gas and electricity consumption for households up to 2000. An estimate for 2005 was obtained by using an (Excel) growth extrapolation based on the data from 1993-2000. This estimate was compared with the data from 1993 to obtain a percentage change.

The known Delft data from figure 1 were converted to a per-household basis using the statistical compendium for 1994 that Delft publishes every year. The national percentage change was applied to this per-household figure, resulting in an estimate per-household consumption for Delft-05. This result was then corrected for the increase in number of households from 1994-2005.

It was investigated whether or not to include specific Delft data for the student population (a large group in Delft), but since the projected consumptions are based on the Delft-93 data this group is already accounted for. It was therefore decided not to specifically distinguish this group.

2.1.2. Supply side

National data were used to determine the amounts of gas and electricity used. Included were biomass, wind, PV (from local data). Heatpumps were not included, since the major installations in Delft are used

for both cooling and heating and CBS does not recognize this as sustainable[1].

2.2. Transport

2.2.1. Demand side

The CBS category "transport" was used to make a one-on-one translation from the national situation 93-05 to the Delft situation, resulting in the total demand for transport.

2.2.2. Supply side

All energy sources mentioned in the CBS data were included, since there is no information available on the overall composition of the modes of transport in Delft. It is expected that this will result in a systematic error.

2.3. Other

2.3.1. Demand side

This figure was obtained by taking the total national energy consumption and subtracting from this number the consumptions from households and transport. The same was done to the Delft-93 data. Applying the national change percentage from 93-05 to the Delft-93 figure resulted in the total demand in the "other" category.

The problem that arose was that there was no way to systematically determine how the total demand was spread over the different categories on the demand side (transport, electricity, heating and cooking). An unscientific approach was therefore taken:

- The division of this data over the categories on the demand side was done by inspecting the sources on the supply side. All natural gas, for instance, was attributed to heating and cooking. All electricity was attributed to the demand category electricity. The remainder, being mostly oil and coal products, were attributed to transport/machinery.

- When adding these results to those of households and transport, a skewed final result appears, when comparing the numbers to those in table 1. Most notably, the relative electricity consumption was comparable to the national relative electricity consumption, which raises questions, since Delft is an urban area without much heavy industry, for instance.

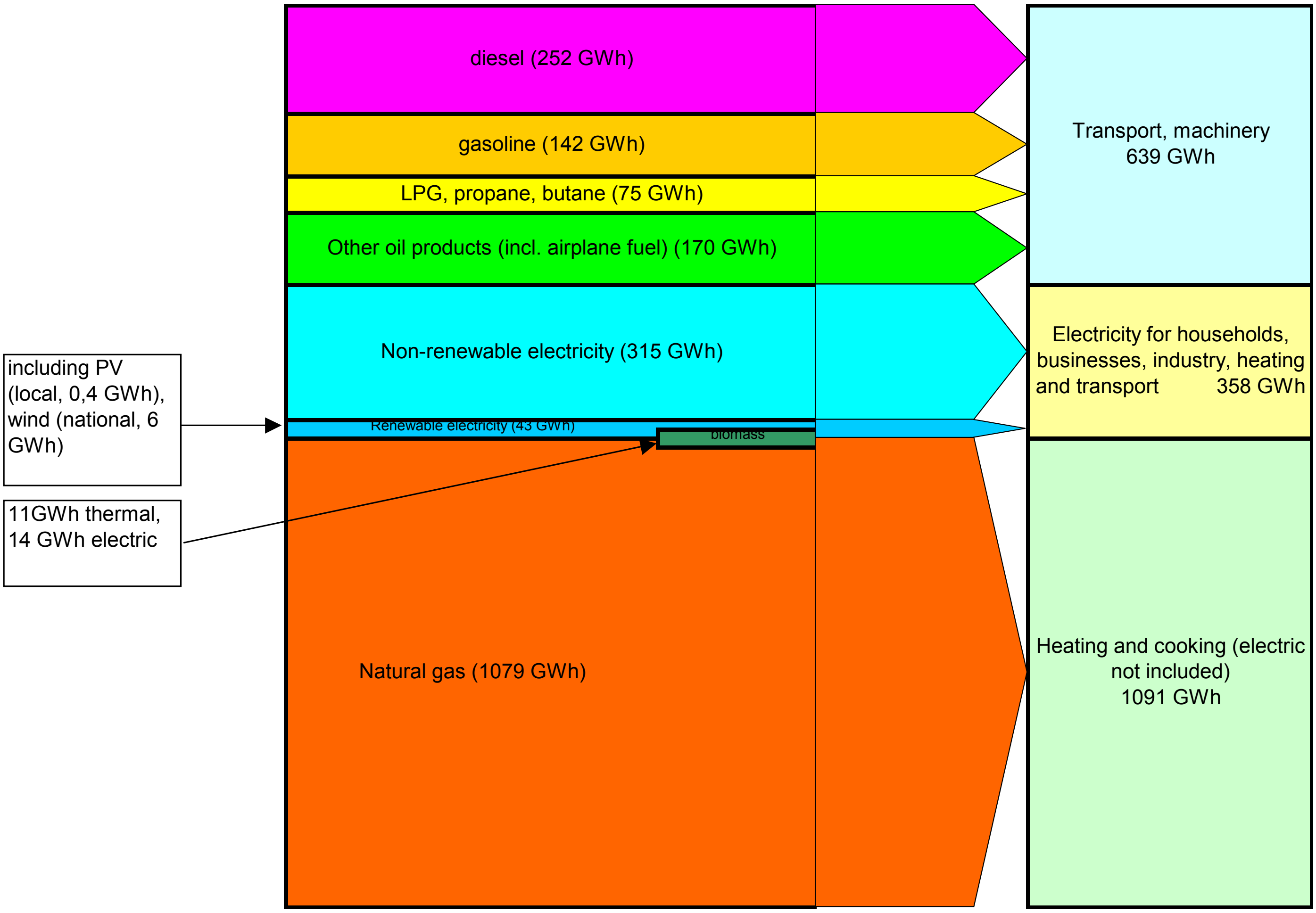
- It was decided to remove several categories from the supply side that can plausibly be attributed to heavy industry (e.g. coal, naphta, aromative oil). This resulted in a better comparison to the amounts from table 1.

However, when comparing the resulting percentage of electricity consumption, it was shown to be closer to the value expected when considering the composition of energy consumers in

[1] Obviously heat pumps can play a very important role in an energy-efficient environment. However, for the sake of statistical correctness they were not specifically distinguished.

Delft. In the absence of supporting data, it was therefore decided to maintain this approach and create a balance from these results.

3. Balance



4. Discussion

During the creation of this balance it was attempted, through various channels, to obtain more detailed information on the “other” category. CEA did not have these numbers anymore. It may still be possible to receive the data from the energy company, as they provided them to CEA in ’99, but they’ve not been known to share information readily since the privatization.

CBS has planned to release a much more detailed set of data some time in 2007. For households this would mean information on postal code level. For businesses it is not yet known what the level of detail will be. But it does seem as if there may be an opportunity for improvement in the not-too-distant future.

Should no further information become available it might be worth determining whether or not a specific energy consumption per business for each business sector can be constructed, using for instance the number of employees. The numbers of businesses and employees for all sectors are known for the Delft situation.

