WORLD BIOENERGY ASSOCIATION

THE ROLE OF BIOENERGY
IN EUROPEAN CITIES

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Cover photo: Paris - France, iStock

1. SUMMARY

In the battle against climate change, cities can play a decisive role. Without a targeted policy for cities to reduce their greenhouse gas emissions, climate mitigation policies cannot be successful.

This study explains the contributions bioenergy can offer to reduce the use of fossil fuels in cities. Bioenergy is a proven option to replace fossil fuels in the heat supply and partly in the transport sector and generation of electricity. Seven European cities are mentioned in this study that demonstrate how bioenergy is integrated into the urban energy system.

The supply of biomass in Europe is increasing. The forest area and the wood stock in forests are growing, the use and production of pellets and chipped forest biomass is increasing whereas the production of fossil fuels: gas, coal and oil is dwindling.

The reduction of greenhouse gas emissions, energy security and development of new jobs in Europe are key arguments in favour of bioenergy. Therefore, it is clear that bioenergy has the potential to become a pillar in the future energy portfolio of cities.

2. INTRODUCTION

The deployment of renewable energies is becoming a major political issue on the global, national and community levels. In this paper, the WBA describes examples and develops concepts for the role of bioenergy in cities with more than 100 000 inhabitants in Central and Northern Europe. The European experience can also be transferred to cities in East Asia and North America, as well as to cities in South and South-East Asia and right across countries south of the equator.

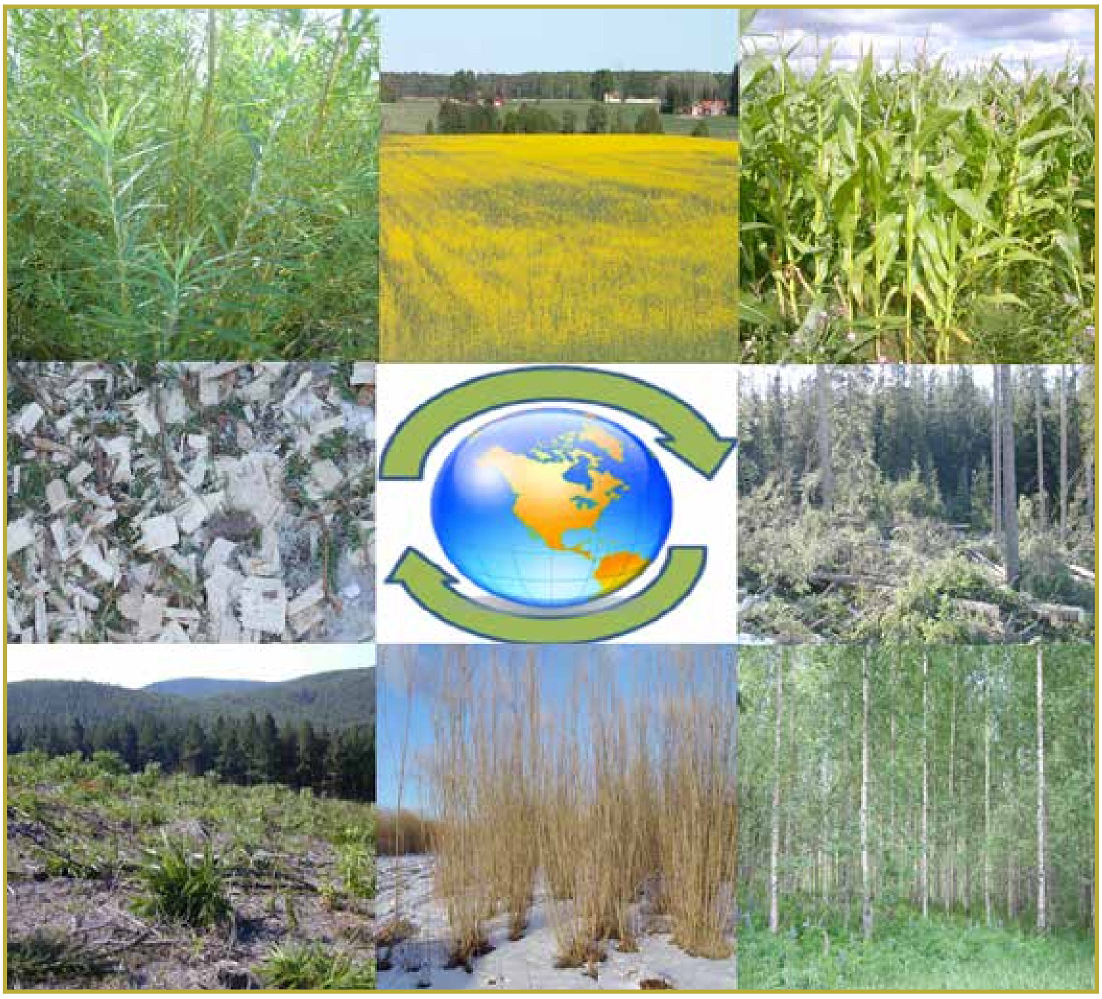


Figure: SLU

This picture illustrates different ecological systems for biomass origins in the country side, for example: short rotation forestry, corn and sugarcane and managed forestry.

