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EU Handbook - CHP Markets
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BBE - Bundesverband BioEnergie
BEE - Federal Renewable Energy Association
BMU - Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CHP - Combined Heat and Power
CWE - Central-Western European Market
DBFZ - German Biomass Research Center
DEA - Danish Energy Agency
DERA - Danish Energy Regulatory Authority
DH - District Heat
EEA - European Environmental Agency
EEC - Energy Efficiency Credit
EEG - Renewable Energy Act
EIB - European Investment Bank
EMCC - European Market Coupling Company
ERM - Exchange Rate Mechanism
EMU - European Monetary Union
EMS - European Monetary System
FIFC - International Finance Corporation
FiT - Feed-in Tariff
FNR - Federal Agency for Renewable Resources
GC - Green Certificates
GHG - Greenhouse Gas
IEA - International Energy Agency
IED - Industrial Emissions Directive
KÁT - Hungarian Mandatory Reception and Price System
NEAP - National Energy Action Plan
NFM - Hungarian Ministry of National Development
nREAP - National Renewable Energy Action Plan
ÖNACE - Austrian Classification of Economic Activities of Companies
PPP - Polluter Pays Principle
PSO - Public Service Obligation
RENERGIE - Raiffeisen Management Gesellschaft für erneuerbare Energie GmbH
RES-E - Renewable Energy Sources Electricity
RES - Renewable energy sources
RS - Renewable sources
Saeima - Parliament of the Republic of Latvia
SRC - Short Rotation Coppice
TGCs - Tradable Green Certificates
TPES - Total Primary Energy Supply
1. **INTRODUCTION TO THE MARKET**

1.1. **AIM AND METHODOLOGY OF THE CROSS BORDER MARKET HANDBOOK**

The general objective of the Crossborder Bioenergy project is to help SMEs to evaluate bioenergy markets in Europe in view of cross-border investments, thereby making SMEs less dependent on fluctuating domestic market conditions and strengthening the whole bioenergy industry. Five different bioenergy market sectors are considered: biogas, small scale heating, district heating, CHP and biofuels for transportation. The project will contribute to member states’ efforts to reach their targets set in the RES directive, to benchmark national RES action plans, and possibly to implement flexibility projects as mentioned in the RES directive.

With this project bioenergy companies will get a ‘navigator’ on potential markets in Europe, and get necessary tools to develop a market entry strategy. The GIS-Tool helps bioenergy companies in comparing European markets and, based on this comparison, in defining possible target markets. Following this first step the market handbooks offer more detailed information about single countries and regions in Europe and furthermore, describe and explain the situation in the different bioenergy markets in Europe. The B2B-plattform can support direct action by facilitating contact and networking between bioenergy stakeholders and companies. In this section of the website, furthermore concrete offers and inquiries can be posted and a calendar informs about interesting upcoming events.

To achieve these goals the consortium of the Cross Border Bioenergy project undertook a detailed study of the five different bioenergy markets in Europe. Under participation and contribution of many international bioenergy companies and stakeholders, the consortium identified about 50 relevant criteria and summarized them in 8 main categories. The 8 categories cover the important factors influencing the bioenergy sectors, namely:
- Basic Country Data
- Energy Policy
- Feedstocks
- Business Case
- Market Environment
- Regulation
- Project Financing
- Readiness for Uptake

The identified criteria are concretized by more than 300 indicators, which are weighted according to their respective importance. By doing so, scores for each indicator, criterion and category as well as an overall sector score were generated. To ensure scientific reliability the Imperial College London was obliged with working out a sound methodology defining the scoring and weighting mechanisms. A method was worked out to process these criteria and find appropriate indicators, and a comprehensive template was produced.

The results that are presented in this
handbook and on the website are based on official statistics, national action plans, support schemes and furthermore on direct information gathered from bioenergy experts from the single countries in interviews and enquiries undertaken especially for this project. As many different reliable sources have been included in the research process, the results offer a comprehensive picture of the bioenergy markets in Europe.

The full list of categories, criteria and indicators chosen for the biogas sector is available in the biogas sector handbook, provided for download at www.crossborderbioenergy.eu under the rubric ‘publications’. The annex furthermore provides a table containing the leading questions on the basis of which the market handbook was built up on.

1.2. INTRODUCTION TO CHP

Combined heat and power (CHP) or co-generation is a technology used to improve energy efficiency through the generation of heat and power in the same plant, generally using a gas turbine with heat recovery. Heat delivered from CHP plants may be used for process or space-heating purposes in any sector of economic activity including the residential sector. CHP thus reduces the need for additional fuel combustion for the generation of heat and avoids the associated environmental impacts, such as CO₂ emissions. The project focuses on solid biomass CHP plants with a minimum capacity of 500 kW thermally (kWth).

In the past years the waste heat from electricity generation was very often not used, whereas the pure electricity production was predominant. Meanwhile in many member states there is a minimum utilization ratio of heat for new plants. Plants without a thermal use are difficult to present economically due to their overall energy yield. Another reason for the minimum efficiency criteria is the finite nature of the resource biomass. CHP plants should operate mostly on a heat-controlled basis. Only through this a high overall efficiency can be reached and the biomass-fuel can be used in the best possible way.

Through the use of RES, CHP plants show a higher CO₂ saving potential and they should be integrated mainly in a decentralized way due to their relatively low energy density of the solid fuel.

The key technologies of the sector are combustion or gasification of solid biomass and generation of power. For combustion there are several technologies available. In the power
A range of 0.5 until >100 MW mostly grate firing systems, fluidised bed combustion systems or jet blower firing systems are used.

Solid biomass was sometimes overlooked and lives under the shadow of the photovoltaic and wind industries, yet it is a giant in terms of socioeconomic impacts. The increased use of solid biomass (+8% in the EU in 2010) underlined its crucial role in creating turnover in the member states. Investments are made for the installation of CHPs plants and the accompanying equipment and the sale of biomass boilers, furnaces or stoves for individual households. Furthermore, the forestry sectors is a major employers. Here the raw materials produced and delivered to the end-users. Biomass-conversion technologies dual uses as both electricity and heat is a major asset, together with the multitude of forms taken by biomass – wood chips, timber, pellets, sawdust, logwoods, pulp etc.
2. **Comparison of European Countries**

2.1. **Cross Border Scores of EU Countries**

The Top Ten Country Score gives an overview of the ten most attractive countries in the CHP sector. All indicators are included in this overall score, which can be a first indicator of attractiveness.

Source: all tables and figures that are not cited otherwise are based on data from the CBB project: http://www.crossborderbioenergy.eu (November 2011)

**Overall attractiveness of European Countries for CHP**

The map displays the overall attractiveness of the EU 27-member states' CHP markets. The darker the green, the higher the attractiveness.
2.2. Basic Country Data

The analysis of the countries’ basic data is based on the analysis of the geographical and climatic conditions, demography and logistical infrastructure. The figure below shows the CBB basic data score for all European Countries.

Northern Region (Austria, Belgium, Denmark, Finland, Germany, Ireland, Netherlands, Sweden, UK)

The Northern Region contains some of Europe’s biggest CHP countries, including the leader in CHP, Denmark. In some of these countries there is already a penetration of CHP in their electricity supply system of over 20%. In the Nordic countries (Denmark, Finland, Sweden), the support of fossil CHPs is limited, since the focus already shifted to renewable and low carbon solutions.

In the remaining countries of the region some very complicated support mechanisms exist, since the national governments of these markets only tend to install the minimum required stimulus to their greatly liberalised markets. Such complexity can act as an entry barrier and also as a cost penalty for new entrants who need to invest to understand the system.

Belgium (Flanders) and Germany are the two EU Member States which have shown convincing promotion systems of CHP. The support mechanisms in these countries lead to advantages that result in increased rate of returns of up to 10%. However, this is not the case for large plants in Germany since this part of the market is not progressing at a parallel pace to the smaller systems where stimulus is clear.

A common theme across the members of the Northern Region is the combination of capital support (through grants or
tax liability reduction) with generation/power export support.

**Eastern Region (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia)**

Feed-in tariffs (FiTs) and bonuses on electricity are the strongest promotional support for CHP that is used in all countries. Even though the details of FiTs in terms of range covered, period, setting, etc. differ amongst countries, the consistent choice of FiTs might be regarded as an indicator that governments of the Eastern Region still tend to manage their electricity markets to a certain extent whilst full market liberalisation still lies ahead.

In countries, such as Slovenia, Slovakia, Czech Republic, Hungary, where end user electricity prices are average/higher, market oriented FiTs that grant premiums on all generated electricity are the most successful mechanisms. These countries have witnessed the fastest recent development (except Slovenia with new support from 2010). For the Baltic countries, that are still characterised by very low wholesale prices and lower end user prices, a fixed purchase price as support seems to be the more suitable option. A fixed purchase price is a good option to support the competitiveness of district heating plants on the electricity market.

**South Eastern Region (Bulgaria, Cyprus, Greece, Romania)**

There are two quite separate experiences of CHP in this region: two of the countries, Bulgaria and Romania, have made considerable investments in district heating, some with CHP; in Greece and Cyprus district heating applications have remained at a limited stage and CHP in general has not become a prominent method. None of the countries in this region have support mechanisms in place that encourage micro-CHP or smaller building and small process sites.

In general, the profitability of CHP across this region is heavily affected by the relatively low level of market liberalisation. The electricity supply price data for Bulgaria, for example shows that the electricity price is lower than the basic fossil fuel price. Market liberalisation issues in Greece affect market access and competition with regards to basic fuel. Despite support mechanisms which could stimulate the market in Greece, the bureaucracy for obtaining permits from many different state organisations are time consuming and act as an entry barrier for new participants. The volatility of fuel prices and the frequent changes in policy structures concerning the electricity and CHP market in recent years also add to the investment risk.

**South Western Region (France, Italy, Luxembourg, Malta, Portugal, Spain)**

Similarly to the Northern Region, the markets of the countries in the South Western region are relatively liberalised. This means that the support mechanisms tend to be complex and tend to reflect the structure of the market with gas and
electricity prices built up in tranches. Even though the supported Renewable Energy Europe (IRR) in France and Italy benefit from an uplift by well over 10%, these markets do not show the expected growth. In France, the limited application and duration of new support contracts mean that in reality investment are merely targeted at the replacement of plants. In Italy additional costs for cogenerators, local legislation and local taxes restrict the development and add risk costs to this basic IRR calculation.

2.3. Energy Policy

The Energy Policy category analyzes how ambitious are the NREAPs, the appropriate measures proposed by country and the political will to develop the RES-sector; On the base of these results the Cross Border Bioenergy consortium score the EU countries, the result of this scoring are showed in the graph below.

There is a significant potential for the development of RES-electricity in the EU, and the use of biomass to produce electricity can substantially contribute to increase the share of RES in the
EU energy mix. The EU has addressed this sector through policy initiatives, predominantly by setting targets for the promotion of the use of biomass in electricity.

With the directive for the promotion of energy from renewable sources (RES Directive), adopted by the European Parliament in December 2008 and officially endorsed by the Council in April 2009 on the promotion of the use of energy from renewable source (RS), significant regulatory measures to
promote the biomass use for electricity production are imminently to become EU law. The mandatory EU target of 20% by 2020 and the individual national targets provide a stabilizing mechanism for electricity markets and incentives for the development of biomass technologies within the EU. The biomass industry is expected to contribute over half of this overall EU target, roughly 12%, through the applications of biomass in transport, electricity and in heating. As far as biomass for electricity is concerned, it is expected to contribute 250 TWh/year by 2020. Under the RES Directive, EU countries are required to take ‘the appropriate steps to develop transmission and distribution grid infrastructure, intelligent networks, storage facilities and the electricity system’ to help develop renewable electricity (including biomass for electricity). EU countries must also speed up authorization procedures for grid infrastructure and ensure that transmission system operators, and distribution system operators guarantee the transmission and distribution electricity generated from biomass and provide for either priority access to the grid system or guaranteed access. This ensures easier access for biogas and biomethane to the electricity grids and to the gas pipelines. Prior to the RES Directive, the RES-E Directive set national targets for renewable electricity and led to the establishment of specific feed-in tariffs for electricity from all RES, including biomass in most of the EU member states, and tradable green certificate schemes in five EU countries.