WP 21 – Deliverable 21c

GRENOBLE METROPOLITAN ENERGY BALANCE

Deliverable date due : Month 18

Start date of WP: 2005.05.25

WP leader name: Thomas SANDBERG

Done by : Jérôme BUFFIERE, Local Energy Agency

Date of preparation: 2006.11.02 *Revision :*

GRENOBLE METROPOLITAN ENERGY BALANCE

INTRODUCTION

The Grenoble Energy Balance, due to be made by the 3 main cities in November 2006 is performed for Grenoble at the Metropolitan level, including cities of Grenoble, Echirolles and 24 other communities.

The system boundaries was enlarged to the Metropolitan level for several reasons:

a. Concerto Area is a fictive area included in Grenoble and Echirolles, for which it is not relevant and easy to collect energy or statistics data
b. A Climate Protection Plan, definition and implementation of actions plans is being coordinated by La Metro" at the Metropolitan level.
c. An energy balance report for 1999, based on concrete and statistics data has already been performed at this area level
d. Population potentially concerned by the benefits of an energy system analyses is far higher in the Metropolitan than in Concerto Area (400000 inhabitants at the Metropolitan Level)

I. OPTIONS FOR EVALUATION METHODOLOGY:

It is important to define the "energy consumption and CO2 emissions" that we consider:

At the metropolitan level ,these consumption would concern not only tertiary (services), housing and industry sectors, but also transportations.

Technical meetings were organized between ALE La Metro and ASCOPARG (local association that studies traffic simulations and air quality) to assess the methodology for energy consumption and CO2 emissions evaluation.

Indeed, when we evaluate industry consumption at local level, most part of this consumption should not be attributed only to Metropolitan inhabitants, as the manufactured products are largely exported in other regions of France and Worldwide.

Same thing for transportation: do we consider consumption and emissions occurring on the Metropolitan area (which include also emissions done by inhabitants from outside the Metropolitan when they drive in the Metropolitan), or do we consider only emissions and consumptions realized by Metropolitan inhabitants?

Considering that a large part of natural gas consumption in the metropolitan area is due to 3 big industries, we have 2 options.

1rst option : Consumption and emissions in the territory

We consider in this option the global energy consumption including the following 3 big industries. CEVCO – PONT DE CLAIX – 2 300 000 MWhPCS
CATERPILLAR – ECHIROLLES 64405 MWhPCS
VICAT - ST EGREVE 1470500 MWhPCS

Concerning transportation we would also consider traffic from inhabitants who live outside Metropolitan area

Transportation simulations performed by the local association ASCOPARG could produce these results due to a traffic simultaion tool (that consider both vehicles characteristics and traffic evolutions).
Global energy consumption data concerning industry, services and households was provided by energy distributors, except for oil and propane (used for individual boilers)

2nd option : consumption and emissions due to Metropolitan inhabitants

In this hypothese it is relevant not to consider the natural gas consumption from the 3 big industries.

In this case, transportation data could be estimated from statistical ratios elaborated by a scientific laboratory (LET ENTPE in Lyon) considering a local population survey in 2002.
This survey could allow to estimate the consumption for direct inhabitants uses (home to work , vacations and Week Ends), not only in the metropiltan area but also in the rest of France. These transportantion do not include train and plane.

Ascoparg simulation traffic also permitted to add the traffic dedicated to metropolitan industrial and economical activities (heavy trucks, compagnies vehicles)

CO2 Emissions data by industrial sectors exist at regional and national level. The methodology would consist in according ponderation factors to Metropolitan industry sectors, depending on the local “use” of the manufactured products.

In both cases the Energy suppliers could provide real energy consumption for each community of the Metropolitan.

The amount of Energy (electricity, natural gas…) distributed in each community will allow to assess the energy consumption with yearly timescale, with better accuracy than national statistics. The involvment of energy providers (CCIAG GEG EDF GDF) was a success.

II. ENERGY BALANCE DATA SOURCES

Data type	
Measurement	M
Collecting	Co
Calculation	Ca
Estimation	E

Energy	Data Source	DataType		Details
Power and Natural gas in Grenoble city	**GEG (1)**	Co	Co	GEG Annual Report 2004 . Electricity supplied 720GWh. Gas supplied includes Natural gas CHP Isergie (314 GWhPCS consumed) , and 9674 MWhPCS of Natural gas used by CCIAG (District Heating Compagny) in other boilers.
Power in 8 communities	**EDF GRD (2)**	Co	Co	Collected data from EDF Distribution: Electricity supplied on 8 communities. Data for open market (not accessible to individuals before mid 2007) and regulated market.
Power in 17 communities	**SE38 (3)**	Co 82 %	E 18 %	Collected data from SE38 (Syndicat d'Energie de l'Isere) : Electricity supplied on 17 communities. Data for regulated market was collected. Data for open market (not accessible to individuals before mid 2007) were not accessible by community, but for 380 communities in Isere it represents 18.52%. We considered also this hypothese for each of the 17 communities
Natural Gas (17communities)	**SE38 (4)**	Co	Co	Natural gas supplied for 17 communities. 4 big industries, with no direct connection with inhabitants consumptions, are directly connected on the transport pipe, and we can't get data from SE38 or GDF. We estimated their consumption from their CO2 emissions declaration (Sassenage Air liquide : Energy transformation / St Egreve VICAT 1470500 MWhPCS / Pont de Claix CEVCO Rhodia 2 300 000 MWhPCS / Echirolles Caterpillar 64405 MWhPCS).. We do not consider these consumption in the energy balance. No distinction by activity sector. No data for Pont de Claix and VIF communities in 2004 because of an old "cahier des charges de concession" These data will be available after 2006
Natural Gas (8 communities)	**GDF GRD (5)**	Co	Co	Natural gas supplied for 17 communities. 4 big industries, with no direct connection with inhabitants consumptions, are directly connected on the transport pipe, and we can't get data from SE38 or GDF. We estimated their consumption from their CO2 emissions declaration (Sassenage Air liquide : Energy transformation / St Egreve VICAT 1470500 MWhPCS / Pont de Claix CEVCO Rhodia 2 300 000 MWhPCS / Echirolles Caterpillar 64405 MWhPCS).. We do not consider these consumption in the energy balance. No distinction by activity sector. No data for Pont de Claix and VIF communities in 2004 because of an old "cahier des charges de concession" These data will be available after 2006.
Oil	**Oil (6)**	Co 40 %	E 60 %	Oil consumption of district heating was collected from CCIAG Data on heating period 2004-2005: 13248 tons. Others oil consumptions for boilers were estimated from 1999 energy balance and regional energy balance statistics 2004. There are too many suppliers to collect data from them
Propane	**Propane(7)**	**E**	**E**	**Propane consumptions (GPL gaz de petrol liquéfié) for boilers were estimated from 1999 energy balance and regional energy balance statistics 2004. There are too many suppliers to collect data directly from them.**
Coal	**Coal (8)**	Co	Co	Coal consumption of district heating was collected from CCIAG Data on heating period 2004-2005. 7 communities are supplied with district heating
Wastes	**Wastes (9)**	Co	Co	waste enrgy in Athanor CHP on district heating (data collected from CCIAG Data on heating period 2004-2005). 7 communities are supplied with district heating
Animal Flours	**Animal**	Co	Co	animal flours energy in La Poterne (CHP on district heating) : data