3. CLIMATE CHANGE MITIGATION

Climate change mitigation is becoming a central concern of the global society. The limitation of global warming to below 2°C above the temperature of pre-industrial society is essential to safeguard the global ecosystem and to provide a safe basis for human activities, as well as to reduce excessive environmental changes. Recent news suggest that we have already crossed the 1°C levels **(1)**.

In the past decades, the burning of fossil fuels has been identified as the main cause of climate change. The faster the reduction of fossil fuel emissions, the greater the probability to limit global warming to less than 2°C. The energy system based on fossil fuels has to be replaced by low carbon emission renewable energy sources along with improved energy efficiency. This is valid for all users of fossil energy: the cities, the countryside, buildings, industry, transport, agriculture and forestry sectors.

Globally, the production of heat accounts for about 10 gigatonnes (Gt) of CO_2 emissions – this is about 30% of all greenhouse gas (GHG) emissions. Presently, almost half of the global natural gas production is being used for production of heat **(2).**

According to Intergovernmental Panel on Climate Change (IPCC) scenarios, the annual GHG emissions per capita across all the world's population should not exceed 1,6 tonne CO_2 in this century, if we are to reach the climate targets with reasonable probability **(3)**. The European GHG emissions in 2012 were 7,9 tonnes per capita – and so 5 times higher than they should be if we are to achieve this goal **(4)**. This discrepancy demonstrates the urgency for action: Future investment should go to renewable energies and better efficiency, and not to fossil fuels.

In the battle against climate change, cities play a decisive role because a steadily growing part of the global population is living in the cities. Without a targeted policy for cities to reduce their CO_2 emissions, climate mitigation policies for countries or the world cannot be successful!

Photo: ppcnet.org

Photo: Per Petersson, Sveaskog

Low carbon renewable energy, an example of forestry sector as source: In a sustainable forest, trees of different age grow side by side (left picture) or in some cases even trees of even ages (right picture).

4. ENERGY USE OF CITIES AND POSSIBILITIES OF BIOENERGY

Cities use energy for different purposes including:

- Heating: for buildings of all sizes , residential and office buildings, buildings of the service sector, and for low and high temperature heat for industry
- Transport: energy for public and private transport
- Cooling: for buildings, cooling along the food supply chain and within the food processing industry
- Electricity: for all types of end use including lighting, cooking, heating water, electric motors for mechanical power, Information and Communication Technologies (ICT), and also for powering public and private transport.

Bioenergy can offer services that contribute to the energy needs of cities which include:

- Solid biomass for district heating and cogeneration units for heat and electricity
- Biofuels (Conventional and Advanced ethanol, biodiesel etc.) and upgraded biogas for the transport sector
- Biogas and syngas for electricity, heat, transport and/or injection into the gas grid

The technologies to deliver these services are well developed and mature. The many types of feedstocks can partly come from the cities directly, but the larger overall fraction of the biomass feedstocks have to be brought from surrounding rural regions or from abroad.

Overview of biomass feedstock in the cities:

- Municipal solid waste (50-65% biomass)
- Municipal liquid waste (Sewage sludge)
- Organic waste from the food industry and waste food in cities
- Solid biomass such as urban waste wood or landscaping wood from parks and gardens inside the cities
- Biomass in the form of wood chips, pellets, straw and biofuels from regions outside the cities.

5. PRINCIPLES OF BIOMASS DEPLOYMENT

The WBA has developed several principles for the deployment of biomass. They can be summarized as follows:

- Sustainable sourcing of biomass
- Efficient conversion and use of biomass
- Priority to regional supply solutions, where possible – and national and international trade, where necessary.

5.1 SUSTAINABILITY

Many definitions and systems exist to define and provide strict guidelines for sustainable biomass sourcing. Private industry has developed well-designed systems to comply with rules of sustainability. Basic requirement for sustainability in supply of biomass can be summarized as follows:

- Not more biomass is harvested annually than annual growth in a given biomass system
- The fertility of the soil and water quality is safeguarded
- Biomass utilization is done so that biodiversity is protected

5.2 EFFICIENCY

The conversion of biomass to final energy, be it heat, electricity or transport fuels, should be realized in such a way that losses are minimized. Therefore, the WBA favours heat-only installations using efficient combustion technologies, or cogeneration units with efficiencies above 60%, as opposed to the electricity-only production with efficiencies below 30%! Also, the equipment used to deliver energy services like cooking, lighting, mechanical power etc., should be as efficient as possible.