According to the IEA’s Deploying Renewables report (2008), the most successful countries in deploying biomass electricity are the Netherlands, Sweden, Belgium and Denmark (for 2000–2005). The case of solid biomass is a good example for showing that different types of incentive schemes can be effective. In Sweden, for instance, quota obligation systems have shown good results at a moderate cost, while in Belgium, the quota obligation system has encouraged biomass deployment at a high cost. The highest growth in biogas generation for 2000–2005 was observed in Germany, the UK and Luxembourg. Germany and Luxembourg applied a feed-in tariff support scheme, and the UK a quota obligation system with tradable green certificates. Besides the UK, Italy’s quota obligation system has shown some of the highest effectiveness levels, with strong growth in both countries being mainly based on an expansion of landfill gas capacity, thus producing methane which is cheap compared to other biogas feedstock.¹

**Useful link:**

- ‘Energy Website’ of the European Commission. The site offers information on energy policies. An up-to-date coverage of EU energy is also available on the policies and activities pages of Europa.

2.4. Feedstock Potential

This category analyzes the feedstock potential to enable CHP projects. The graph below shows the scores for all EU countries.

The theoretical potential of biomass for energy in Europe is much bigger than its present use; however, this potential first has to be developed by activities at the local, regional, national and international level.

So far, forest based biomass is the main biomass fuel provider with the maximum forest fuels potential of 543 million m³ (94.6 Mtoe) in the EU, which covers logging residues that make up 251 million m³ (43.73 Mtoe). Logging residues have the highest potential to increase the forestry fuels used for bioenergy production.

By-products of wood processing industries will also play an important
role. For example, refined fuel pellets account for 6.6 Mtoe (in 2005 and 7.5 Mtoe in 2007) of which 3.3 Mtoe are used for electricity and 3 Mtoe for heat production.

Pellets had a 3% share in the bioenergy production in 2005. Nevertheless, the potential estimated for 2020 is much higher and could reach 14% bioenergy production with 25 Mt pellets (10 Mtoe) used for bio-electricity and 50 Mt (21 Mtoe) for heat production.

Nevertheless, the agricultural sector has the greatest potential and could become the most important energy supplier by 2020. Out of numerous biomass fuels, dedicated energy crops, such as willows, poplars, miscanthus, reed canary grass etc. used for heating and electricity production have enormous potential to increase the use of biomass by increasing the yield per hectare. So far, there are only about 60,000 ha of land planted with such crops whereas 2.5 million ha of land are planted with traditional energy crops.

Biogas also has a huge potential. The production of biogas reached 7 Mtoe in 2008. Considering the available resources, such as manure, organic wastes, by-products, and crop residues, the theoretical biogas potential reaches up to 60 Mtoe by 2020 (if 5% of agricultural land and all available manure is being used). Nevertheless, the realistic potential is more likely to be around 30 Mtoe with 2.5% of agricultural land used and half of the available manure utilized. Presently, there are about 114 million ha of arable land in Europe. If 5% of this land were used for energy crops, a yield of 10 tons of solid dry matter per hectare could provide 22.8 Mtoe of energy if combusted completely, or 18.2 Mtoe if converted into biogas. As not all biomass compounds (especially lignin) can be digested, a general conversion efficiency of 80% is assumed. According to a study of the EEA of 2006, around 10.5% of Europe’s gross energy consumption (9.5% of final energy demand) in 2020 could be met with biomass alone (compared to 4.5% of gross energy demand in 2005), if all the theoretical potential was realized. Respectively, 16% of the EU-27 gross energy demand would be met by bioenergy in 2030. Bioenergy would meet 18.1% of European demand for heat, 12.5% of electricity demand, and 5.4% of transport fuel demand (corresponding to 7% of the diesel and gasoline demand in road transport).

The potential for pellet production is very large. The raw material includes wood residues, wood from forest thinning and short rotation coppicing, as well agricultural residues. Due to this great diversity of feedstock, a 2020 target of 60 to 80 million tons of pellets appears to be feasible. In 2008, more than 440 pellet plants in Europe produced about 7.5 million tons of pellets per year securing a reliable supply. The number of plants is increasing continuously due to the dynamic market development.²

2.5. **Business Cases**

The business case analyses economic conditions which are based on the price levels, subsidies guarantees and support schemes that can affect the viability of specific bioenergy technology applications; the graph below shows the scores of all EU countries in this category.

![Graph showing scores of EU countries in 'Business Case' category]

Many industries, organizations and research bodies are involved in the biomass-based electricity sector, which is scattered and very diverse in size. As a result, there is currently no bioenergy community or bioenergy industry in Europe as such. The sector crosscuts the forestry, agriculture, chemical, food, feed, power and heat industries. It is therefore an oxymoron to speak of a ‘bioenergy industry’. However, in order to generally classify this sector, the term ‘biopower’ industry could be used to define biomass utilized for electricity production. Unstable fuel prices and an increase in energy demand have rendered the power generation from biomass more economically competitive than ever before. Combined with the recent EU legislation on promoting energy from RS, the biopower industry has a huge growth potential. Biomass used for the generation of electricity will play a vital role in achieving the 20% share of renewable energy by 2020. Both, government and industry, have already been investing in innovative biomass based power generation. In the long term cooperation will be necessary in order to fulfil the long term objectives.

The EU's Bioenergy Industrial Initiative, which is currently being prepared in coordination of the Biofuels Technology Platform and other Biomass Associations, is one tool that will help to secure the long term objectives if it runs in close cooperation with the EU Commission.
and other industry stakeholders. The industry has to take a leading role regarding innovation in biomass based power technologies and their subsequent deployment. Technological innovation will be crucial for the future of the industry; in the meantime, however, solutions have to be found that use existing technologies in an economic attractive way. The power industry and utilities need to invest in biopower, as today’s investment decisions will define the energy supply of the next generation. Co-firing is the technology with the largest growth potential in the power sector and it is also the most cost-effective method for large-scale power generation from biomass, which is particularly relevant for power utilities. Traditional electricity utilities will continue to look at co-firing and at plants operating on biomass by 100%. Due to their small size, dedicated biomass power plants are more expensive than co-firing plants. Nevertheless, dedicated biomass plants and dedicated biomass CHP plants are becoming more economically viable. With growing landfills, waste-to-energy has become one of the booming sectors in biopower generation. Despite recycling and waste reduction schemes, waste-to-energy is seen as the most viable large-scale alternative to landfills.

### CHP subsidies (in % of investment)

<table>
<thead>
<tr>
<th>Country</th>
<th>Austria</th>
<th>Germany</th>
<th>Estonia</th>
<th>Finland</th>
<th>Hungary</th>
<th>Lithuania</th>
<th>Latvia</th>
<th>Slovak Republic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>15%</td>
<td>30-70%</td>
<td>50%</td>
<td>30-40%</td>
<td>&gt;30%</td>
<td>40%</td>
<td>35%</td>
<td>&gt;30%</td>
</tr>
</tbody>
</table>
The biogas sector will experience growth as traditional gas utilities will have to increase their shares of renewable energy. Upgrading biogas to the quality of natural gas and injecting it into the natural gas grid is a renewable option for gas utilisation. In the coming years, treatment prices are expected to fall due to economies of scale and also due to the economic downscaling of the upgrading facilities so as to fit the modular biogas plants existing in countries such as Germany and Austria. Industrialists are more and more interested in the biomass CHP market, while this market is currently much more developed in the very high capacity sector (industrial boilers of the forestry sector). The increased importance of this market can be explained by its revalorization through feed-in tariffs, the green certificate trading systems, and EU quotas.

The table ‘Gross Electricity Production’ shows the gross electricity production from biogas in the EU in 2006 and 2007. It is very likely that the most critical non-technical barrier to bioenergy is the availability of resources that are needed in order to ensure continuous long-term supply at a reasonable cost for the market users. The supply with resources is a key factor for bioenergy. It is crucial to develop a sustainable supply chain for biomass feedstock for the biopower industry, and for biomass for heating purposes. Sourcing adequate supplies of feedstock will be the biggest challenge facing the future of the bioenergy industry, as competition for supplies is getting fiercer. Bioenergy is going to commoditize quickly and must make use of all the outputs from its feedstock. Looking 10 or 20 years ahead, there will be a pull on the entire biomass supply chain from a number of sectors – energy, biofuels, and bio-renewable chemicals for example. Hence, the industries from the food, agriculture, energy, oil and forestry sectors must come together to create a secure and reliable feedstock supply chain in order to ensure the growth of a future bioenergy industry.  

Promotion instruments can be classified

Feed-in tariffs (FITs) are generation-based, price-driven incentives. The price per unit of electricity that a utility, a supplier, or a grid operator is legally obliged to pay for electricity from RES-E producers is determined by the system. Thus, a federal (or provincial) government regulates the tariff rate. It usually takes the form of either a total price for RES-E production, or an additional premium on top of the electricity market price paid to RES-E producers. Apart from the level of the tariff, its guaranteed duration represents an important parameter for assessing the actual financial incentive. FITs allow technology-specific and band-specific promotion as well as an acknowledgement of future cost-reductions by implementing decreasing tariffs (see, e.g. the German Renewable Energy Act).

Quota obligations based on Tradable Green Certificates (TGCs) are generation-based, quantity-driven instruments. The government defines targets for RES-E to be installed and obliges any party of the electricity supply-chain (e.g. generator, wholesaler, or consumer) to fulfil these targets. Once defined, a parallel market for renewable energy certificates is established and their price is set according to demand and supply conditions (forced by the obligation). Hence, for RES-E producers, financial support may arise from selling certificates in addition to the income from selling electricity on the power market.

Production tax incentives are generation-based, price-driven mechanisms that work through payment exemptions from according to different criteria (i.e. whether they affect the demand or the supply of RES-E, or whether they support capacity or generation). A common terminology can be applied at least within this handbook in order to provide a classification of these instruments that covers all the strategies referring to the promotion of RES-E deployment that are currently applied. A brief explanation of the terminology is provided below for instruments of high relevance.

Investment incentives establish an incentive for the development of RES-E projects as a percentage of total costs, or as a predefined amount of Euro per installed kW. The level of incentive is usually technology-specific.
electricity taxes applied to all producers. This type of instrument, thus, differs from premium feed-in tariffs solely in terms of the cash flow for RES-E producers: it represents an avoided cost rather than an additional income.

Tendering systems are quantity-driven mechanisms. The financial support can either be investment-focused or generation-based. In the first case, a fixed amount of capacity to be installed is announced and contracts are given following a predefined bidding process offering winners a set of favourable investment conditions, including investment subsidies per installed kW. The generation-based tendering systems work in a similar way. However, instead of providing up-front support, they offer support in the size of the ‘bid price’ per kWh for a guaranteed duration.

As the regulatory instruments described above, more and more voluntary approaches have emerged with on-going market liberalisation. They are mainly based on the willingness of consumers to pay premium rates for renewable energy. However, in terms of effectiveness so far – i.e. actual installations resulting from their appliance – their impact on total RES-E instalment is negligible. 

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4 Summary report, Monitoring and evaluation of policy instruments to support renewable electricity in EU member states; a research project funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety; Institute Systemste and Innovation Research and Energy Economics Group; 2005
2.6. Market Environment

The graph below shows the EU countries’ scores as a result of the analysis of the energy market dimensions in these countries. The consortium of the Cross Border Bioenergy project analyzes here the energy market, the transferable technologies, the logistics and access to the customer base through established networks.