	Flours (10)			collected from CCIAG Data on heating period 2004-2005. 7 communities are supplied with district heating
Wood chips on District Heating	**Wood chips CCIAG (10)**	Co	Co	Wood chips energy in La Poterne (CHP on district heating) : data collected from CCIAG Data on heating period 2004-2005. 7 communities are supplied with district heating.
Other wood chips	**Other wood chips (11)**	Co	Co	
Wood	**Wood (12)**	E	E	Hypothèse Bilan : 100 000 stères (1m3) at metropolitan level - 1333kWh/stère – hypotheses : no wood in Grenoble because of urban density. Data from Explicit in 1999, 3300 houses (2,1%) heated with wood (9000 TEP/an) . Data from ADAYG : 273000 stères on large metropolitan (Y grenoblois), including 100000 steres bought and 17self produced
Solaire thermal	**Solaire thermal (13)**	Co	Co	Data collected from AGEDEN 2004 report of Plan Soleil in Isère (ratio of population 40% Metropolitan/Isère).
Solar Photovoltaics Power	**Solar Photovoltaics (14)**	Co	Co	Data collected from AGEDEN 2004 report of Plan Soleil in Isère (ratio of population 40% Metropolitan/Isère). 25000kWh GEG (STmicro, Actis)
Hydropower	**Hydropower(15)**	Co	Co	Data collected from GEG (8 Power station in Alps making green electricity), EDF(Power station on DRAC River in Pont de Claix and Fontaine)
Wind Power	**Wind Power(16)**	Co	Co	No windmills in Metropolitan area
Electricity from Combined Heat and Power (CHP)	**Elec.CHP (17)**	Co	Co	Rapport annuel 2004 de GEG. Données CCIAG et GEG 2004-2005: La poterne 39981 MWhelec ; Ile d'amour 21705 MWhe ; Isergie 104250 MWhe ; Clinique des bains 1050 Mwhe; GEG Agence Vaucanson 9 MWhe
Transportations				
Benzin (Gazoil)	**Benzin (Gazoil)(18)**	E	E	Transport consumptions of metropolitan inhabitants in and outside the metropolitan, for working and vacation trips : LET ENTPE Damien Verry – Data from population survey in 2002, Heavy trucks and companies vehicles into Metropolitan: ASCOPARG Data from traffic simulations
(Gasoline) Supercarburants	**Gasoline (Supercarburants)(19)**	E	E	Transport consumptions of metropolitan inhabitants in and outside the metropolitan, for working and vacation trips : LET ENTPE Damien Verry – Data from population survey in 2002, Heavy trucks and companies vehicles into Metropolitan: Benzin engines
Natural gas for vehicles	**Natural GAs for véhicles (20)**	Co	Co	Data collected from GEG report 2004: 2105000 Nm3 for 72 bus in Grenoble
GPL (liquefied gaz from petro)	**GPL (Liquefied gaz from petrol) (21)**			No data, but very few vehicles in metropolitan
Biofuels	**Biofuels (22)**	Co	Co	Data from Daniel Ballerini, author of " Les biocarburants, état des lieux, perspectives et enjeux du développement » : 1,5% of biofuels are integrated in the classic fuels at the pumps

III. ENERGY PROCESSES

This part relates to the description of energy consumed at the Metropolitan level, classified by

- Final energy consumed: based on energy consumption data or estimations
- **Primary energy sources**: conversion factors between final and primary energy were defined, considering electricity process at local or national level, conventions for fossils fuels (Gas, Fuel, Coal, Propane) ans electricity production.
- **CO2 emissions**: conversion factors in grams CO2/kWh final are available for fossils fuel and electricity production

Note: The documents used for conversion factors (final to primary energy, and final energy to CO2 emissions) were the following

FINAL TO PRIMARY ENERGY:
- French RT2005 : Thermal Regulation for new buildings

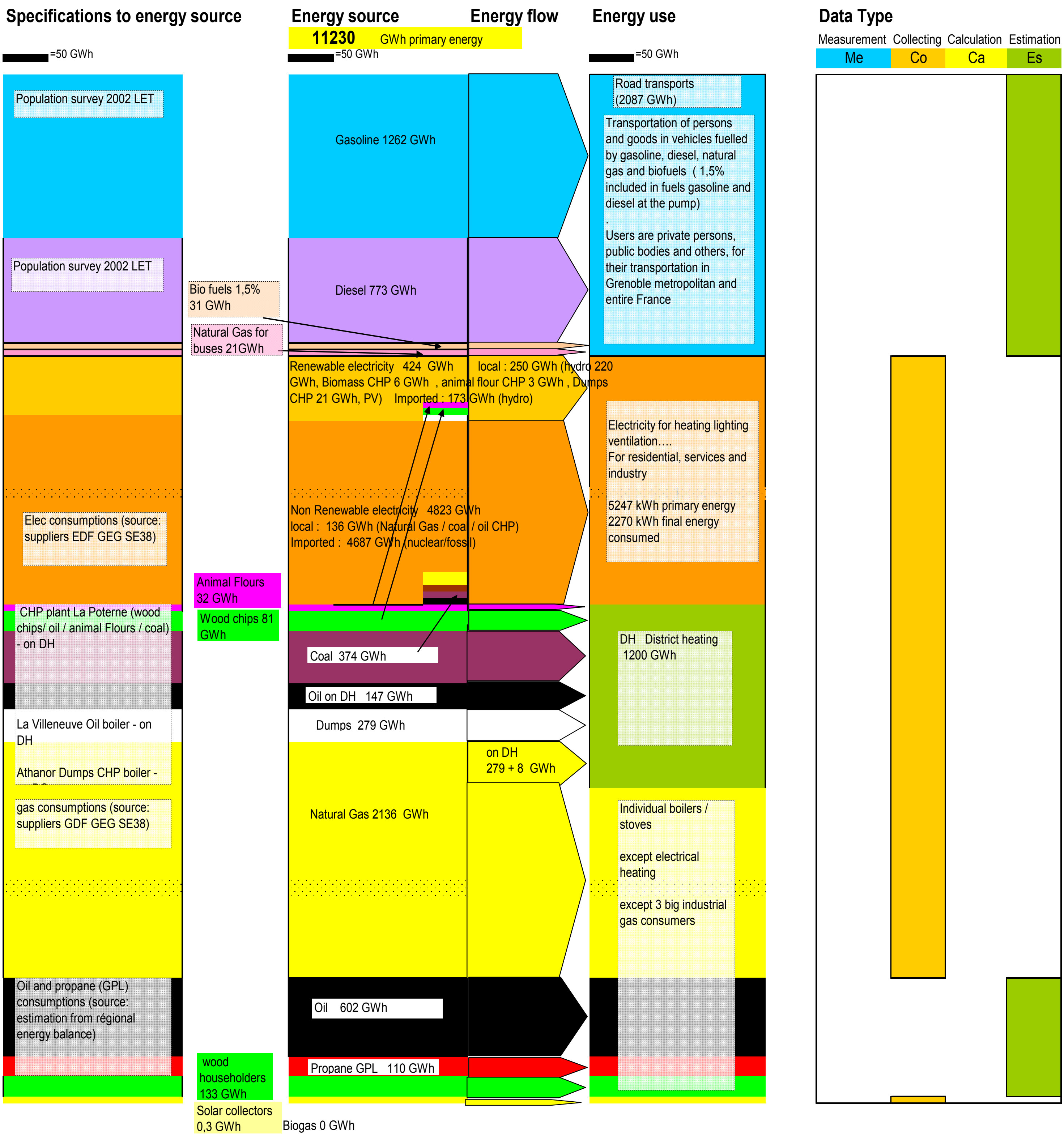
CO2 EMISSIONS :
- BILAN CARBONE Calcul des facteurs d'émissions et sources bibliographiques utilisées (version 3.0) AVRIL 2005
- ADEME/EDF Note for electricity conversion factor