5.3 REGIONAL SOLUTIONS AND/OR TRADE

The priority is given to solutions where the biomass produced can be used in the same region. This will be possible in rural regions. But, obviously this principle has its limitations. There are regions with a surplus of biomass production, and on the other hand there are big cities within economic freight distance with a very low biomass production.

On the path toward a 100% renewable society, it is obvious that cities will source biomass from regions with a surplus production. These surplus regions can be within the same country, the same continent, or even in other continents. In a mature biomass market, the trade of biomass will only be limited by topics of sustainability and economics. Also, institutional regulations are of importance.

Trade has the dual purpose of supplying biomass competitively from regions with low-cost, surplus biomass to regions with insufficient or expensive biomass, and also of providing jobs and economic wellbeing in the supplying regions, many with few other development opportunities. The intent of trade is not to limit local bioenergy in exporting countries, but often local markets grow slowly, and trade enables the building of efficient, world-scale plants to densify biomass, participate in a growing local market, while exporting the rest to offshore markets.

6.

BENEFITS OF BIOENERGY COMPARED TO FOSSIL GAS

On average, in the last years, Europe consumed 500 billion m³ fossil gas per year, of which 35% was used for the generation of electricity, 40% for the heating of buildings and 25% for industry and other purposes. Of the total quantity used in Europe, 65% was imported. Almost 30% of the European gas supply comes from Russia **(5)**.

6.1 SECURITY OF SUPPLY

A comparison of the years between 1995 and 2012 shows a growing consumption and dwindling domestic production of natural gas. Within this period, the European production declined by 30%, the net imports increased by 77%, and the inland consumption by 17%. Two thirds of consumed gas was imported in 2012. It can be expected that the European dependency on gas imports will steadily grow in the future (Table 1).

TABLE 1: EUROPEAN GAS SUPPLY: 1995 – 2012, MTOE (MILLION TONS OF OIL EQUIVALENT)

	1995	2012	Change in %
Production	191	133	-30%
Net imports	146	259	+ 77%
Gross inland consumption	336	393	+ 17%

Source: EU commission energy in figures, pocket book **(5)**

6.2 CO_2 EMISSIONS

Natural gas is a fossil energy carrier that consists of carbon and hydrogen. By burning natural gas, carbon stored within the earth's crust is released to the atmosphere. In addition, CO_2 is also released along the whole supply chain, starting from the gas exploration to the final consumption.

However, in the production of heat by burning of wood pellets, no fossil carbon stored within the earth's crust is released, because the carbon contained in wood was taken up by the trees from the atmosphere during their growth. It is true that some minor fossil CO_2 emissions do occur along the supply chain of pellets. A comparison of the total CO_2 emissions for a quantity of 100 000 GWh primary energy looks as shown in Table 2.

TABLE 2: CO_2 EMISSIONS, COMPARISON 100 GWh PRIMARY ENERGY PELLETS VS NATURAL GAS

Energy carrier	Quantity of Primary energy, GWh	Total CO_2 emissions, tonnes
Natural gas	100	24 000
Pellets	100	4 400*
Difference		19 600

Source: CO_2 calculator, UBA, Vienna **(6).** * This figure is high and varies with technology used.

The CO_2 emissions using pellets are 82% smaller compared to emission from use of natural gas for producing the same amount of heat. The CO_2 savings on the basis of 100GWh primary energy are 19 600 tonnes of CO_2!

6.3 GAS PRICES

The gas prices are following the crude oil price. In 2013, the average price of natural gas for business clients in Austria was 3,55 cent/kWh without taxes **(7)**.

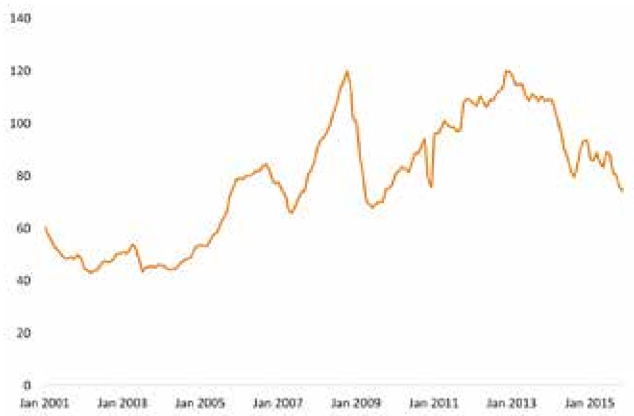
TABLE 3: GASPRICE 2013

	Unit	Price
Average import price Austrian border	c/kWh	2,85
Price for business consumers	c/kWh	3,55

Source: e-control, Vienna, 2015 **(7)**

Between 2000 and 2013, the prices went up by almost 150%. In the past, the prices followed the oil price with a delay of 6 -12 months. Therefore, in the years between 2015 and 2016 also, the gas prices may go down.