Scoring ‘Market Environment’

Europe is assisting the expansion of biomass use for power and CHP generation. Austria, Germany, the UK, Denmark, Finland and Sweden are leading this process, mostly producing bio-electricity from wood residues in co-generation plants. A large part of these yields come from power plants belonging to the lumber and wood pulp (paper and chipboard panels) industry. Waste products, such as black liqueurs, wood waste, bark or sawdust, are also treated internally in large-scale power plants in CHP operation, which can use biomass alone, or mix it with other fuels. As well as producing electricity, heat and steam necessary for industrial processes, they generate surplus electricity that can be fed into the grid. Due to incentive schemes that have been installed recently in those countries (guaranteed feed-in tariffs, call for tender procedures and green certificates), new power plants have been implemented using biomass over the last few years. Eurobserv’Er observed a slow-down in solid biomass electricity growth in 2007 (+4.4% with respect to 2006, in other words, an additional 2.1 TWh) after the strong growth in the previous two years (+11.4% between 2004 and 2005 and +13% between 2005 and 2006). CHP
systems remain the principle technology used to produce electricity from solid biomass, representing three-quarters (76.8%) of total electricity production in 2007. See table ‘Country Comparison’ below for an overview of gross electricity production in 2006 and 2007, and Figure ‘Development Bioelectricity’ for the overview of the development of the bioelectricity sector compared to other renewables up to 2007.

In the EU, both the primary production of biogas and the gross electricity production from biogas increased by almost 18% between 2006 and 2007. The greatest share of this growth was achieved in Germany. German biogas companies also expanded their business in 2008, despite rising biomass costs. Small-scale electricity production is one of the strong assets of biogas use as this co-generation is very effective with regard to the ratio of heat and power.  

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5 European Renewable Energy Council (EREC):
In March 2007, the heads of state and governments of the 27 EU member states adopted a binding target of 20% renewable energy of final energy consumption by 2020. Combined with the commitment to increase energy efficiency by 20% until 2020 and to reduce GHG emissions by at least 20% within the same period (or respectively 30% in case of a new international agreement), Europe’s political leaders paved the way for a more sustainable energy future. In January 2008, the European Commission presented a draft directive for the promotion of the use of energy from RES which contains a series
of elements to create the necessary legislative framework for making the set targets become reality. The Directive sets the legislative framework that should ensure an increase of renewable energy of the total energy consumption from 8.5% in 2005 to 20% in 2020. If this gets properly transposed into national law, it will become the most ambitious legislation on renewable energy in the world. The RES Directive (DIRECTIVE 2009/28/EC) was approved by the European Parliament in December 2008 and by the Council at the end of March 2009. It was published in the Official Journal in June 2009 and will now have to be transposed into national law. By June 2010, member states will need to submit national action plans on how they foresee reaching their binding national target. In order to reach the binding overall 20% target outlined in the RES Directive, the development of all existing RES and a balanced mix in the sectors of heating and cooling, electricity, and transport are needed.6

6 European Renewable Energy Council (EREC):

2.8. PROJECT FINANCING

This category addresses elements of export feasibility such as a good credit market in the country, good conditions as a target for export as reflected in the Euler-Hermes Rating for instance. The graph below shows the scores for all the EU countries.

The principal debt financier in the European renewable energy sector has been the banking sector. A few projects have accessed debt capital markets, but the depth in the institutional market is relatively low compared to the US institutional market, where projects in the energy and infrastructure sector

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loans to the RES sector reached over €4 billion in 2009, have filled a void on the project finance market and significantly increased their involvement in RES projects.

Capital availability in the renewable sector from banks is influenced by a number of factors:

1. Capacity of banks to lend long-term to the renewable energy sector;
2. Ability of banks to recycle the loan capital through secondary loan markets to other long term institutional lenders, such as pension funds, insurance funds or other capital markets (through financial mechanisms through project loan securitizations etc.);
3. Impact of bank regulations on asset-liability mismatches.

Useful links:

- ‘ManagEnergy’ is a technical support initiative of the Intelligent Energy – Europe (IEE) programme of the European Commission which aims to assist actors from the public sector and their advisers working on energy efficiency and renewable energy at the local and regional level.
  - [http://www.managenergy.net/emap/maphome.html](http://www.managenergy.net/emap/maphome.html)

2.9. Readiness for Uptake

This category was only analyzed for the countries partners of the CBB project. It includes the availability of support these countries, such as industry associations and it also reflects the reality of the potential customer base in terms of suitable awareness about and willingness to adopt technology, which in turn relates to maturity of the market.

The EU aims at generating 21% of its electricity from RES by 2010. The Directive 2001/77/EC formulates this target on the promotion of renewable electricity. While some member states, such as Germany, Spain and Denmark are well on track to reach their targets, the Renewable Energy Framework Directive needs to maintain and strengthen the existing legislative frameworks for renewable electricity. It needs to establish minimum requirements for the removal of administrative barriers, including streamlined procedures such as one-step authorization. Issues, such as priority grid access and a more balanced sharing of the costs related to grid connection need to be addressed.8 Growth of electricity output from solid biomass in particular has been steadily increasing by an average of 14.7% per annum since 2001 resulting in a rise from 20.8 to 62.2 TWh in 2009 (see Table ‘Solid Biomass EU’). Most of this production, 62.5% in 2009, comes from cogeneration plants. A survey conducted by Ecoprog and Fraunhofer Umsicht reports that the number of solid biomass power plants has practically doubled over the past

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It also asserts that there are about 800 biomass plants in Europe with a combined capacity of some 7.1 GW. Furthermore, the capacity of these power plants should rise to 10 GW before the end of 2013. These figures do not include fossil fuel based co-combustion power plants, which are highly popular in the UK and Germany. The reasons for this significant growth are the introduction of an incentive system for biomass electricity production (feed-in tariff and green certificate) and the introduction of subsidies that facilitate investments. The main producer countries are the major Scandinavian forestry countries, Germany, and Austria. They have led the way by subsidising biomass electricity for over a decade. Political solutions arrived much more recently in other countries such as France, the UK and the Baltic States, and will lead to increases in production capacities in the coming years. The major waste wood production sites (forestry and paper pulp industries) will be the first to take advantage of the adjustments to biomass remuneration.9

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3. Country Attractiveness - In Depth Analyses

3.1. Austria

Austrian Biomass Association (ABA)
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A-1010 Wien
Tel.: +43-1-533 07 97 25
Email: rosenberger@biomasseverband.at

3.1.1. Country Score

In the general scoring for sector, Austria - Upper Austria is rated place 62 out of total 81. The underlying categories that influence this result are displayed in the bar chart above.

3.1.2. Basic Data

Austria is a democratic republic and consists of nine federal states (Graph ‘Map of Austria’). The capital and largest city is Vienna. Austria has a land area of 83,879 km² (573 km between the western and easternmost points of Austria, the longest north-south stretch totals 294 km) and is, thus, somewhat smaller than Portugal and Hungary, and somewhat larger than the Czech Republic. Located in the southern part of Central Europe, the republic shares borders with Germany and the Czech Republic in the north, the Slovak Republic and Hungary in the east, Slovenia and Italy in the south, and Switzerland and Liechtenstein in the west.

8.4 million Austrian inhabitants were counted at the beginning of 2011. By 2050, the figure should reach ca. 9.4 million, according to the projection. The municipality with the largest population is Vienna, which had 1.7 million residents at the beginning of 2011. A fifth of Austria’s population, thus, lives in the
Austria's weather is characterized by a transitional climate. Consequently, an oceanic climate with moist westerly winds predominates in western Austria, whilst further to the east the climate becomes increasingly continental with decreasing precipitation, hot summers, and cold winters. The local climate is strongly influenced by the altitude, local topography, and exposure to the prevailing westerly weather conditions.

Useful links:
- ÖNACE – Austrian classification of economic activities of companies
- Statistics Austria

### 3.1.3. Energy Policy

Energy independence – 100% energy supply from domestic and renewable sources – is the objective for Austria by 2050. RES have a special status in Austria. In recent years big efforts were made to promote green energy. As a result, 30.8% of the Austrian energy consumption came from RS in 2010. The measures are divers in nature and comprise initiatives sensitizing the public on energy issues (e.g. ‘klima:aktiv’) on the one hand, and support schemes in the form of subsidies and beneficial framework conditions on the other hand.

According to the internal burden-sharing of the EU, Austria has to reduce its emissions by 13%. In the year 2009, GHG emissions in Austria reached 80.1 million tons. Thus, the emissions of the year 2009 were 11.3 million tons above the allowable average in the period from 2008 to 2012 of the established
Kyoto target. Taking into consideration the activities of Joint Implementation and Clean Development Mechanism, and the balance from afforestation and deforestation, the deviation from the target amounts to approximately 5 million tons of CO$_2$-equivalents. Hence, the over-all gap from the years 2008 and 2009 results in 11.9 million tons CO$_2$-equivalents. To keep the gap as small as possible the implementation of effective domestic measures is necessary.

Due to the requirements set by the EU, Austria is bound to

- reduce its greenhouse gas emissions in the sectors covered by the emissions trading system by at least 21%, and in those sectors not covered by the emissions trading system at least 16%,
- increase the share of renewable energy sources of the total energy consumption to 34% – the share in the transport sector should be at least 10% and
- reduce the energy consumption by 20% of the prognosticated level of the year 2020 through improved energy efficiency.

The Table ‘Bioenergy Consumption Austria’ on the following page shows the development and the expectations of bioenergy consumption in Austria from 2005 to 2020.

### 3.1.4. Feedstock

The forest cover is particularly high in Austria: Almost half (47.6%) of the country, hence 3.99 million ha or 39.926 km$^2$, is covered by forest. Agriculture and forestry constitutes the backbone of a viable rural community and also reflects the cultural tradition of the nation. Structural economic changes have naturally had an impact on agriculture and forestry: as in most other EU member states, a steady downward trend in the number of operations is accompanied by a simultaneous increase in the average size of the operations. The total output of agriculture and forestry accounted for €8.0 billion in 2010. The Table ‘Land Use’ shows the distribution of land use in Austria, subdivided to the federal states. Amongst other function, the agricultural sector ensures food production, cultural landscape preservation, landscape management and energy generation. The ability to compete within the EU is achieved through sustainable agriculture, and through an increasing specialization of agricultural and forestry operations. The coupling of agriculture and forestry with the tourist industry, and the increasing cultivation of energy crops to promote sustainable raw materials, guarantees the conservation of economically healthy, productive, farmer-oriented agriculture and forestry in a functional rural community.

In addition to raw materials from forests and timber processing industries, domestic wastes and agricultural feedstock will gain more importance. These raw materials can be used for the production of solid biomass, biogas and biofuels. In 2009, about 46,500 ha of arable land and grassland were used for the production of biomass, while energy crops on arable land dominated (46,000
Table 'Bioenergy Consumption Austria’: Consumption of Bioenergy in Austria – Development & Potential from 2005 to 2020

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Energy sources</td>
<td>PJ</td>
<td>PJ</td>
<td>PJ</td>
<td>PJ</td>
</tr>
<tr>
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<td>95.4</td>
<td>103.9</td>
<td>110.9</td>
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<tr>
<td>Black liquor</td>
<td>15.6</td>
<td>17.5</td>
<td>18.4</td>
<td>19.0</td>
</tr>
<tr>
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<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
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<tr>
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<td>0.4</td>
<td>2.8</td>
<td>4.8</td>
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<tr>
<td>Other solid biomass</td>
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<td>5.5</td>
<td>6.5</td>
<td>7.4</td>
</tr>
<tr>
<td>Heat from biomass – single units</td>
<td>115.8</td>
<td>119.1</td>
<td>131.8</td>
<td>142.4</td>
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<tr>
<td>Domestic waste (bio-shares)</td>
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<td>1.9</td>
<td>1.9</td>
<td>1.9</td>
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<tr>
<td>Wood-based</td>
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<td>20.6</td>
<td>26.1</td>
<td>30.7</td>
</tr>
<tr>
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<td>0.2</td>
<td>0.4</td>
<td>1.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Liquid biomass</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Black liquor</td>
<td>0.0</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Other solid biomass</td>
<td>0.6</td>
<td>0.9</td>
<td>2.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Heat from biomass – district heating</td>
<td>12.7</td>
<td>24.5</td>
<td>32.1</td>
<td>38.4</td>
</tr>
<tr>
<td>Total heat from Biomass</td>
<td>128.5</td>
<td>143.5</td>
<td>163.9</td>
<td>180.9</td>
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</table>