The energy consumptions and emissions can also be classified:

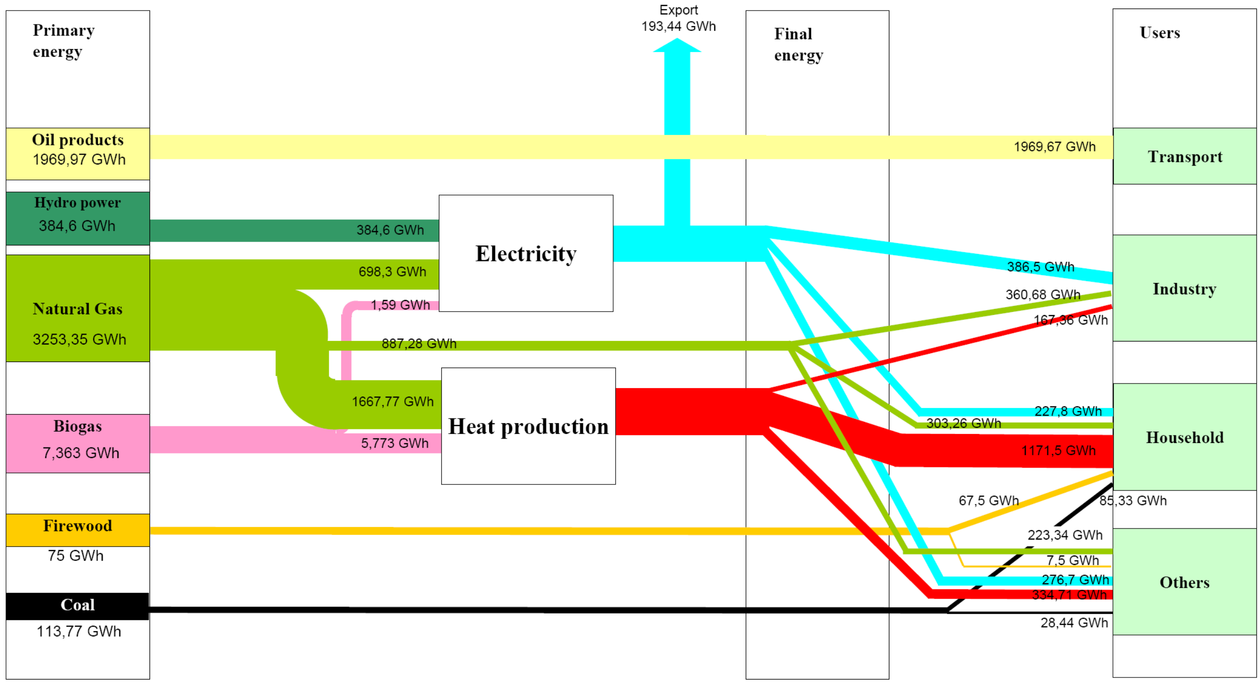
- by use: Power, heating, fuel for transportation
- by sector : households, industry, service, transportation (regional statistics have to be used to "ventilate" the real consumption into these different activity sectors)

IV. GRENOBLE METROPOLITAN ENERGY BALANCE 2004

26 Communities – 400 000 Inhabitants



Kaunas energy balance 2005



Energy use in Kaunas municipality 2004-2005

Energy use

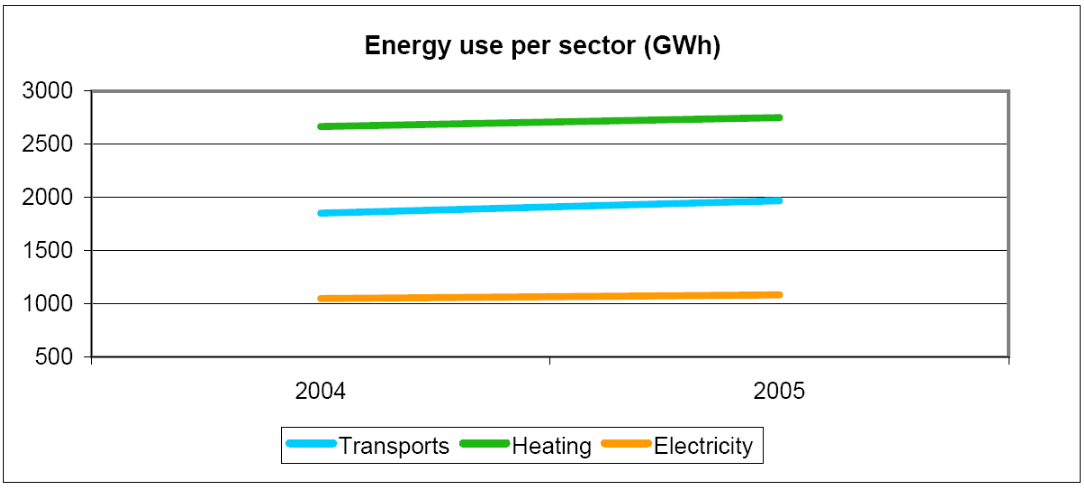
All figures in GWh

Transports	2004	2005
Total	1850,45	1969,67
of which renewable	0,00	0,00
% renewable	0,0%	0,0%

Heating	2004	2005
Total	2666,86	2749,63
of which renewable	81,10	80,80
% renewable	3,0%	2,9%

Electricity	2004	2005
Total	1049,10	1084,49
of which renewable	359,00	386,19
% renewable	34,2%	35,6%

	2004	2005
Transports	1850,45	1969,67
Heating	2666,86	2749,63
Electricity	1049,10	1084,49