FIGURE 1: DEVELOPMENT AVERAGE IMPORT PRICE OF NATURAL GAS (AUSTRIAN BORDER)



Source: e-control, Austria

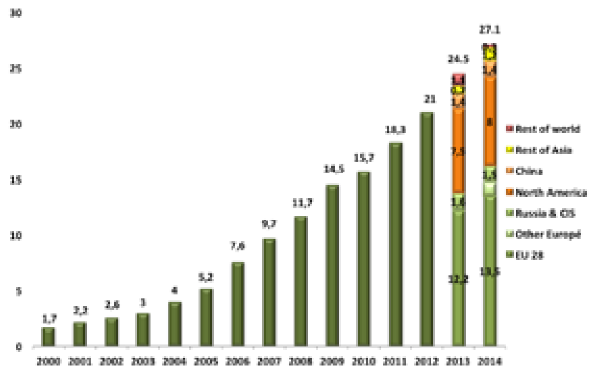
6.4 BIOMASS AVAILABILITY

Whereas the European natural gas production is declining, the European forests are growing. The forests cover 179 million ha of land, or 45% of the total land area; in the period from 1990 to 2010, the forest cover grew by 4.9%, which is around 7 million ha **(8)**.

Only 62% of the annual increment is used, and so the live wood volume increases year by year. If necessary, an additional 290 million m³ wood could be harvested annually from forest for wood supply without decreasing the live wood volume below its replacement.

The forest area is growing and also the pellets production is growing steadily. Over the last 10 years, from 2004 to 2014, global pellet production grew by 21% annually, from 4 million tonnes to 27,1 million tonnes. In 2014, the main producing regions are Europe with 16,2 million tonnes, and North America with 8 million tonnes.

FIGURE 2: ESTIMATED WORLD WOOD PELLET PRODUCTION (IN MILLION TONNES)



Source: AEBIOM Statistical REport 2015

Internationally, the growth in pellet production continues with a number of new plants under construction. In Europe, already 600 plants are producing pellets. Globally, pellets delivered 4,68 EJ energy in 2014, and this is about 8% of the total supply of biomass. It can be expected that the global pellets production will surpass 50 million tonnes within the next 15 years.

Pellets are just an example of the growing supply of biomass. Wood chips, straw bales, and other by-products of agriculture (seed husks, etc.) also can be used for the supply of urban heating systems, depending on the regional situation. Pellets have the advantage as compared to other lower density biomass feedstock, that they can easily be hauled for long distances.

The price per unit of energy in biomass varies greatly depending on the feedstock, the region, the quantity, and the origin of the biomass. As a guideline, prices of between 16 to 36 Euro per MWh delivered to the plant can be expected.

7.

HEATING CITIES WITH RENEWABLE ENERGY

District heating systems are the backbone and the basis of using renewable heat for many cities. In the future, gas grids should partly be replaced by district heating grids. Heat generation should be based on the following origins: waste heat from industry and the service sector, organic waste as feedstock for combustion or anaerobic digestion, solar thermal heat, and other biomass.

Electricity is a high quality energy carrier that should not be used as a main heating source, as in for space heating systems for buildings. As soon as an excess of electricity from renewable sources, such as wind, is available, electricity becomes an interesting option for space heating in combination with other heating sources such as biomass. Flexible systems are needed that avoid a peak demand for electricity during cold days by using more biomass and allow the use of electricity instead of biomass during hours with excess electricity. The combination of district heating systems with integration into such a system of all the range of alternative heating sources including biomass boilers, hot water storage, solar thermal heating systems, and heat produced from excess electricity. This approach should be the basis of a flexible renewable heating concept for cities, with the possible addition of waste heat from industries.

8.

MOBILITY FOR CITIES WITH RENEWABLE ENERGY

Improved public means of transport in the cities, powered by renewable electricity, should become the norm. Individual cars using electric storage batteries will also help to reduce the dependency on fossil fuels.

Biofuels such as ethanol and biodiesel, and biogas upgraded to biomethane, are already important energy carries for public transport in big cities such as Stockholm - where already over 85% of public bus transport is renewable. All cities should develop strategies to organize the public transport system on the basis of renewable energy – electricity and liquid biofuels/biogas!

Renewable electricity, liquid biofuels, and biomethane will become the basis of fossil-free transport systems in the cities of the future. This underlines the importance of a rapid growth in renewable electricity generation based on wind, solar PV, hydro and biomass/biogas.

9.