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<td>Energy sources</td>
<td>PJ</td>
<td>PJ</td>
<td>PJ</td>
<td>PJ</td>
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<tr>
<td>Domestic waste (bio-shares)</td>
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<td>Wood-based</td>
<td>2.6</td>
<td>7.3</td>
<td>8.4</td>
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<tr>
<td>Biogas</td>
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<td>2.3</td>
<td>3.6</td>
<td>4.7</td>
</tr>
<tr>
<td>Liquid biomass</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Black liquor</td>
<td>4.0</td>
<td>4.0</td>
<td>4.4</td>
<td>4.6</td>
</tr>
<tr>
<td>Other solid biomass</td>
<td>0.3</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Total electricity from biomass</td>
<td>9.3</td>
<td>15.5</td>
<td>18.3</td>
<td>20.7</td>
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</table>

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Energy sources</td>
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<td>PJ</td>
<td>PJ</td>
<td>PJ</td>
</tr>
<tr>
<td>Pure bio fuel</td>
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<td>5.0</td>
<td>6.2</td>
<td>8.0</td>
</tr>
<tr>
<td>Bioethanol – admixture</td>
<td>0.0</td>
<td>2.7</td>
<td>4.9</td>
<td>5.3</td>
</tr>
<tr>
<td>Biodiesel – admixture</td>
<td>1.4</td>
<td>14.9</td>
<td>17.6</td>
<td>22.3</td>
</tr>
<tr>
<td>Biofuel – admixture</td>
<td>1.4</td>
<td>17.5</td>
<td>22.5</td>
<td>27.7</td>
</tr>
<tr>
<td>Total bio fuel</td>
<td>2.3</td>
<td>22.5</td>
<td>28.7</td>
<td>35.7</td>
</tr>
</tbody>
</table>

| SUM OF BIOENERGY          | 140.2 | 181.5 | 210.9          | 237.2          |

This corresponds to 3.4% of the total arable land in Austria. Until 2020, the cultivation of energy crops as a main crop could be extended to 122,000 ha, roughly 80% on arable land and 20% on grassland. This corresponds to 7.2% of the arable land and 1.4% of the grassland. In addition, catch crops can be produced on 23,000 ha and harvesting residues can be taken from 150,000 ha. The increased use of biomass wastes and residues from agriculture, such as dung, also provide additional energy potential.

In 2009 about 1,000 ha of short rotation wood and 800 ha miscanthus were used energetically in Austria. It is estimated that the area of short rotation crops can be extended to 15,000 ha by 2020. The energy production could increase from current 0.16 PJ to 3.5 PJ by 2020. For miscanthus, an extension up to 3,500 ha has been estimated. This corresponds to an energy increase from 0.14 PJ to 0.9 PJ. Currently, agricultural residues are only marginally used for energy production. Until 2020 agricultural residues, such as straw, corn cobs or hay from landscape maintenance, will gain importance, since they do not compete with food and feed production. Thus, the use of straw of 15% of the Austrian corn cropland (about 92,000 ha) could produce 3.8 PJ of primary energy. The energy of corn cobs from 25% of the corn cropland (45,000 acres) is estimated at 0.7 PJ. The hay from 1.5% of extensively used grassland (13,000 ha) could produce 0.6 PJ. Overall, energy crops and agricultural residues, in form of solid biomass, could produce 9.4 PJ of primary energy by 2020.

<table>
<thead>
<tr>
<th>Federal state</th>
<th>Area in km²</th>
<th>Agriculture use</th>
<th>Forests</th>
<th>Alps</th>
<th>Inshore waters</th>
<th>Other 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burgenland</td>
<td>3 962</td>
<td>48.6</td>
<td>30.7</td>
<td>7.4</td>
<td>1.9</td>
<td>5.7</td>
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<td>Carinthia</td>
<td>9 538</td>
<td>19.6</td>
<td>53.5</td>
<td>1.9</td>
<td>12.7</td>
<td>10.3</td>
</tr>
<tr>
<td>Lower Austria</td>
<td>19 186</td>
<td>48.7</td>
<td>40.0</td>
<td>0.2</td>
<td>1.3</td>
<td>5.0</td>
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<td>Upper Austria</td>
<td>11 980</td>
<td>46.8</td>
<td>39.3</td>
<td>0.3</td>
<td>2.2</td>
<td>7.7</td>
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<tr>
<td>Salzburg</td>
<td>7 156</td>
<td>16.0</td>
<td>39.8</td>
<td>25.3</td>
<td>1.5</td>
<td>15.8</td>
</tr>
<tr>
<td>Styria</td>
<td>16 401</td>
<td>23.8</td>
<td>57.3</td>
<td>6.3</td>
<td>0.9</td>
<td>8.5</td>
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<td>Tyrol</td>
<td>12 640</td>
<td>9.1</td>
<td>36.9</td>
<td>26.3</td>
<td>1.0</td>
<td>25.4</td>
</tr>
<tr>
<td>Vorarlberg</td>
<td>2 601</td>
<td>17.0</td>
<td>34.0</td>
<td>25.3</td>
<td>2.6</td>
<td>18.0</td>
</tr>
<tr>
<td>Vienna</td>
<td>415</td>
<td>13.8</td>
<td>18.8</td>
<td>-</td>
<td>4.6</td>
<td>28.8</td>
</tr>
<tr>
<td>Austria</td>
<td>83 879</td>
<td>30.3</td>
<td>43.5</td>
<td>9.7</td>
<td>1.7</td>
<td>11.2</td>
</tr>
</tbody>
</table>

3.1.5. Business Case

The growth of the renewable energy sector is a success story that will develop further, also in spite of the increasing energy consumption. The total turnover of investments in renewable energy technologies reached €5.229 billion in 2010; this was a 5.1% increase to the previous year. The production and service of renewable energy appliances, offered employment for 37,649 people in 2010 – 5.1% more than in 2009. The importance of renewable energies for the national economy is, however, goes beyond its turnover and employment effects. The ability to generate energy from domestic sources reduces the need of fossil fuel imports making the national economy less prone to crises. In a longer term the economy will gain sustainability.

In general, the Austrian feed-in law establishes excellent framework conditions by providing investment security through its tariffs with 15(20)-years payment periods, the prioritized grid access, and the purchase obligation of grid operators. The tariffs for solid biomass (wood) remained unchanged. Depending on the plant capacity, they vary between 14.98 Cent/kWh for appliances up to 500 kW, and 10 Cent/kWh for appliances over 10 MW. During the biogas production, heat is produced as a by-product. The complete usage of the arising heat is promoted. This does not apply for the heat from wood-based electricity production. For the profitability of wood-based plants, a tariff of 18 Cent/kWh is needed, which makes this method currently unfeasible from an economic perspective.

The issued tariffs pertain until the new Green Electricity Act comes into effect on the 1st July 2012 (Table ‘FiT Austria’). Based on this directive, new tariffs will be determined.

3.1.6. Market Environment

The consumption of bioenergy increased by 30% from 140 PJ in 2005 to 182 PJ in 2009 (Figure ‘Final Energy Consumption Biomass Austria’). The heating market is the main sales market for biomass with a share of 79%, followed by the biofuel market with 12.4%, and the green electricity market with a share of 8.6%. Assuming that the full resource-potential will be exploited, the final consumption of bioenergy could rise about 31% up to 237 PJ. With estimated 76%, the heating market will remain to be the primary sector using biomass by 2020. A share of 15% of biofuels and a share of 9% of green electricity from biomass and biogas are assumed.

The production of heat from biomass sources increased by about 12% from 128.5 PJ in 2005 to 143.5 PJ in 2009, while in 2009 about 83% of the produced heat contributed to small scale heating and 17% arose from district heating (Figure ‘Biomass heat Production’). During this period, the heat from biomass sources nearly doubled from 12.7 PJ to 24.5 PJ. The heat production from small scale heating increased slightly from 115.8 PJ to 119.1 PJ.
The development potential of heat from biomass sources is estimated to increase by 37.3 PJ until 2020 (Table 'Forecast Potential') and can, hence, reach 181 PJ in total. The most important resource for a further expansion is wood with 69%, followed by biogas with 15% and other biomass combustibles with 13%. It is expected, that about 60% of the development potential lies in small scale heating. The remaining 40% will be covered by district heating, micro-grids and industrial waste heat from CHP-appliances. To reach this goal, heating appliances with a thermal capacity of about 5,050 MW need to be newly installed. Additional 500,000 households with an estimated heat consumption of 10 kW/household could be switched from fossil to biomass heating. Moreover, old biomass heating appliances need to be replaced. About 140,000 outdated heating appliances based on wood should be replaced to
reach a higher level of efficiency. With the fuel amount saved through the replacement of old appliances, another 45,000 households can be heated.

Green energy from liquid and solid biomass, as well as biogas increased by approximately 67% from 9.3 PJ in 2005 to 15.5 PJ in 2009. In this time period, green electricity from solid biomass including black liquor rose from 7.9 PJ to 13 PJ, while green electricity from biogas increased from 1.1 PJ to 2.3 PJ.

If the total potential was to be explored, green electricity generated by solid and fluid biomass, as well as biogas could increase by about 34% to 20.7 PJ by 2020 (Figure 'Green Energy Development'). Around 55% of the potential is based on solid biomass, and 45% on biogas. To utilize the full potential, CHP-appliances operating with solid biomass and biogas, each producing 100 MW in total, need to be build.

### 3.1.7. Regulation

In October 2011, the tenth anniversary of the full liberalisation of the Austrian electricity market took place. The liberalisation of the Austrian electricity market had been a consequence to Austria’s accession to the EU and the EU’s first energy package.

In Austria there are a variety of rules and laws for CHP-plants operating on biomass. Some of the most important regulations are declared in the following. The federal ‘CHP law’ (KWK-Gesetz)
governs the nationwide uniform distribution of funding for the generation of green electricity in CHP systems. On the one hand, funding covers parts of the expenses that arise during the operation of existing and modernized cogeneration installations for public district heating, and on the other hand funding is available in the form of investment grants for new CHP plants.

For air and noise emissions there are binding thresholds defined within the

Table ‘Forecast Potential’: Forecast potential for production of heat from biomass in Austria from 2009 to 2020.

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>PJ</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood based</td>
<td>25,6</td>
<td>68,6</td>
</tr>
<tr>
<td>Black liquor</td>
<td>1,5</td>
<td>4,0</td>
</tr>
<tr>
<td>Biogas</td>
<td>5,4</td>
<td>14,5</td>
</tr>
<tr>
<td>Other solid biomass</td>
<td>4,8</td>
<td>12,9</td>
</tr>
<tr>
<td>Sum</td>
<td>37,3</td>
<td>100,0</td>
</tr>
</tbody>
</table>

federal ‘emission law for boiler plants in Austria’ (Emissionsschutzgesetz für Kesselanlagen – EG-K).

There are numerous regulations in Austria that affect the operation of heating systems based on biomass. The most important ones are listed below.

The EG-K and the ‘Luftreinhalte-VO für Kesselanlagen’ (LRV-K) are regulating the approval, the operation, the air emissions, and the monitoring of steam and gas generators.

The ‘Feuerungsanlagenverordnung’ (FAV) applies to subjects under approval and already approved appliances with a capacity of more than 50 kW.

The ‘Abfallverbrennungsverordnung’ (AVV) regulates combustion techniques, emission limits, and operation conditions.

The ‘Immissionsschutzgesetz-Luft’ (IG-L) comprises limits and targets for several pollutants.

The target of the ‘Emissionshöchstmengengesetzes Luft’ (EG-L) is the regulation of air pollutants (NOx, SO₂, NMVOC and NH₃) through the determination of national emission limits.

The federal law ‘Green Electricity Law Austria 2012’ (Ökostromgesetz 2012) regulates the financial support

Figure ‘Green Energy Development’: Development of green energy from liquid and solid biomass and biogas in Austria from 2005 to 2009 and forecast potentials for 2020

of the feed-in tariffs, the grid access, the acknowledgement of plants, the obligations for applicants and plant operators, investment subsidies, etc. Since the year 2003 the ‘Green Electricity Law Austria’ regulates homogeneous subsidies and support schemes for the whole of Austria.