Energy supply in Kaunas municipality 2004-2005

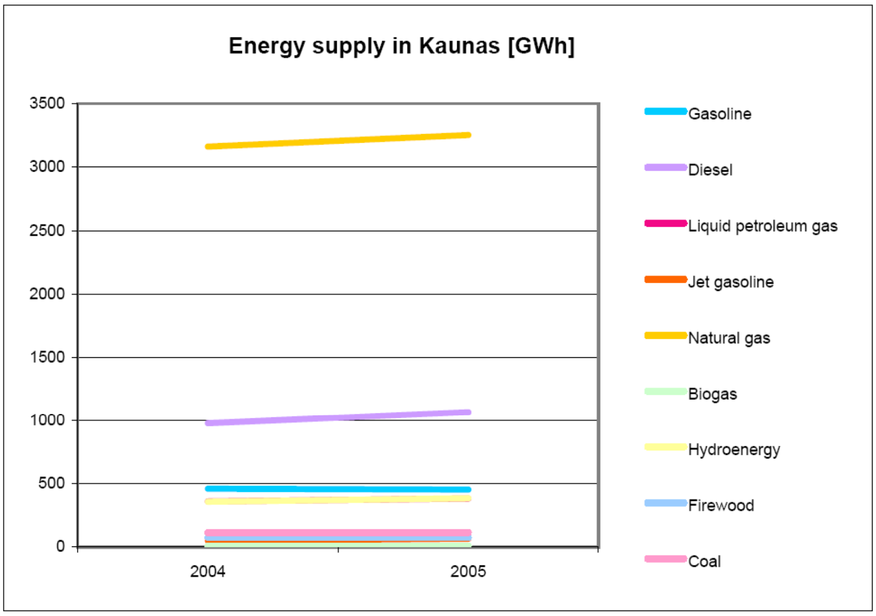
	2004	2005
Gasoline (t)	37717	37059
m3	50969	50080
Diesel (t)	82232	89797
m3	99075	108189
Liquid petroleum gas (t)	27959	29713
m3	54821	58261
Jet gasoline (t)	4166	5372
m3		
Naturas gas (1000m3)	430727	436642
Kaunas CHP	*320000*	*320000*
Small heat plants	*9497*	*10172*
Households (heating, cooking)	*33380*	*36390*
Industry	*44150*	*43280*
Others (heating)	*23700*	*26800*
Biogas (GWh)	6,10	7,39
Hydroenergy (GWh)	359,0	384,6
Firewood (m^3)	32894,7	32894,7
Coal (t)	16300,0	16300,0

Gasoline *12,22 MWh/t*
Diesel *11,89 MWh/t*
Liquid petroleum gas *12,92 MWh/t*
Jet gasoline *12,14 MWh/t*
Natural gas *8,33 MWh/1000m3*
Firewood *2,28 MWh/m^3*
Coal *6,98 MWh/t*

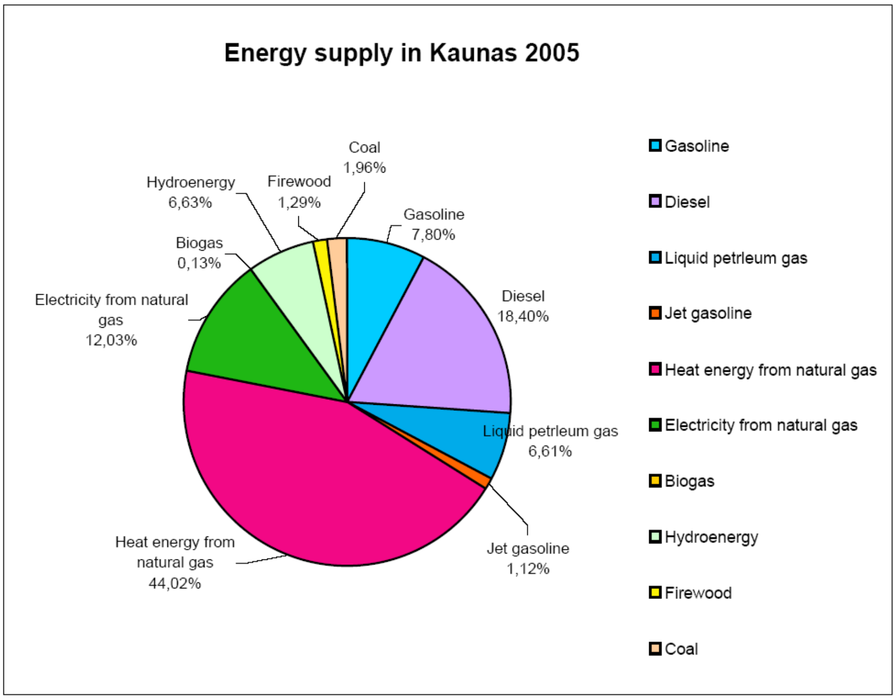
All data in GWh

	2004	2005
Gasoline	460,90	452,86
Diesel	977,74	1067,69
Liquid petroleum gas	361,23	383,89
Jet gasoline	50,58	65,22
Natural gas	3162,09	3253,35
Kaunas CHP heat production	1550	1583
Kaunas CHP electricity	690	698
Small heat plants	78	85
Households (heating, cooking)	278	303
Industry	368	361
Others (heating)	198	223
Biogas	6,10	7,39
Hydroenergy	359,0	384,6
Firewood	75,0	75,0
Coal	113,8	113,8
TOTAL	***5566,41***	***5803,79***

Renewable energy (GWh)	440,10	466,99
Non renewable energy (GWh)	5126,31	5336,80
Share of renewable enrgy	7,9%	8,0%
Energy supply/inhabitant (MWh)	15,1	15,9



Gasoline	452,86	7,8%
Diesel	1067,69	18,4%
Liquid petrleum gas	383,89	6,6%
Jet gasoline	65,22	1,1%
Heat energy from natural gas	2555,05	44,0%
Electricity from natural gas	698,30	12,0%
Biogas	7,39	0,1%
Hydroenergy	384,60	6,6%
Firewood	75,00	1,3%
Coal	113,77	2,0%
Total	**5803,79**	**100,0%**



Vastseliina energy balance 2005

	2002	2003	2004	2005
Gasoline (m3)	663,3	589,6	515,9	515,9
Diesel and light oil (m3)	981,7	850,8	1112,6	1112,6
Heavy Oil (m3)	0	0	0	0
Peat	0	0	0	0
Biomass (tm)	11330	10615	10285	10010
woodchips and sawdust	6270	6380	6765	6380
wood	5060	4235	3520	3630
Electricity (kwh)**				5000000

data based on natianal statistic
** data by Estonian Energy (national company)
wood tm here full wood

Gasoline	*8,722*	*MWh/m3*
Diesel	*9,889*	*MWh/m3*
Jet gasoline	*9,083*	*MWh/m3*
Oil (light oil)	*9,889*	*MWh/m3*
Oil (heavy oil)	*10,806*	*MWh/m3*
Ethanol	*5,9*	*MWh/m3*
RME	*9,34*	*MWh/m3*
wood	1,9	*MWh/m3*