BIOENERGY LOGISTICS

Usually, biomass-heating plants source most of the biomass from regions outside the cities. The origin of the biomass can be in areas 150 km around the cities, but also in other countries or even other continents. In cities, large amount of biomass is produced in park, gardens, recreational areas, along roads etc. The detailed planning of the supply logistics is of utmost importance. It depends on the type of biomass used, such as: straw bales, sunflower and other fruit shells, low quality round wood, wood chips, wood from short rotation forests, wood residues and recycled wood, pellets etc. For any kind of biomass feedstock, specific logistic chains have to be developed, planned and implemented. Examples presented below will illustrate that the planning of the supply chain for a biomass plant needs specific attention.

9.1 SHORT ROTATION FORESTS

Short rotation forests can be planted densely and harvested every two years or planted more widely and harvested in a period from 4 – 8 years. The harvest technique, the intermediate storage, the form of transport, the place of chipping and the maximal distance between the production site and the plant differ widely and depend on the chosen planting system and tree variety. In order to optimize the supply chain, all steps between harvest and use must be well defined before the first steps of implementation are taken. Long run contracts should be the basis for this cooperation between the grower and the heating plant.

9.2 STRAW BALES

In some regions of Europe, considerable quantities of straw are available for energy purposes; only a small part of this quantity is used so far.

Straw for heating plants is harvested in bales. Different types of balers are in use. The weight depends upon the type of straw, the type of the baling machine and the moisture content.

Following steps have to be performed from harvest to use in heat plants: Harvest of bales – Intermediate storage – Loading of straw bales – transport – unloading – feeding into the combustion chamber.

The storage of the straw can be made at intermediate storage places near the field where the straw was harvested or at the power plant.

Big power plants use cubic bales of about 500kg and special trucks that transport up to 18 tonnes of straw. At a distance of 100km, the energy needed as diesel for the transport is about 1% of the energy content of the straw transported. In the heat and power plant, the straw is unloaded and injected into the combustion chamber automatically.

Bigger heating plants will also have to secure investments in a fully integrated supply chain from the field to the boiler house to get a reliable and cost competitive feedstock.

Photo: Hermann Wieser

Picture shows corn straw baling in Region of Sombo, Serbia.

9.3 PELLETS

In the case of pellets, the situation is different. Industrial pellets are now a global commodity. Various companies are offering pellets with different origins: from the region, from Europe or from abroad. Depending on the origin of the pellets and the location of the plant, the means of transport differ: boats, train or trucks. During the procurement procedure, the details including the sustainability criteria have to be defined in order to optimize the supply chain.

9.4 EXAMPLE OF BIOMASS LOGISTICS FOR THE WORLD'S LARGEST BIOMASS FIRED CHP PLANT IN THE MIDDLE OF STOCKHOLM CITY

The world's largest biomass fired CHP plant, Värtan CHP8, co-owned by Fortum and the City of Stockholm started its operation in early 2016. This biomass giant is located in the middle of Stockholm city, making the fuel logistics and handling a challenge.

FLEXIBLE FUEL USE AND LOGISTICS

The new CHP plant can flexibly use a wide range of biomass assortments. Main fuel types are forest residues and wood waste, such as saw dust, bark and logging residues. Fuel flexibility enables also the use of new fuels from the developing bioenergy market.

Flexibility is key in the fuel logistics. The aim is to ensure security of supply and access to a wide geographic biomass market over time. The Värtan site is well located for efficient logistics: it has full access to road, rail and sea transportation. Most of biomass is supplied by rail and by vessels. Trucks are used only temporarily.

FUEL HANDLING IN URBAN SURROUNDINGS

The entire power plant is fully adapted to the urban surroundings and requirements. Already in the design phase, the prerequisites were set by limited space and demand for closed fuel systems to avoid dust emissions and noise. A large part of the fuel system is underground. An old rock cavern, an earlier oil storage, has been converted into an enormous wood chip storage with a capacity of 60 000 m^3, meeting about five days' fuel demand.

A new 200 m pier was constructed in the harbour area to enable vessels up to Panamax size. The pier can hold two vessels at the time, and the new crane has a discharge capacity of 2 000 - 3 000 tonnes/hour. In average, the plan is to require 3-4 shipments per week to meets the fuel demand.

In addition, five trains a week transport biomass. The capacity of each train is approx. 4 600 cubic meters.

Fuel unloading and processing is done indoor in a closed and fully automatic system. All fuel is processed before its delivery to the power plant.