The Green Electricity Act in Austria provides the main framework for electricity generation from biomass and biogas. By the end of 2009, electricity generation systems based on solid biomass with a capacity of 313.4 MW, biogas plants with a capacity of 77 MW, systems based on liquid biomass with a capacity of 9.6 MW, and plants working with landfill- and sewage gas with a capacity of 21.2 MW had been established in Austria. These plants generated 2,566 GWh in total. The electricity, subsidised by the Renewable Energy Act, was fed into the grid. Additionally, 1,100 GWh of electricity from black liquor and 600 GWh from sewage sludge, carcass meal and other renewable waste were generated without subsidisation. In total, 4,300 GWh electricity were generated from biomass sources. It is assumed that both, the electricity generation from solid biomass and from biogas can be extended by 100 MW, if the Green Electricity Act creates appropriate boundary conditions that allow an economic system operation. With these systems additional 1,300 GWh of green electricity could be generated.

The most important measures for further expansion of green power are:

- Longer-term predictability of frame-work conditions: In the interests of long-term development, stable framework conditions should be created.
- Decentralization of plants: The power generation from solid biomass should focus on the decentralisation of plants.

Hence, the establishment of plants with a capacity of less than 500 kW are recommended because efficient regional supply concepts are more feasible than nationwide mega-projects. Domestic companies are working intensively to develop new technologies for low capacity-systems. Only if these companies succeed in establishing their products on the domestic market, they will be able to benefit from export opportunities that appear to be enormous. Especially small-scale facilities in existing biomass heating plants and industrial plants offer a great potential to switch from mere heat generation to combined heat and power. For the green electricity generation from solid biomass new sources, like short-rotation wood, corn cobs and other agricultural residues should be used to complement the raw material range. With regards to the production of feedstock for biogas plants, it is crucial to avoid competition over land for food and feed production – food production should always have the highest priority. If designed and planned well, food and bioenergy production can coexist. Hence, intelligent designs are needed to manage the food and feed production. A considerable potential for a further expansion of biogas usage arises
from higher yields through the use of fertilizers as well as the use of grassland biomass and catch crops. Small systems based on the previously named raw materials, should be considered in the Green Electricity Act. This management measure would also lead to decreasing carbon emissions in the rural areas. Gas produced in larger biogas plants should be injected into the gas grid or used to generate fuels. In the future, the cascading use of resources is important. Accumulating residual products should be used in biogas plants to generate energy.

Useful Links:
- [Green electricity law Austria 2012 (Ökostromgesetz 2012)](#)
- [E-Control Austria](#)
- [OeMAG – Abwicklungsstelle für Ökostrom AG (processing and administration centre for green electricity in Austria)](#)
- [CHP-law Austria (KWK-Gesetz Austria)](#)
- [Emissionsschutzgesetz für Kesselanlagen - EG-K (emission law for boiler plants)](#)
- [Luftreinhalte-VO für Kesselanlagen (LRV-K)](#)

3.1.8. Project Financing

According to outcomes from recognized rating agencies like Standard & Poor’s and Moody’s, Austrian markets can be considered as safe from the country risk perspective. The reliability and credit worthiness of the Austrian economy is rated with best scores. COFACE country risk rating sees Austria on the fifth place in Europe after Luxembourg, Norway, Sweden and Switzerland. According to the Corruption Perception Index, that measures the level of transparency, Austria is on the 16th position of the whole world. Austria achieved the 32nd place of 183 countries on the IFC ranking on the ‘Ease of doing business’. Austria’s rank of ‘Starting a Business’, however, is relatively low due to the very high administrative and regulative requirements.

As Austria is member of the Eurozone, currency exchange risk within this zone, that is to say for investors coming from other member countries of the Eurozone, is low. With an average inflation rate of 1.8% for the period from 2005 to 2010, it is one of the lowest within Europe. The European average for the same period is 2.3%.

The easiness of getting a credit by banks is very much dependent on individual project designs as the bank will assess reliability of the chosen technology, feedstock supply security and price risks. The development of appropriate measures or strategies for the use of bioenergy is very specific. The optimal solution for the specific situation must consider ecological, economic, as well as social aspects.

Project financing institution:
RENERGIE offers support with regards to the financing and operation of energy generating facilities using renewable sources, develops projects for renewable power and heat, and realizes the appropriate production plants. The
projects are implemented by equity investments in selected European markets.

3.1.8. Readiness for Uptake

The readiness for uptake seems to be good. New projects need to be planned and implemented in a considerate and well adapted way under the participation of local inhabitants and stakeholders.

3.2.2. Basic Data

Germany, officially the Federal Republic
German Bioenergy Association (BBE)
Thomas Siegmund
Godesberger Allee 142-148
D-53175 Bonn
Tel.: +49-228 81 002-22
Email: siegmund@bioenergie.de

3.2.1. Country Score

In the general scoring for sector, Germany - Bavaria is rated place 14 out of total 81. The underlying categories that influence this result are displayed in the bar chart above.

of Germany, is a federal parliamentary republic in Europe. The country consists of sixteen federal states (see Figure ‘Map Germany’). The capital and largest city is Berlin. Germany is, with 357,104 km² land area, one of the largest countries in Europe, located in a temperate climate zone with average temperatures of -0.5 degree Celsius in January and 17 degree Celsius in July. The forest area in Germany amounts to 107,000 km² (nearly 30% of the whole land area). 188,000 km² (52% of the land area) of the area is agricultural land (grassland, parkland, heather, marshland, gardens).

Considering a total population of 81 million, and an average of 229 inhabitants/km² the population density is considered to be high enough to provide sufficient sales potentials even on regional scale; although there are geographical differences in real terms, with lower densities in the eastern and northern parts compared to the western and southern regions of Germany.

Useful links:
Facts and Figures:
3.2.3. Energy Policy

The German government aims at reaching a share of RES on final energy consumption of approximately 20% in 2020, thereof 35% in the electricity sector. This number is supposed to rise to 80% in 2050. Due to the storability of feedstock and the flexibility of energy supply, bioenergy will play a key role in this strategy. In 2010, electricity generation with solid biomass had a share of 11.9% of total RES-E production (102 TWh). The most important support scheme is the Renewable-Energy-Act (EEG) which supports the installation of CHP-plants fired with biomass. Amongst the different bioenergy technologies, the amount of electricity produced by German CHP-plants from solid biomass in 2009 was 12 TWh (TWel) with more than 7.5 million tons of wood (atro). The EEG, which provides feed-in tariffs according to the capacity installed and feedstock used, is a key driver of a steady market growth. Since 2012, however, the utilization of waste wood is not supported any longer. Within the nREAP there is a target value for the expansion of the use of solid biomass in the energy sector of 17,5 TWh. So there still is a production gap which will have to be filled during the coming decade.

The political will to develop the CHP-sector can be seen as quite favorable, as the benefits of biomass are well recognized and biomass is seen as a key technology to increase the market share of RES in general. As biomass can provide both base and peak load electricity, it can furthermore balance fluctuating RES energies, such as wind power and photovoltaic. The proposed measures to reach these targets, as described in the nREAP and experienced in practice, are considered to range from ‘very good’ to ‘sufficient’; however, there is still room for improvements.

With the feed-in law in Germany, called ‘Renewable Energies Act’ (EEG), the government introduced an excellent support scheme with fixed feed-in tariffs for different feedstock and capacities, long-term payment periods and guaranteed grid access, and regulated grid connection rules. The feed-in law is amended in regular periods to adjust the tariffs to actual market developments and needs. This Act serves to implement Directive 2001/77/EC of the European Parliament and of the Council of the 27th September 2001 on the promotion of electricity produced from RES in the international electricity market. In terms of achieving expansion targets for renewable energies in the electricity sector, the Renewable Energy Sources Act is the most effective funding instrument at the German government’s disposal.
Also international observers consider it an exemplary act. The amendment of the EEG in 2011 introduced additional options to invest into biogas storage facilities and to integrate biogas into the energy market. For the CHP-production with solid biomass there are new possibilities, too. With the amended EEG there is an obligation of a 60% heat usage in every plant to increase the efficiency factor. The usage of used wood in newly built CHP-plants (from the 1st of January 2012) is not promoted any more.  

Due to the rising success of the bioenergy sector in the electricity market, different concepts and strategies were introduced in the new EEG. At policy-making-level, this led to different viewpoints concerning which strategy was best to follow. Eventually, this resulted in constant public discussions on changing tariffs and regulations – and therewith to rising uncertainty and decreasing confidence in the stability of policy frameworks on the investor-side.

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has established a clearing house under the EEG, which has started its operations in October 2007. The clearing house settles disputes and tackles application issues arising under the EEG. Its services are free of charge for all stakeholders who have obligations or rights under the EEG. In the case of a dispute, the clearing house will act and try to provide solutions or arbitrations if all stakeholders wish for that. It does not offer unilateral legal advice or project consulting.

**Useful links:**

Laws and Ordinances:
- National Renewable Energy Action Plan
- BMU - nationaler Aktionsplan
- Brochure - Biomasseaktionsplan
- Transparency Platform - Action Plan
- EEG Clearing House

Renewable-Energy-Heat-Law:
- BMU - Erneuerbare Energien
- Gesetze im Internet

Market Incentive program for Renewable Energies
- Bafa - Energy Index
- Bafa - Biomass Index
- Kfw Index

Institutions:
- Renewable-Energy-Heat-Tax
- Federal Office of Economics and Export Control (BAFA)
- Pellets F&E and Marketing =&gt; Federal Agency for Renewable Ressources
- German Biomass Research Center (DBFZ)

Associations:
- German Renewable Energy Federation (BEE)
- German Bioenergy Association (BBE)
- Association for CHP Germany

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1 Amendment of the Renewable-Energy-Sources-Act (EEG) in 2011: www.erneuerbare-energien.de
3.2.4. Feedstock

In Germany, 2,300 m² of farm land (including grassland), and 1,460 m² of arable farm land (without grassland) per capita are available. 107,000 km² of forest area contain a wood reservoir of more than 3.5 billion m³ and a yearly growth of 120 million m³ of new biomass. There is great potential for wooden biomass in Germany. The usage of wood per year in Germany amounts to approximately 120 m³ (including material use of wood in saw mills). In addition, about 40 million private households, a strong biomass processing industry, energy crops cultivation and bio-wastes offer a considerable potential for biomass based CHP energy production in Germany.

In Germany 56% of the forest area is owned by public bodies, whilst 44% is in private hands. More than 50 million m³ wood is used annually for electricity and heating purposes. Out of all renewables used for electricity, bioenergy contributes more than 16.3 billion kWh (solid biomass and biologic part of waste), which corresponds to nearly 3% of the entire German electricity supply. In 2011, more than 265 CHP plants were installed. The installed capacity increased up to 1.210 MWel (beginning of 2010).

Regions with the highest number of farm land (grassland and arable land) and forests in total terms are Bavaria (m3.5 ha), Lower Saxony (m2.9 ha), North Rhine-Westphalia (m1.7 ha), Brandenburg (m1.5 ha) and Mecklenburg-Western Pomerania (m1.5 ha).

Germany has a large stock of wood at hand. From its 3.4 billion m³ of wood emerges a growth of about 120 million m³ every year, including bark. Only 50% is used for energetic purposes, whilst more than 80 million m³ wood is used for material purposes.

Although the demand for wood chips has increased in the last years, German forests are not close to overexploitation. Moreover, the supply with wood chips suffices for a stable supply of CHP-plants for a couple of years, even if the number of plants increases. Even so, raw material suppliers are already exploring alternatives, especially from Short Rotation Coppice (SRC) with cottonwood or willow. In 2011 the whole cultivated area for energy wood added up to 6000 hectares. The total potential for SRC is calculated to 500,000 ha (See Figure ‘Increase German Wood’).