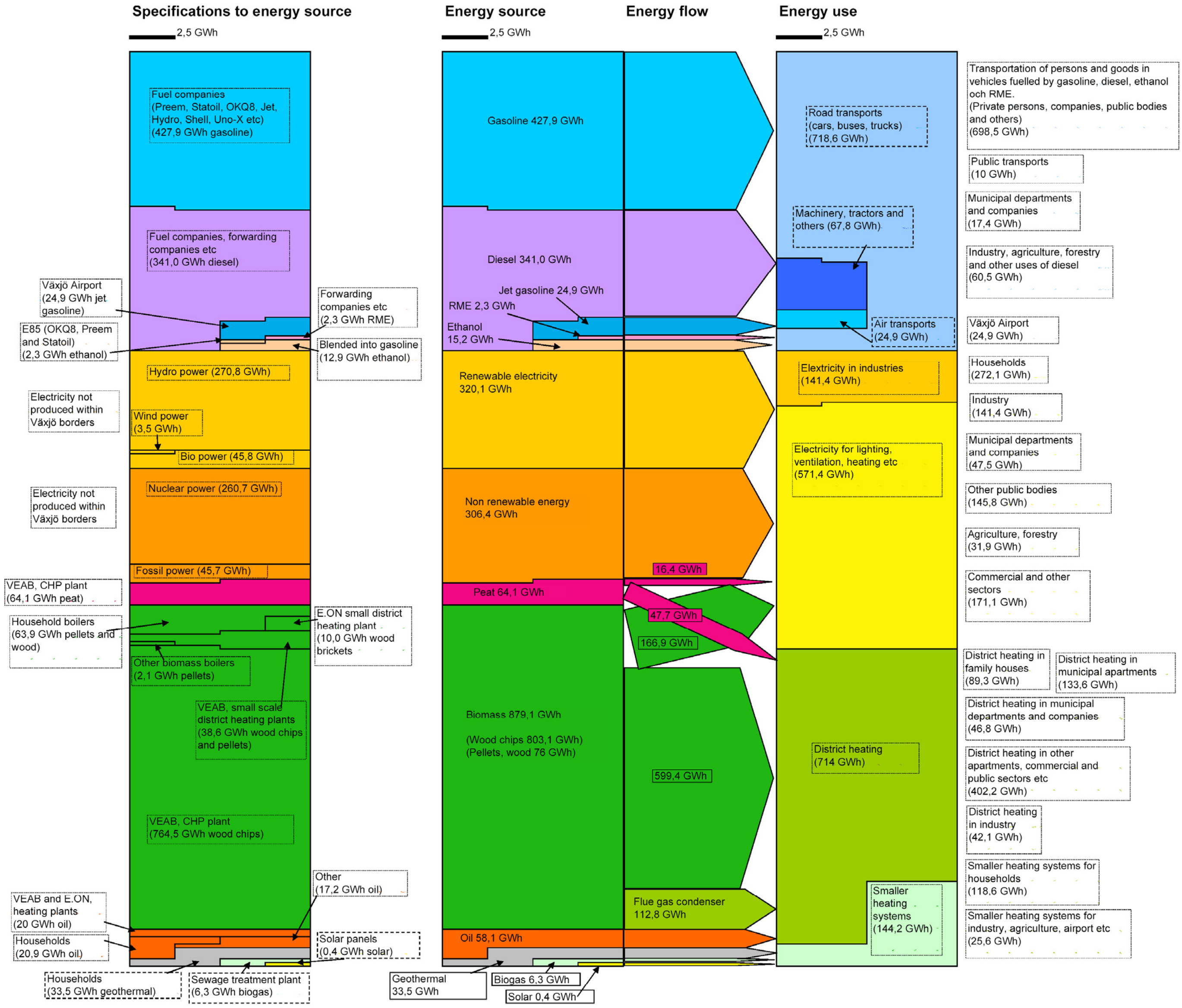
all data on MWh

	2002	2003	2004	2005
Gasoline	5785,30	5142,49	4499,68	4499,68
Diesel and light oil	9708,03	8413,56	11002,50	11002,50
Heavy Oil	0,00	0,00	0,00	0,00
Peat	0,00	0,00	0,00	0,00
Biomass	21527,00	20168,50	19541,50	19019,00
Electricity				5000,00

detailed data

	2002	2003	2004	2005
Gasoline (m3)	663,3	589,6	515,9	515,9
Diesel and light oil (m3)	981,7	850,8	1112,6	1112,6
Heavy Oil (m3)	0	0	0	0
Peat	0	0	0	0
Biomass (tm)	11330	10615	10285	16390
woodchips and sawdust	6270	6380	6765	6380
central heating plant (1 MW)				*2500*
Gymnasuim plant				*900*
Förman NT AS(1 MW)				*2500*
SEP holding				*480*
wood	5060	4235	3520	3630
mostly households				
Electricity (kwh)**				5000000
organisations and companies (35 biggest)				2910141
private sector				1700000