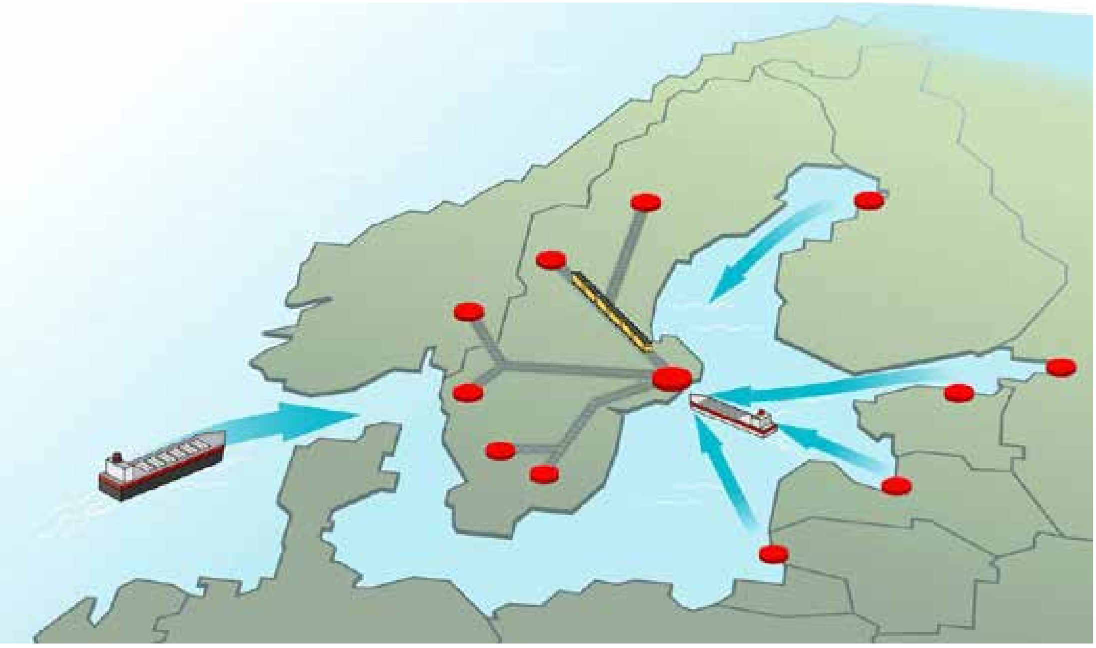


Figure: Fortum Sverige

Picture shows Fuel supply from local, regional and global sources: Basic fuel supply by train and ship from terminals and ports in the Nordic and Baltic Sea region. Security of supply through major logistical flexibility is essential to reach global markets.

Photo:Hans Ekestang

Fortum's bioenergy CHP plant in Värtan, Stockholm.

BIOMASS FROM THE BALTIC SEA REGION

Biomass for Värtan CHP8 will be supplied from local and regional sources around the Baltic Sea. The current fuel procurement plan is based on 40% of fuel by rail from Nordic biomass suppliers and another 60% from the Baltic Region and Russia by ship.

All the logistics are controlled and coordinated inhouse to optimize the logistic system and the supply chain as a whole and to control supply risks.

SUSTAINABILITY SYSTEM

Since 2005, Fortum Värme has been working in close cooperation with WWF Sweden as a member of the Global Forest and Trade Network to define and develop the sustainability aspects of the biomass supply chain.

In 2015, Fortum Värme received a FSC chain of custody certification for its biomass fuel as the first energy company in Europe and as the second worldwide. From 2016, all forest biomass will be under a third party control according to FSC´s standards for Forest Management of Controlled Wood.

VÄRTAN NEW CHP PLANT - FACTS
Capacity: 130 MW electricity, 280 MW heat
Heat and electricity: for 190,000 households
Fuel consumption: 2.4 TWh/a (1 million m^3/a) or 12,000 m^3 per day
Investment cost: EUR 480 million
Constructed: 2012-2015
Emission reduction: 126,000 tonnes CO_2/a
(=12% of the annual emissions from the area's transport sector)

10.

BIOENERGY IN EUROPEAN CITIES

European pioneer cities are demonstrating the various options for integration of energy from biomass in the urban energy system. A few of them are briefly mentioned and described here.

Stockholm, Göteborg, Copenhagen, Ulm, Pecs and Paris.

10.1 STOCKHOLM, SWEDEN

The City of Stockholm, the capital of Sweden, has 0.9 million inhabitants and the greater region of Stockholm has 2.1 million.

HEATING AND ELECTRICITY:

District heating, by cogeneration of heat and power, is the dominating heating system in Stockholm. Less than 20 % of the energy comes from fossil sources. The rest is from biomass, waste and heat-pumps. Besides heating the system generates 20 TWh of electricity. The heat-pumps also provide district cooling.

TRANSPORT:

Stockholm is also a pioneer city in using renewable energy for transport. Public buses run on upgraded biogas, biodiesel or ethanol. Also, cars run on biofuels and at present almost 20 % of all fuel used is renewable. Hydrogenated Vegetable Oil (HVO) dominates the market, replacing fossil diesel to an increasing extent. Biogas is produced using wet organic wastes, principally sewage but soon also organic household waste. Ethanol is produced from cereals or is imported from abroad, and the biodiesel is largely made from rapeseed oil and other vegetable oils.