For 2020 the German Biomass Research Center (DBFZ) prognosticates a supply gap for wood (See Figure ‘Supply Gap’) in the German economy. The biggest consumer groups of wood in 2020 will be the material use (nearly 50%), split log heating systems (etc. 10%), and CHP-plants with more than 12%. Other consumer groups are pellet heating systems, district heating systems, and fuels for transport (Please see the left

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2 Inventurstudie 2008: www.vti.bund.de
3 Data source: www.bmelv.de
4 German Wood Fuel and Pellet Association: www.depv.de
5 Ministry of Food, Agriculture and Consumer Protection (BMELV): www.bmelv.de
6 www.erneuerbare-energien.de
7 Federal Ministry for Food, Agriculture and Consumer Protection: www.bmelv.de
bar in Figure ‘Supply Gap’). To cover this demand there are different wood types which will be available in 2020: The biggest source will be forest wood (50%), saw mill residues (10%), used wood (less than 10%), landscaping residues, SRCs, and other minor important sources.

Useful links:

Facts and figures:
- Federal Agency for Renewable Resources (FNR)
- German Biomass Research Center (DBFZ)

3.2.5. Business Case

Although prices for fossil energy carriers in the heat, transportation and electricity market have risen steadily over the last decade, the break-even point of bioenergy has not yet been reached, because production costs of bioenergy have also been increasing due to rising feedstock prices. Even the energy production with wood chips increases slowly (See Figure ‘Price Development’). In the beginning of 2012, it cost 3 cent to produce one kilowatt-hour (kWh) of energy with wood chips. This is still half of the costs for one kilowatt-hour produced with natural gas or oil.

Also prices for fossil fuels, which are mainly being imported, took a jump in prices, especially since 2003. Compared with the reference year 1991 (index = 100) the price index for crude oil imports rose to 376 points in 2008, resulting in a 276% growth for this period. Between January 2009 and April 2010 prices advanced strongly by 90%. The price development for coal is comparable with an increase from 100 points in 1991 to 248 points in 2008, although this development was marked with fewer fluctuations. The main driver for the price increase is the rise in coal demand in the BRIC countries and the US. The higher fuel procurement costs are also
reflected in increased electricity prices for households, which rose from €40.67 per month for a reference household (3.500 kWh/a) in 2000 to €67.7 per month in 2009. The highest share of the increase in electricity prices goes to the generation, transportation and sales with 61%, while increased costs of RES via EEG, allocated to all electricity consumers, have a share of 11%.\(^8\)

The average price for wood chips in Germany in 2012 lies between €130 – 140 for one ton. The prices diverge between southern and northern Germany (See Figure ‘Average Price’).

Investments into CHP-plants fired with solid biomass are supported with public budgets. The most important support scheme is the EEG, which supports the installation of CHP-plants fired with solid biomass. The fixed, long-term, guaranteed feed-in tariffs for power produced using renewable energies that were legally established in the EEG have provided for enormous growth in the German market for decentralized electricity generation from solid biomass (see Figure ‘Development CHP’).

In June 2011 an amended version of the EEG was published by the German Government. In terms of achieving expansion targets for renewable energies in the electricity sector, the EEG is the most effective funding instrument at the German government’s disposal. International observers see it as exemplary.

The new EEG maintains the basic structure. However, in detail far reaching improvements with the purpose of further increasing the share of renewable energies in electricity generation by 2020 have been introduced according to the cabinet decision (2010) concerning the energy transition. According to this Act, operators of renewable energy systems are statutorily entitled against the grid operator to payments for electricity exported to the grid. The EEG has also introduced the so-called market premium and the flexibility premium for system operators who directly sell their electricity from RS. In general, all technologies used to generate electricity from RS are eligible for feed-in tariffs (§ 16 par. 1 EEG). Eligibility also applies to electricity that was temporarily stored prior to being exported to the grid.

Eligible under the following conditions concerning CHP plants with solid biomass (§ 27 EEG):

- Definition of biomass. The substances regarded as biomass are specified in a
separate ordinance (BiomasseV).\(^9\)

- Obligation to employ CHP technology. Electricity is eligible for the full tariff as specified in the EEG only if a certain percentage of the electricity (usually 60%) was generated from CHP. Where a generator fails to meet this requirement, his tariff level will be reduced to the market price.

- Obligation to keep a record of substances. Electricity will be eligible for the full tariff as specified in the EEG only if the system operator can prove which type of biomass is being used by presenting a copy of a record of the substances used. He furthermore has to provide evidence that no other substances are being used. Where a generator fails to meet this requirement, his tariff level will be reduced to the market price.

- Liquid biomass is ineligible for the tariff. In general, electricity is ineligible for the feed-in tariff if generated by new plants using liquid biomass. If generated by new plants, this type of electricity is eligible only, if the biomass is required as start-up, priming and supporting fuel (e.g. in dual-fuel CHP units).

The current version of the EEG sets out the tariffs for 2012. The BMU has published an overview of the tariff levels and degression rates (The degression rate is 2% for solid biomass) as set out in the EEG. The overview in Figure 'Tariff

\(^9\) www.erneuerbare-energien.de
Level’ shows an example on how these tariffs are calculated for a plant fired with solid biomass (just wood chips from SRC in raw material promotion tariff 1):

The promotion demand for the exemplary plant is 17.25 €ct/kWh. Basically the feed-in tariff for CHP-plants fired with solid biomass counts the nominal power output (Leistungsanteil). For this output the operator gets a basic support of 6 – 14.3 €ct/kWh (according to the system size). Additionally a bonus is paid for the use of special substances:

- €ct 6 – 14.3 per kWh (according to system size) plus (if applicable)
- bonus of €ct 2.5 – 8 per kWh for use of special substances (§ 27 par. 1, 2 EEG in conjunction with BiomasseV)

The tariff payment period is usually 20 years plus the year in which the system or plant was put into operation (§ 21 EEG). The payment of the basic feed-in tariff related to the nominal power output is combined with an annual depression of this feed-in-tariff of 2%. The costs of the feed-in tariff scheme are borne by the final consumers.

**Useful links:**

Facts and figures:

- FNR, Federal Agency for Renewable Resources, [www.fnr.de](http://www.fnr.de) / [www.biologie.de](http://www.biologie.de)
- Federal Ministry of Economics and Technology

![Figure ‘Development CHP’: Development of CHP-plants in Germany linked to the development of the EEG](image-url)
Market Handbook CHP

Worldwide, the use of solid biomass is of key importance with regards to energy supply. Solid biomass is still by far the most utilized form of renewable energy in Germany. At the end of 2010, an estimated number of 264 CHP plants with electrical outputs from 0.12 MWel to 100 MWel were producing power and heat in Germany. Total installed capacity amounted to approximately 1,250 MWel (see Figure ‘Installed CHP plants’). Plants fed an estimated 8,400 GWh of electricity into the public grid in 2010, remunerated as specified in the EEG. The trend favours medium sized plants.

The spatial distribution of solid biomass CHP-plants in Germany is strongly linked to locations with high population and construction centers (used wood), but also to the forest areas in the South and East of Germany (wood residues of forestry and wood processing industry). As it is obvious in Figure ‘Distribution’ and Figure ‘Raw Materials’ used wood dominates solid biomass power generation.

<table>
<thead>
<tr>
<th>Leistungsanteil</th>
<th>Vergütete Arbeit* [kWh]</th>
<th>Grundvergütung</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>absolut [E]</td>
<td>anteilig [ct/kWh]</td>
</tr>
<tr>
<td>bis 150 kW</td>
<td>14,3</td>
<td>1,317,600</td>
</tr>
<tr>
<td>von 150 kW bis 500 kW</td>
<td>12.3</td>
<td>3,074,400</td>
</tr>
<tr>
<td>von 500 kW bis 750 kW</td>
<td>11.0</td>
<td>2,196,000</td>
</tr>
<tr>
<td>500 kW bis 2.5 MW</td>
<td>11.0</td>
<td>2,196,000</td>
</tr>
<tr>
<td>Summe</td>
<td>8,784,000</td>
<td>1,049,688</td>
</tr>
</tbody>
</table>

*2012 ist ein Schaltjahr mit 8784 Stunden

Figure ‘Tariff Level’: Tariff level as set out in the EEG for a plant fired just with solid biomass (wood from short rotation copices with an installed capacity of 1200 kW and 7230 hours of plant operation in one year.

<table>
<thead>
<tr>
<th>Anteil</th>
<th>vergütete Arbeit [kWh]</th>
<th>absolut [€]</th>
<th>anteilig [ct/kWh]</th>
</tr>
</thead>
<tbody>
<tr>
<td>bis 500 kW</td>
<td>6.0</td>
<td>4,392,000</td>
<td>263,520</td>
</tr>
<tr>
<td>bis 750 kW</td>
<td>5.0</td>
<td>2,196,000</td>
<td>109,800</td>
</tr>
<tr>
<td>bis 5.000 kW</td>
<td>4.0</td>
<td>2,196,000</td>
<td>87,840</td>
</tr>
<tr>
<td>Summe</td>
<td>8,784,000</td>
<td>461,160</td>
<td>5.25</td>
</tr>
</tbody>
</table>

Source: www.bmu.de
In Germany there is a broad consensus in society advocating the end of the usage of nuclear power by 2022. There will be an accelerated development of RES and also a significant increase in energy efficiency in the German market. The major part of the RES power plants will be wind and solar, which are depending on weather and daytime. Hence, base-load is not longer needed, but flexibility of conventional as well as non intermittent RES power plants will get more and more important. To produce energy on demand will be a paradigm change for bioenergy: quality instead of quantity. Technical challenges for solid biomass CHP-plants hereby are:

- Plant lay-out
- Raw material supply
- Storage technologies

The main organizational challenge will be the transformation of the energy (power) market. Consequently new instruments for ‘market and system integration’ have been in the focus of the EEG revision.

Bioenergy represents one third of the RES power generation in Germany. Solid biomass represents one third of the bioenergy power generation in Germany. Market growth of solid biomass slowed down significantly and fell short of biogas due to political conditions and fuel shortages for bigger plants. Even if combustion technologies with steam turbines are still dominating the power generation, ORC turbines became more important in the last five years (see Figure ‘CHP technologies’). Gasifiers are still under development.

Whilst the relative share of bioenergy in

![Image: Installed CHP plants: Number of installed CHP-plants in Germany fired with solid biomass in different size groups]

Source:
Figure ‘Distribution’: Spatial distribution of biomass CHP-Plants in Germany with different raw material supply

Figure ‘Raw Materials’: Raw material use in solid Biomass plants in Germany in 2010

Source: www.dbfz.de
the overall energy supply will decrease, its importance will rise since it will be crucial to balance the fluctuating production of wind and solar.

Useful links:
- DBFZ, German Biomass Research Center: www.dbfz.de

3.2.7. Regulation

The financial support of the feed-in law for solid biomass used in CHP is complemented with regulations for emissions. For the electricity grid, rules are defined within the feed-in law itself. In these regulations, grid operators are obliged to feed RES-electricity into their grid, to extend their grid if required, and to transmit RES electricity with priority through the grid.

In their monitoring report of the EEG, the DBFZ advises the German government to guarantee the sustainability of wooden raw materials, since sooner or later the need to proof the sustainability of solid biomass in Germany will emerge. Until now there is no sustainability certification.
for wood chips. As soon as the EU will regulate this topic by publishing a new directive for the sustainability of solid biomass there will also be an ordinance within the German legislation.

The approval of solid biomass plants by authorities is not seen as a barrier; but of course approval periods can vary from authority to authority, depending on their workload, skilled personnel or local conditions. For approval, several emission thresholds have to be fulfilled, such as emissions into the air, odor emissions, and noise.