Energy balance for Växjö 2005



Energy supply in Växjö municipality (geographical area) 1993-2005

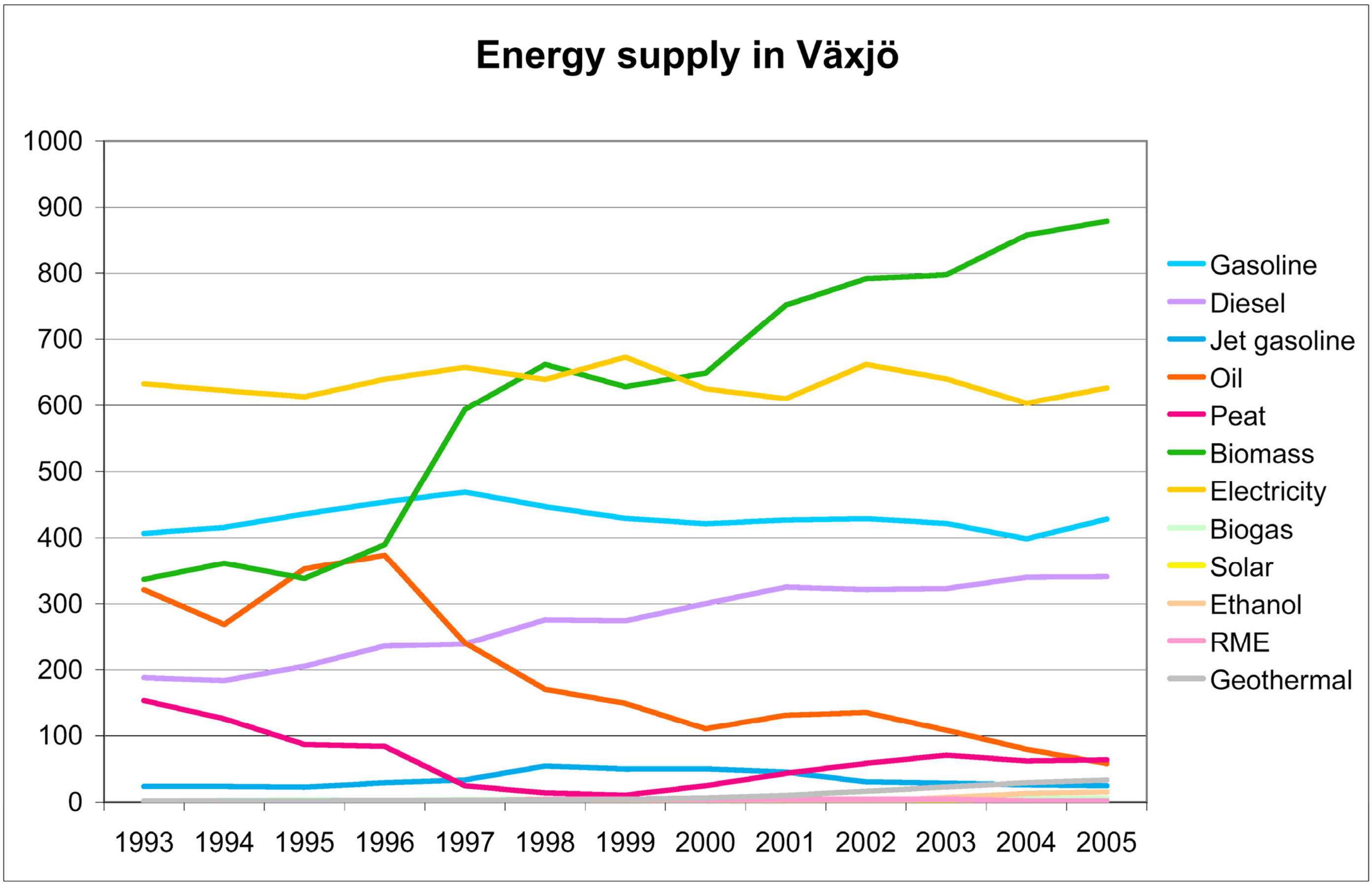
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline (m3)	**46616**	**47649**	**49932**	**51996**	**53732**	**51202**	**49202**	**48270**	**48902**	**49137**	**48328**	**45656**	**49061**
pure gasoline	*46616*	*47649*	*49932*	*51996*	*53732*	*51202*	*49200*	*48269*	*48900*	*49128*	*48309*	*45620*	*48991*
15% gasoline in ethanol fuel E85							*1,7*	*0,9*	*2,3*	*9,4*	*18,8*	*35,7*	*70,0*
Diesel (m3)	**19052**	**18609**	**20774**	**23879**	**24224**	**27896**	**27765**	**30382**	**32887**	**32541**	**32655**	**34394**	**34487**
Jet gasoline (m3)	**2601**	**2628**	**2499**	**3211**	**3712**	**5997**	**5529**	**5553**	**5003**	**3388**	**3126**	**2907**	**2745**
Oil (light oil) (m3)	**18600**	**16381**	**19336**	**24299**	**21075**	**15450**	**13411**	**10427**	**12281**	**11548**	**6437**	**5747**	**4675**
Oil (heavy oil) (m3)	**12700**	**9901**	**14988**	**12326**	**2997**	**1651**	**1568**	**701**	**930**	**1973**	**4162**	**2121**	**1102**
Peat (GWh)	**154**	**126**	**87**	**84**	**24,7**	**13,9**	**10,5**	**24,8**	**43,6**	**58,3**	**70,74**	**62,21**	**64,11**
Biomass (GWh)	**337,10**	**361,40**	**338,60**	**389,80**	**593,67**	**662,01**	**628,35**	**648,80**	**751,69**	**791,82**	**797,59**	**857,73**	**879,07**
Sandvik CHP plant	*251,3*	*270,9*	*254,1*	*307,3*	*480,4*	*514,3*	*466,1*	*466,1*	*547,3*	*568,9*	*582,9*	*639,8*	*651,7*
flue gas condenser, Sandvik	*31,0*	*35,7*	*29,7*	*27,7*	*54,4*	*80,3*	*82,5*	*92,7*	*107,5*	*117,7*	*101,9*	*105,4*	*112,8*
district heating Rottne						*6,40*	*6,10*	*6,06*	*8,19*	*8,35*	*8,50*	*6,93*	*9,91*
district heating Ingelstad					*4,07*	*4,98*	*4,63*	*4,03*	*5,08*	*5,52*	*6,07*	*6,63*	*7,35*
district heating Braås							*8,01*	*14,49*	*16,83*	*17,47*	*20,62*	*21,18*	*21,37*
district heating Lammhult						*1,20*	*3,60*	*6,50*	*3,93*	*7,88*	*9,84*	*10,74*	*9,94*
district heating Räppe								*0,32*	*2,17*	*2,93*	*3,73*	*2,19*	
biomass boiler Kronoberg							*1,2*	*1,2*	*1,4*	*1,4*	*1,4*	*1,4*	*1,4*
biomass boiler Airport							*0,8*	*1,0*	*1,3*	*1,1*	*1,1*	*1,0*	*0,7*
households (subsidised)						*0,03*	*0,61*	*1,64*	*3,14*	*5,78*	*6,75*	*7,70*	*9,13*
households (before subsidy)	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*	*54,8*
Electricity (GWh)	**632,5**	**622,5**	**613,0**	**639,6**	**657,7**	**639,2**	**673,0**	**625**	**610**	**662**	**640**	**603,2**	**626,5**
renewable sources	*316,3*	*280,1*	*300,4*	*262,2*	*322,3*	*319,6*	*329,8*	*356,3*	*317,2*	*324,38*	*291,20*	*272,65*	*320,14*
non-renewable sources	*316,3*	*342,4*	*312,6*	*377,4*	*335,4*	*319,6*	*343,2*	*268,8*	*292,8*	*337,62*	*348,80*	*330,55*	*306,36*
Biogas (GWh)	**2,00**	**3,00**	**3,50**	**3,00**	**3,97**	**4,62**	**4,83**	**4,81**	**4,79**	**4,10**	**4,72**	**5,28**	**6,29**
Solar (GWh)	**0,90**	**0,90**	**0,90**	**0,90**	**0,11**	**0,14**	**0,16**	**0,19**	**0,21**	**0,25**	**0,29**	**0,32**	**0,37**
municipal company Värendshus	*0,30*	*0,30*	*0,30*	*0,30*	*0,01*	*0,00*							
large scale solar plant Ingelstad	*0,50*	*0,50*	*0,50*	*0,50*									
Swimming hall						*0,04*	*0,05*	*0,05*	*0,06*	*0,06*	*0,06*	*0,05*	*0,06*
solar collectors (subsidised)						*0,00*	*0,01*	*0,03*	*0,05*	*0,10*	*0,13*	*0,17*	*0,21*
households' solar collectors	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*	*0,10*
Ethanol (m3)	**58,50**	**60,00**	**64,95**	**64,50**	**60,75**	**0,00**	**9,78**	**5,10**	**12,75**	**53,13**	**1155,62**	**2227,39**	**2571,57**
Public transport	*58,50*	*60,00*	*64,95*	*64,50*	*60,75*								
85% ethanol in ethanol fuel E85							*9,78*	*5,10*	*12,75*	*53,13*	*106,62*	*202,39*	*396,57*
5% ethanol blended in gasoline											*1049,00*	*2025,00*	*2175,00*
RME (m3)	**250,00**	**250,00**	**250,00**	**250,00**	**250,00**	**484,00**	**458,50**	**492,00**	**492,50**	**497,00**	**499,00**	**250,00**	**250,00**
Public transport						*234,00*	*208,50*	*242,00*	*242,50*	*247,00*	*249,00*		
others	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*	*250,00*
Heat pumps (number of)	**74**	**80**	**84**	**104**	**122**	**134**	**175**	**251**	**411**	**659**	**919**	**1165**	**1340**