Photo: iStock

Picture shows Stockhoklm (Sweden) where 80% of the district heating and 20% of transport sector is supplied by renewables.

10.2 GOTHENBURG, SWEDEN

Göteborg, home to several oil refineries and Sweden's second largest city, has 900 000 inhabitants.

HEATING:

District heating is the dominant heating system in Göteborg, where over 90 % of the households are customers. Residual heat from refineries and incineration of waste are the main heat sources for district heating, in addition to biomass. In summer, the residual heat is used to provide the necessary energy for the district cooling grid.

TRANSPORT:

Göteborg is a pioneer city in producing and using renewable energy for transport, especially biogas. Public buses run on upgraded biogas, biodiesel or electricity. The city produces biogas from various wastes such as sewage sludge and municipal putrescible wastes, and is currently running a unique demonstration of producing methane from forest residues at the gasification plant GoBiGas.

Photo: iStock

Picture shows Göteborg (Sweden) where district heating is predominantly from residual heat, incineration and biomass use.

10.3 COPENHAGEN, DENMARK

Copenhagen, the capital of Denmark, has 1,3 million inhabitants.

HEATING:

District heating covers all of the city's central parts, where more than 98% of households are connected. Heat production is mainly based on renewable energy such as wood pellets, wood chips, straw, waste and geothermal as well as fossil fuels for peak demand. The last combined-heat-and-power (CHP) unit at Avedøre Power Station will be converted to use wood pellets as fuel instead of coal, providing green heat for an additional 65 000 households in the Greater Copenhagen area by the end of 2016. When the conversion of unit 1 is complete, the Avedøre Power Station facility will generate heat based entirely on wood pellets and straw instead of coal and gas.

ELECTRICITY:

The city of Copenhagen produces renewable electricity from biomass in the combined heat and power plants as well as from MSW-fuelled plants. Also electricity from on-shore and offshore wind turbines is integrated in the city power supply.

TRANSPORT:

Public transport is widespread and efficient, and a new metro circle line will soon connect the new developments in Nordhavn and Sydhavn to the city centre. Copenhagen has worked to support and increase the use of the bicycle by providing bike parking at railway stations and separate bike lanes and traffic lights. 45 % of all trips to and from work are taken on a bike.

Photo: iStock

Picture shows Copenhagen (Denmark) where renewables including biomass dominate the heating and electricity sector.

10.4 ULM, GERMANY

Ulm is a city in Southern Germany with 120 000 inhabitants.

HEAT:

The district heat system delivers 600GWh and the grid has a length of 160km. 20 years ago, heat generation was based 100% on fossil fuels, mainly coal and a smaller portion from gas and oil. By 2006, already 50% of the heat was generated using biomass and organic waste and the other 50% was sourced from fossil fuels. In 2013, 75% of district heat was generated using renewable feedstocks, and the CO_2 emissions were reduced by 150 000 tons as compared to the year 1996. In 2012, two coal-fired boilers were shut down and in 2013, the biomass boiler II started operation. The capacity of the biomass boilers is almost 100MW_{th}. **(9)**

Photo: iStock

Picture shows Ulm (Germany) where distrct heating moved from using 0% to 75% renewables within 20 years.

10.5 PECS, HUNGARY

Pecs is a city in the South West of Hungary with a population of 160 000 inhabitants.

HEATING AND ELECTRICITY:

The city has a district heating system for 31 000 clients. 15 years ago, coal and gas were used to generate heat and electricity for the city. Since then, the use of fossil fuels has been abandoned and heat and electricity for the city are generated using 100% biomass. The heat is produced in two cogeneration units with a capacity of about 300MW thermal. The feedstock in one unit is wood residues and in the other unit is straw. About 180 000 tonnes of straw are collected from cereal fields in a circle of about 100km radius around Pecs.

Photo: iStock

Picture shows Pecs (Hungary) where 100% biomass to heat and electricity is a reality.

10.6 PARIS, FRANCE

The city of Paris has about 2.4 million inhabitants, with about 10,5 million people living in the city and the total area surrounding the city.

HEAT:

Renewable heat for district heat is based on geothermal and biomass. In the commune of Saint Quen, near Paris, an existing 495 MW_{th} coal fired plant is modified to enable about half of the heat production to come from biomass pellets. The heat will be fed into the district heating system of Paris. This project contributes to the use of at least 50% renewable sources in the Paris district heating system. To reduce dust emissions, "black pellets" will be used. The project consumes 133 000 tonnes of pellets to generate 590 GWh of heat. About 40 000 tonnes will be sourced regionally, and the rest is to be imported **(10)**.

Photo: iStock

Picture shows Paris (France) where geothermal energy and biomass supply district heating to the city.