Requirements to reduce emissions into the air depend on whether the solid biomass plant needs an approval according to the 4th Ordinance for the Implementation of the Federal Immission Control Act (4th BImSchV) or not. If this is the case, the solid biomass plant has to actively undertake measures to guarantee that the emissions into the air do not exceed given thresholds, which are CO 1 g/m³, NOx 0.5 g/m³, dust 0.2 g/m³, SO2 0.3 g/m³ and 0.6 g/m³ for Formaldehyde. The 4th BImSchV is just valid for plants bigger than 1 megawatt. Plants with a nominal power output below 1 megawatt are considered under the 1st BImSchV. CHP-plants, which are fired with used wood (category III or IV), additionally have to follow the 17th BImSchV of the Federal Ministry for Environment, Nature Protection and Nuclear Safety, because this ordinance regulates the utilization of contaminated used wood (with varnish, stain, etc.). If no approval according to 4th BImSchV or 1st BImSchV is required, rules of the Technical Instructions on Air Quality Control (TA Luft) apply, stating that total immissions to housings must not exceed given thresholds. Hence, a solid biomass plant does not need to reduce emissions, if the total impact for surrounding households does not exceed the thresholds.

Concerning noise emissions there are binding thresholds defined within the BImSchG. For biogas plants, which do not require an approval according to the 4th BImSchV, the same thresholds can be applied by authorities. Thresholds vary in relation to land category (see Table ‘Noise Emission Thresholds’).

The industrial emissions directive IED (2010/75/EU) will replace various other guidelines in Germany concerning the rules regarding waste burning (2000/75/EG) or the guideline with regards to large combustion plants (2001/80/EG). The IED pursues the target to reduce environmental pollution caused by industry plants. In this new directive, which should be implemented in national law until the beginning of 2013, different regulations concerning emission reduction for large scale plants (>50 MW with used wood) will be integrated. The branch expects a huge influence of IED on the planning and building of solid biomass CHP-plants.

Useful links:

Facts and figures:

- Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

10 www.bmu.de
Projects offer a participation in sustainable energy supply with renewable energies. Investments into CHP-plants fired with solid biomass are supported by public budgets. The most important support scheme is the EEG, which supports the installation of CHP-plants fired with solid biomass. In addition, the Federal Agency for Renewable Resources (FNR) supports R&D-activities.

The market perspectives, political framework conditions and economic parameters are usually well-known to decision makers. A special focus when deciding about credits and loans is put on the reliable, sustainable and long-term feedstock supply as well as a sound concept for the sales of the product.

With more than 250 plants the German market of solid biomass plants is not yet saturated. In general, public subsidies can be claimed in addition to EEG-support at KfW-Bank in terms of low interest loans for credits with a long payback period. Several private equity funds are doing business in the German bioenergy market, too, looking for attractive investment opportunities.

**Facts and figures:**

- **Standard & Poor’s**

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### Table ‘Noise Emission Thresholds’: Noise emission thresholds in different areas

<table>
<thead>
<tr>
<th>Area</th>
<th>Industrial</th>
<th>Commercial</th>
<th>Mixed</th>
<th>General residential</th>
<th>Pure residential</th>
<th>Around hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>70 dB(A)</td>
<td>65 dB(A)</td>
<td>60 dB(A)</td>
<td>55 dB(A)</td>
<td>50 dB(A)</td>
<td>45 dB(A)</td>
</tr>
<tr>
<td>Night</td>
<td>70 dB(A)</td>
<td>55 dB(A)</td>
<td>45 dB(A)</td>
<td>40 dB(A)</td>
<td>35 dB(A)</td>
<td>35 dB(A)</td>
</tr>
</tbody>
</table>

Source: Presentation Doris Einfeldt

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**3.2.8. Project Financing**

Germany is seen to be a ‘save’ country for foreign investments. Its ratings of well-known organizations like Standard and Poor’s show best notes with triple A in 2011. Also COFACE index attests German markets a low country risk concerning payment failures; the same is true for the market transparency which is seen to be very good as measured by the Corruption Perception Index. However, easiness of starting a business in Germany is assessed by IFC World as merely moderate due to the sophisticated regulatory environment.

Banks are familiar with financing bioenergy projects with view on solid biomass plants and biomass projects. Different investment fonds for biomass projects offer a participation in sustainable energy supply with renewable energies.

Investments into CHP-plants fired with solid biomass are supported by public budgets. The most important support scheme is the EEG, which supports the installation of CHP-plants fired with solid biomass. In addition, the Federal Agency for Renewable Resources (FNR) supports R&D-activities.

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**Facts and figures:**

- **Standard & Poor’s**
in the best suitable way, while being able to speak with one voice when it comes to overall policies. The BBE is part of the Federal Renewable Energy Association (BEE) who represents the interests of all renewable energy associations in Germany.

The accelerated development of RES in Germany is, with more than 95%, accepted by a huge majority. Even when the direct neighborhood is concerned 60-70% remain in favour of RES. Renewable energies in general are warmly welcomed in German society. Especially wood chips are beheld in a very positive way. Technical concerns, like dust emissions have been mitigated. The biggest concern remains to be the raw material supply for the production of wood chips in large-scale plants. Basically there is enough raw material available, but there are also other stakeholders (like material utilization of used wood, residential wood, etc.) who want access to established wood potentials. Therefore, there is a competitive pressure on raw material and on prices.

A big challenge for the acceptance of solid biomass plants would arise, if there was more co-firing with industrial pellets in coal-fired CHP-plants, like it is already done in England or Denmark. In this case the concern, assuming that there is a sufficient amount of raw materials for the wood chip production available, also the good name of solid biomass plants in Germany would be impaired.

In addition to concerns with regards to difficulties of supply, consumers
have been getting anxious about the sustainability and environmental benefits of biomass due to manifold and aggressive, partly dubious campaigns of environmental and clerical NGOs.

**Useful links:**

**Associations:**
- German Bioenergy Association (BBE).
- German Farmers Union (DBV)
- German Renewable Energy Federation (BEE)
- Bundesverband Kraft-Wärme-Koppelung

**Institutions:**
- Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)
- Federal Ministry of Food, Agriculture and Consumer Protection (BMELV)
3.3. Italy

Associazione Italiana Energie Agroforestali (AIEL)
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I-35020 Legarno
Tel.: +49-88 30 772
Email: paniz.aiel@cia.it

3.3.1 Country Score

Country Score Central Italy - CHP (November 2011)

In the general scoring for sector, Italy - Central is rated place 6 out of total 81. The underlying categories that influence this result are displayed in the bar chart above.

3.3.2 Basic data

Italy, officially the Italian Republic, is a unitary parliamentary republic in south-central Europe. In the north, Italy borders with France, Switzerland, Austria, and Slovenia along the Alps. Southern Italy is made up of the Italian Peninsula, Sicily, Sardinia – the two largest islands in the Mediterranean Sea – and many other smaller islands. Italy is spread over some 301,338 km² and is characterized by a temperate seasonal climate. With 60.6 million inhabitants, Italy is the fifth most populous country in Europe, and the 23rd most populous country in the world. The population density, which amounts to 201 people/km² (520/sq. mile), is higher than that of most Western European countries. However, the distribution of the population is rather heterogeneous. Whereas areas, such as the metropolitan areas of Rome and Naples, or the Po Valley, which alone accounts for almost half of the national population, are densely populated, vast
regions, such as the Alps, the Apennine highlands, the plateaus of Basilicata, and the island of Sardinia are only very sparsely populated. Italy is divided into 20 regions, five of which are having a special autonomous status that enables them to enact legislation on various local matters. The country is furthermore subdivided into 110 provinces and 8,100 municipalities.

Due to the longitudinal extension of the Italian peninsula, and its largely mountainous internal conformation, Italy's climate is highly diverse. In the inland of the northern and central regions, climate classifications range from humid subtropical to humid continental, as well as oceanic along the coasts. The climate of the Po valley region is continental and, therefore, characterized by harsh winters and hot summers. The coastal areas of Liguria, Tuscany and most parts of southern Italy have a Mediterranean climate.

Italy has a relatively small number of global multinational corporations in comparison to other economies of comparable size; however, there is a large number of small and medium-sized enterprises, notoriously clustered in several industrial districts, which constitute the backbone of the Italian industry.

In 2009, Italy was the world’s 7th largest exporter. Italy’s closest trade ties are within the EU, where 59% of its total trade is conducted. Its largest EU trading partners, in the order of market share, are Germany (12.9%), France (11.4%), and Spain (7.4%).

Nowadays, the Italian economy suffers from numerous problems. After a strong GDP growth of 5–6% per year from the 1950s to the early 1970s, and a progressive slowdown in the 1980s and 1990s, the last decade’s average annual growth rates performed rather poorly at 1.23%, whereas the average annual growth of the EU was at 2.28%. The stagnation of economic growth, and the political efforts to revive it with massive government spending from the 1980s onwards, eventually produced a severe rise in public debt. According to the EU’s statistical office, Eurostat, Italian public debt rose to 116% of GDP in 2010, resulting in the second biggest debt ratio after Greece (with 126.8%).

However, a major difference between Greece and Italy constitutes the fact that the biggest share of Italian public debt is owned by national subjects. Furthermore, Italian living standards are marked by a considerable north-south divide. Whilst the average GDP per capita in the north exceeds the EU average by far, many southern regions lie significantly below this average. Italy has often been referred to as the sick man of Europe, characterised by economic stagnation, political instability and problems in pursuing reform programs.

More specifically, Italy suffers from structural weaknesses which are due to the geographical conformation, and the lack of raw materials and energy resources: in 2006, the country imported more than 86% of its total
energy consumption (99.7% of solid fuels, 92.5% of oil, 91.2% of natural gas, and 15% of electricity). The Italian economy is weakened by its high public deficit as well as its lack of infrastructural development, market reforms, and investment into research. On the Index of Economic Freedom of 2008, the country ranked 64th in the world and 29th in Europe - the lowest rating in the Eurozone.

Italy suffers from an inefficient state bureaucracy, low property rights protection, high levels of corruption, heavy taxation and public spending that accounts for about half of the national GDP. The most recent data show that Italy’s spending in R&D in 2006 was equal to 1.14% of GDP which is significantly lower than the EU average of 1.84%.

Regarding the national road network, there were 668,721 km (415,524 mi) of serviceable roads in Italy in 2002, including 6,487 km (4,031 mi) of motorways which are state-owned but privately operated by Atlantia. In 2005, about 34,667,000 passenger cars (590 cars per 1,000 people) and 4,015,000 goods vehicles circulated on the national road network.

In 2003, the national railway network, which is state-owned and operated by Ferrovie dello Stato, extended to 16,287 km (10,120 mi) of which 69% are electrified. 4,937 locomotives and railcars are circulating on this network. In 2002, the national inland waterways network comprised 1,477 km (918 mi) of navigable rivers and channels.

### 3.3.3. Energy Policy

The biomass sector plays a strategic role in Italian policy for RES: according to the National Energy Action Plan (NEAP), approved in June 2010 following EU Directive 28/2009, biomass is supposed to become the primary RES by 2020, covering 44% of renewable energy consumption (22.3 Mtoe) — 20% in electric power generation, 58% in thermal power generation and 84% in the production of biofuels (see Figure ‘NEAP’). The final energy consumption in 2009 was approximately 132.7 Mtoe and estimates predict 145.6 Mtoe by 2020.

By 2020, 39% of total energy consumption in Italy will be represented by electricity (Figure ‘Energy Consumption’). Also by the year 2020, biomass will have reached a record of 54% of the total thermal energy produced among RS (10.5 Mtoe). However, there are no specific incentives or subsidies in favour of thermal energy production in place at the moment. Structural policies are urgently needed.

The Italian nREAP sets some targets for the use of solid biomass in order to meet the binding targets set for 2020, and the provisional contribution to the indicative trajectory for the shares of energy from RS. In 2009, the production of electricity generated from RS was estimated at 5.3 Mtoe, of which 0.38 Mtoe were derived from solid biomass. The target set by NEAP for 2020 is 0.68 Mtoe (Table ‘RES Production’, Figure ‘NEAP Target’).
Figure ‘Energy Consumption’: Distribution of the three categories of renewable energy consumption in 2020

Table ‘RES production’: Gross RES electricity production in 2009 and forecasts for 2020

Data processed by AIEL on NEAP source

Figure ‘NEAP’: National Energy Action Plan (NEAP): The contribution of energy generated from solid biomass to total energy consumption
3.3.4. Feedstock

The use of solid biomass, mainly represented by wood, has been assigned a primary role as a RES. According to the estimate reported in the National Forests and Carbon Inventory\(^1\), the Italian forest area amounts to 8.8 million hectares (Mha), with a potential availability of 874 Mt (dry basis) corresponding to 1,270 million m\(^3\)/year. The wood stock is 145 m\(^3\)/ha, and the current annual increment is 36 million m\(^3\), corresponding to an average current increment of 4.1 m\(^3\)/ha. The arable land under SRC is about 5.000 ha (2008) and it is mainly made up by poplar plantations with cutting cycles of two years. The annual chips production of SRC is around 50.000 tons of dry matter per year.