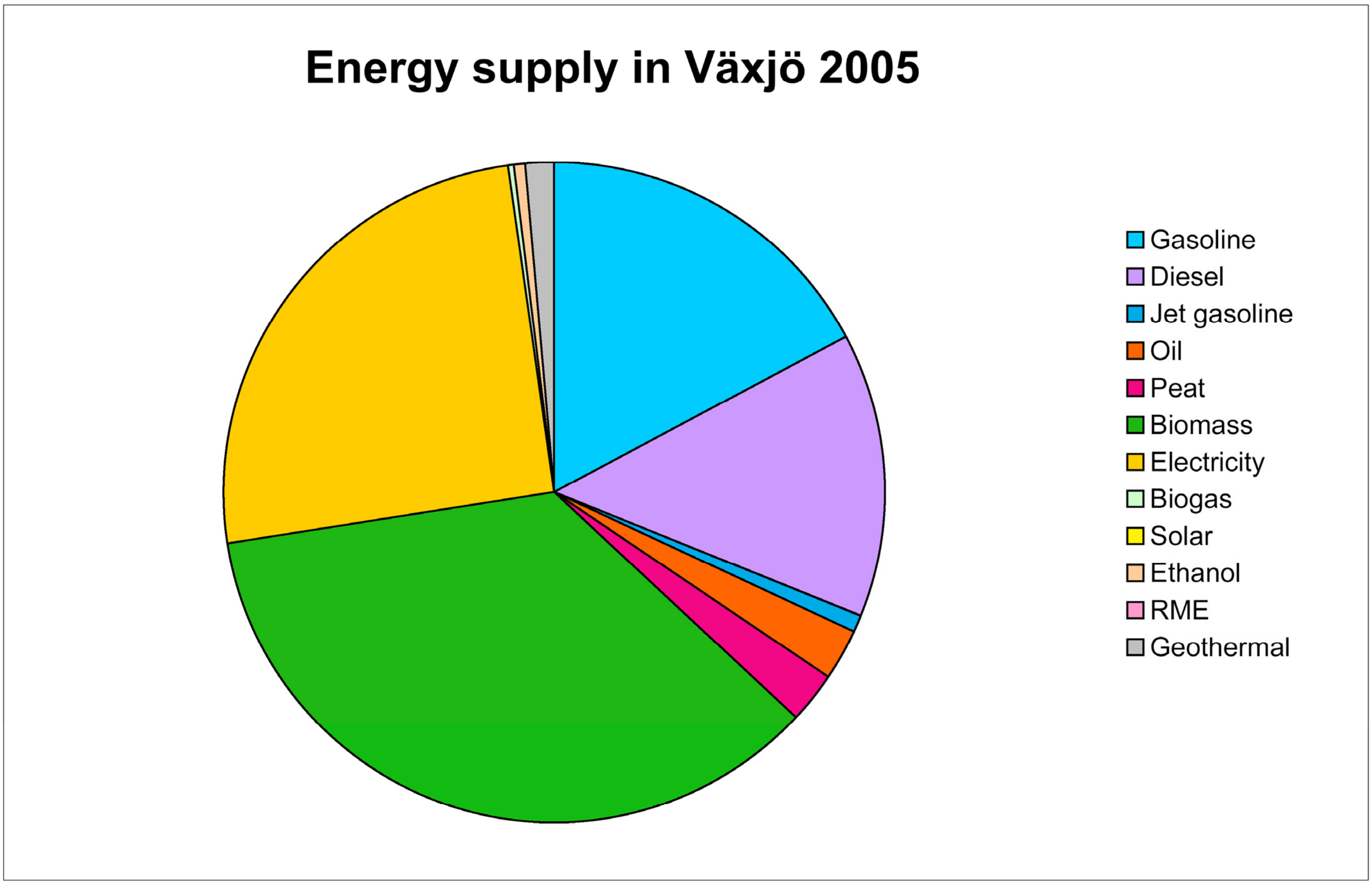
Gasoline	*8,722*	*MWh/m3*
Diesel	*9,889*	*MWh/m3*
Jet gasoline	*9,083*	*MWh/m3*
Oil (light oil)	*9,889*	*MWh/m3*
Oil (heavy oil)	*10,806*	*MWh/m3*
Ethanol	*5,9*	*MWh/m3*
RME	*9,34*	*MWh/m3*
Heat pumps	*25*	*MWh/heat pump*

all numbers in GWh

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline	406,58	415,59	435,51	453,51	468,65	446,58	429,14	421,01	426,53	428,58	421,52	398,21	427,91
Diesel	188,41	184,02	205,43	236,14	239,55	275,86	274,57	300,45	325,22	321,80	322,93	340,12	341,04
Jet gasoline	23,62	23,87	22,70	29,17	33,72	54,47	50,22	50,44	45,44	30,77	28,39	26,40	24,93
Oil	321,17	268,98	353,17	373,49	240,80	170,63	149,57	110,69	131,50	135,52	108,63	79,75	58,14
Peat	154,00	126,00	87,00	84,00	24,70	13,90	10,50	24,80	43,60	58,30	70,74	62,21	64,11
Biomass	337,10	361,40	338,60	389,80	593,67	662,01	628,35	648,80	751,69	791,82	797,59	857,73	879,07
Electricity	632,50	622,50	613,00	639,60	657,70	639,20	673,00	625,00	610,00	662,00	640,00	603,20	626,50
Biogas	2,00	3,00	3,50	3,00	3,97	4,62	4,83	4,81	4,79	4,10	4,72	5,28	6,29
Solar	0,90	0,90	0,90	0,90	0,11	0,14	0,16	0,19	0,21	0,25	0,29	0,32	0,37
Ethanol	0,35	0,35	0,38	0,38	0,36	0,00	0,06	0,03	0,08	0,31	6,82	13,14	15,17
RME	2,34	2,34	2,34	2,34	2,34	4,52	4,28	4,60	4,60	4,64	4,66	2,34	2,34
Geothermal	1,85	2,00	2,10	2,60	3,05	3,35	4,38	6,28	10,28	16,48	22,98	29,13	33,50
TOTAL	***2070,82***	***2010,96***	***2064,63***	***2214,92***	***2268,60***	***2275,29***	***2229,04***	***2197,09***	***2353,92***	***2454,56***	***2429,26***	***2417,83***	***2479,37***

Renewable energy	660,78	650,11	648,19	661,25	925,76	994,25	971,82	1020,95	1088,84	1141,98	1128,25	1180,58	1256,88
Non renewable energy	1410,04	1360,85	1416,44	1553,67	1342,84	1281,04	1257,22	1176,13	1265,08	1312,59	1301,01	1237,25	1222,49
Share of renewable energy	31,9%	32,3%	31,4%	29,9%	40,8%	43,7%	43,6%	46,5%	46,3%	46,5%	46,4%	48,8%	50,7%
Energy supply/inhabitant	29,0	27,8	28,4	30,3	30,9	30,9	30,2	29,7	31,8	32,7	32,0	31,5	32,0


Energy supply in Växjö
1000
900
800
700
600
500
400
300
200
100
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Gasoline
Diesel
Jet gasoline
Oil
Peat
Biomass
Electricity
Biogas
Solar
Ethanol
RME
Geothermal


Energy supply in Växjö 2005
Gasoline
Diesel
Jet gasoline
Oil
Peat
Biomass
Electricity
Biogas
Solar
Ethanol
RME
Geothermal