ICLEI – LOCAL GOVERNMENTS FOR SUSTAINABILITY

ICLEI – Local Governments for Sustainability – is an international association of local and metropolitan governments dedicated to sustainable development.

ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level. Locally designed and driven initiatives can provide an effective and cost-efficient way to achieve local, national, and global sustainability objectives. ICLEI offers also many prime examples that demonstrate how cities are able to move to a low-carbon system. All over the world, many hundreds of large and smaller cities participate in this organisation. ICLEI members share and promote their experiences of how biomass can help to reduce the CO_2 emissions in cities. In addition to having some involvement with ICLEI, WBA has made a small survey about the use of biomass in European cities. A few results are presented here.

11.

CITY OF GRAZ, AUSTRIA

Graz, the capital of the province of Styria, is a city with 283 000 inhabitants in the south of Austria. The city has a developed district heating grid with a length of 370 km and an annual consumption of energy of 1 100 GWh by 2013. The city is growing and so is both the district heating grid and the heat demand.

At present, about 70% of the heat is generated in a coal-fired combined heat and power plant, situated in Mellach, 19 km to the south of Graz. The heat is transported to the city in a pipeline with a capacity of 230 MW. The other part of the heat is generated in several smaller CHP installations or is sourced as waste heat from industries and a small portion comes from solar thermal installations. In 2013, the peak capacity demand for heat was above 500 MW.

The coal fired power plant which is the back bone of the heat supply, has been constructed about 30 years ago. It is not clear how long it will stay in operation and therefore a new solution for the future heat supply of Graz is being developed. Different options have been studied. At present the preferred option is option A as described below and an option B is also being discussed, but so far not strongly supported due to economic reasons:

OPTION A

According to the city of Graz, the heat supply will be based on heat coming from waste heat from industries, from new, large solar thermal installations, from biomass installations and from existing and newly built gas boilers with a total capacity of 500 MW. In addition to the existing gas fired cogeneration units with a capacity of 315 MW a new gas fired boiler with a capacity of 190 MW is being built. According to this concept more than 50% of the heat would be generated using fossil fuels by 2030.

OPTION B

WBA foresees that the base load in the size of 160 – 180 MW will be generated using biomass on the site of Mellach. A quantity of 600 to 700 GWh primary energy from biomass would be needed for this alternative. In combination with the stronger reliance on solar thermal heat as well as the use of waste heat, more than 80% of the heat supply would be based on renewable energies. Gas would be needed to cover the peak demand and as additional redundant energy source to improve the supply security. As there are already many regional and local district heating plants in Styria, the experts came to the conclusion that this additional biomass cannot be sourced in the region and would have to be sourced from other European regions or abroad.

There might be also other cities in Europe facing similar choices as the city of Graz. If decision makers bear in mind the threats of climate change, the choice in favour of Option B should be clear.

Photo: iStock

Picture shows the city of Graz (Austria) where a coal fired power plant supplying 70% of energy has to be replaced soon and options include using waste heat or biomass for replacing fossil fuels.

CONCLUSIONS

This study addresses the challenges cities are facing within the global climate mitigation policy and explains the contributions biomass can offer to reduce the use of fossil fuels in cities. Biomass is a proven renewable and cost-competitive source of on-demand energy to replace fossil fuels in the supply of heat, and also partly in the transport sector.

The supply of biomass in Europe measured in terms of growing forest area, growing wood stock in the forests or the steadily increasing pellet production is improving over time. By contrast, the production of fossil fuels, be it gas, coal or oil, is finite and in Europe declining. Decision makers in cities dealing with the issues of the sources of future heat supply and solutions for the transport sector should consider a few key criteria such as:

- Impact on greenhouse gas emissions
- Security of supply
- Regional development by regional energy solutions

All these criteria favour solutions based on biomass and other renewables. The WBA is of the opinion that cities should take into account these criteria and direct all new investment toward renewable energy solutions and improved energy efficiency, and avoid new investment in fossil structures. This requires a new way of thinking: When confronting this issue we should not forget the inspirational words of Nelson Mandela: "everything seems impossible until it is done!"

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Sustainability is an important value for which GRAWE stands since the year 1828. At the time, Archduke Johann founded Grazer Wechselseitige as a mutual insurance company and since then, from the original fire insurance a versatile international company developed and this value is more relevant than ever. The responsible handling of resources, renewable energies as well as the climate and environmental protection are among the foundations of economic action of the company. Therefore, GRAWE is also very happy to support this study.

The European Pellet Council (EPC) is an umbrella organisation representing the interests of the European wood pellet sector. Its members are national pellet associations or related organisations from 20 countries. The European Pellet Council is a platform for the pellet sector to discuss the issues that need to be managed in the transition from a niche product to a major energy commodity. These issues include standardisation and certification of pellet quality, safety, security of supply, education and training, and the quality of pellet using devices.

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