The Figure 'Italian Forests' shows the composition of forest area: 95% of forestland is located in hilly-mountainous areas; 60% of forests are in private hands whilst the rest is owned by local municipalities and communities (public bodies).

The area felled in 2007 amounted to approximately 5.5 million m\(^3\), of which

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\(^1\) www.infc.it
3.6 million m$^3$ were logwood for domestic heating purposes$^2$, and two million m$^3$ were destined for the wood processing industries. The internal wood chips production is not recorded by the national statistics office yet; nevertheless, based on the plants’ consumption and the amount of chips imported, the production can be estimated to account for 1.2 million fresh tons per year.

In conclusion it is important to note that, for various reasons, forest statistics are underestimated and characterized by a certain level of uncertainty.$^3$

### 3.3.5. Business Case

Since August 2009, there is an ‘all inclusive feed-in-tariff’ in place which amounts to €280/MWh for a period over 15 years. This feed-in-tariff is applicable for the electricity produced by CHP plants whose capacities are less than 1 MWe.

The feed-in tariff has triggered a great interest in CHP technologies, in particular in those based on the ORC cycle. Recently there has also been a growing interest in gasification processes, even though this technology has still to be tested for a lasting praxis performance.

CHP plants in Italy are mainly fuelled with wood chips. The Table ‘Costs of Wood Chips’ shows a comparison between costs of wood chips from different origins and sources (January 2012).

The all-inclusive feed-in tariff is a new national support scheme for upgraded/repowered, totally or partially renovated, reactivated or new plants that meet the following requirements:

- use of RES (excluding solar)
- nominal real power does not exceed 1 MW

Since 2003, GSE.it has been the national authority managing this feed-in-tariff, whilst GME (GSE.it’s parent company) has been in charge of operating the Green Certificates Market where Green Certificates (GC) are traded.

In the Figure ‘National Framework’, the main instruments used to promote

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2 ISTAT 2007  
3 Pettenella, 2009  

<table>
<thead>
<tr>
<th>Table ‘Costs Wood Chips’: Costs of wood chips (VAT excluded)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moisture content (%)</strong></td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>Whole trees without roots, stem wood, sawmills logging residues</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Whole trees with branches, treetops, fresh wood and other virgin wood</td>
</tr>
<tr>
<td>Sawmills logging residues</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
electricity generation from solid biomass are summarized.

In 2005 Energy Efficiency Credits (EEC), also known as the White Certificate Scheme, were introduced containing special qualifications for biomass district heating and CHP. EECs constitute a market mechanism aiming to promote energy-savings within the industrial and residential sector. EECs certify the reduction of primary energy consumption achieved either by improvement of energy efficiency and/or the substitution of fossil fuels with RES. In this context, 1 EEC corresponds to 1 toe of energy saved.

The criteria that qualify generating units as high-efficiency CHP are set out in the Ministerial Decree, which became effective on the 1st of January 2011. This decree completed the implementation of Directive 2004/8/EC into Italian legislation, starting with the Legislative Decree no. 20 of 2007.

Generating units qualified as high-efficiency CHP gain access to the EEC (or white certificates) scheme, under the terms, conditions, and procedures that are specified in the Ministerial Decree of the 5th September 2011.

GSE carries out the following activities:
- qualifying high-efficiency CHP plants
- determining the number of EECs to be issued to high-efficiency CHP units whose owners have applied for this form of support
- buying back EECs - in response to a request made by a producer - at a price equal to the one applicable on the date of commissioning of the unit (or on the date of entry into force of the Ministerial Decree of 5 September 2011 in the case

Figure 'National Framework':
Current national framework to promote electricity production from solid biomass
of units already in operation);
• carrying out activities of verification and monitoring of the supported plants and notifying the Ministry of Economic Development and the producer of their outcome;
• issuing the Guarantee of Origin of electricity from high-efficiency co-generation (CHP-GO) in compliance with Legislative Decree no. 20 of 2007.

In 2011, the medium value of EECs was around €105-106/toe saved (Figure ‘EEC price trend’). Around 56% of EECs emitted over the last years are related to electricity generation purposes in the civil/private sector (Figure ‘EEC Sectors’).

New requirements regarding the application of EEC were introduced in October 2011 in the Deliberation of Authority for Electricity Energy and Gas (EEN 9/11).

The general principles of these new support measures, which will take effect in 2013, are defined in Art. 29 of D.Lgs 28/2011; however, the decree law has not yet been proclaimed.

### 3.3.6. Market Environment

A rough estimate of the total energy generated from solid-biomas in 2010 reached about 6.7 Mtoe, of which 0.3 Mtoe were consumed in CHP plants (Table ‘Consumption Estimates’ and Figure Consumption Wood Fuel Types’).

Unfortunately, no statistics on electricity and heat produced in CHPs that use wood fuels exist in Italy yet. In any case, according to a survey carried out by ITABIA, around 61 plants comprising power plants and CHPs are in operation. Together they produce a total energy consumption.
output of 436 MW. 32 plants are CHP plants. Across Italy, 18 CHP plants based on ORC are in operation with a total installed capacity of 13.5 MWe producing about 100 GWh per year. In Figure ‘Power Output’, the geographical distribution of CHP plants and power plants is displayed.
3.3.7. Regulation

The CHP emission thresholds are defined in D. Lgs n. 152/06 Allegato 1 parte III, as reported in Table ‘Emission Threshold’.

Specific emission threshold can additionally be imposed at the regional level, i.e. in Piemonte and the Lombardia Regions.

The approval process can be subdivided into two cases:

- Conferenza dei servizi (Unified procedures): all the competent authorities are involved in the same meetings (region or province, municipality, health authority, fire brigades, etc.)
- Declaration of activity start (DIA) to be presented to the municipality in addition to all the single authorizations required.

In the first case, specific emission thresholds could be imposed on a single plant by the competent authorities depending on the geographic location.

Table ‘Emission Thresholds’: CHP emission thresholds

<table>
<thead>
<tr>
<th>Thermal power output</th>
<th>35-150 kW</th>
<th>150 kW-3 MW</th>
<th>3-6 MW</th>
<th>6-20 MW</th>
<th>&gt;20 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust</td>
<td>20</td>
<td>100</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Total Organic Carbon (COT)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>20 / 10⁵⁵</td>
</tr>
<tr>
<td>CO</td>
<td>-</td>
<td>350</td>
<td>300</td>
<td>250 / 150⁵</td>
<td>200 / 10⁵⁵</td>
</tr>
<tr>
<td>NO₂</td>
<td>-</td>
<td>500</td>
<td>500</td>
<td>400 / 300⁵</td>
<td>400 / 200⁵</td>
</tr>
<tr>
<td>SO₂</td>
<td>-</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>
where the plant will be located.

3.3.8. Project Financing

Banks are familiar with financing bioenergy projects with regards to biogas and biomass projects. The market perspectives, political framework conditions, and economic parameters are usually well-known to decision makers. A particular focus is put on the evaluation of the long-term reliability and sustainability of the availability of feedstock supplies as well as on a good sales plan to market the product during the process of granting loans and credits. Investments in the Italian market are considered to be 'quite safe' from a country risk perspective. According to COFACE country risk rating\(^4\), Italy positions itself in the centre span. However, the Corruption Perception Index\(^5\) for the level of transparency is not encouraging.

3.3.9. Readiness for Uptake

Generally, CHP plants are widely accepted by the public. The most common problems are related to the origin, supply, and sustainability of biomass and its production. Another issue is that of particle emissions, that sometimes affects district heating systems with wood biomass. Since combustion particles are a health concern and PM10 emission threshold values are regularly exceeded, especially in winter, public concern with regards to district heating cannot be eliminated. 71% of all plants that are opposed by the public or residents nearby are renewable energy plants. Figure ‘Publicly Opposed’ indicates the location of these plants (marked with the colour red) in Italy (all

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\(^4\) COFACE: http://www.coface.com/CofacePortal/COM_en_EN/pages/home/risks_home/country_risks/country_file/Italy?extraUid=572148

renewable energy sources for heat and electricity production are included).

**Usefull Links:**

**Facts and Figures:**
- [nREAP](#)
- EEG – Autorità per l'energia elettrica e il gas
- GSE – Gestore servizi energetici:
- Inventario Forestale delle Foreste e del Carbonio (National Forests and Carbon Inventory)
- Istituto Nazionale di Statistica (ISTAT)
- APAT Lombardia
- REF Ricerche SRL
- CECED Italia
- Agriforenergy/Technical Review
- Titoli di Efficienza Energetica/Gestore Mercato Elettrico
- Titoli di Efficienza Energetica/Pubblicazione a Cura di Enea

**Associations / Institutions:**
- Associazione Italiana Energie Agroforestali (AIEL)
- ITABIA
- Ente Nazionale per l’Energia e l’Ambiente (ENEA)
- FIRE Italia
- FIPER Italia
3.4. Hungary

Hungarian Bioenergy Competence Centre (HBCC)
Imre Németh
4 Tessedik Road
HU - 2100 Gödöllo
Tel.: +36 28 420 291
Email: obekk@invitel.hu

3.4.1. Country Score

Country Score Hungary Central Transdanubia- CHP (November 2011)

In the general scoring for sector, Hungary - Central Transdanubia is rated place 44 out of total 81. The underlying categories that influence this result are displayed in the bar chart above.

3.4.2. Basic Data

Hungary is a relatively small country with a territory of 93,303 km². It is located in Europe's continental zone with moderate climate. The annual mean temperature as an average of the past years is 11.2 °C, the mean temperature in January is -1.7 °C, and in July it is +22.5 °C. The annual absolute minimum is -16.7 °C, and the absolute maximum is +35.9 °C. 59.5% of the country’s territory is used for agricultural purposes and 20.5% is covered by forests. The total cultivation area (agricultural + forest + reed + fish pond) adds up to 81.2% of the country’s territory. The population is 9,986 thousand.

69.6% of the population lives in towns, including 17.4% living in the capital Budapest, and 30.4% live in rural settlements. The number of settlements is 3,154, from this 2826 (89.6%) are
rural (village) settlements, 304 (9.6%) are rural towns; the number of cities with county rights is 23 (0.73%). The number of dwellings in Hungary is 4,348,955. From this 19.8% are located in the capital, Budapest, 50.4% in rural towns, and 29.8% in villages.

**Useful links:**
- Hungarian Central Statistical Office
- Ministry of National Development
- Hungarian Energy Office
- Energy Centre Non-profit Ltd.

### 3.4.3. Energy Policy

It caused considerable tensions that combined energy producing gas turbine power plants with capacities less than 50 MW, which are basically aiming at district heating supply were able to sell their electric power for a more favourable official price (equal to green power), resulting in actual economic benefit for them. The 700 MW energy produced by these power plants make up 35% of the total energy supply of the country. Due to the fact that the electric power was sold at a higher price, these power plants could enter the heating market with more favourable district heating prices. These gas turbine driven power plants for district heating purposes have quickly become popular among investors, as the market for district heating was already developed, and based on the favourable remuneration, they could account for a relatively short return. The regulations for operation and remuneration of gas turbine power plants have become more restricted. They have to reach an annual average efficiency of 75%, and a strict schedule is to be fulfilled concerning the purchasing of gas and the sales of electricity. Specialists and environmentalist have been arguing from the start about the rightfulness of feed-in-tariff electricity produced in these power plants from natural gas on ‘green power price’ because gas turbine power plants of less than 50 MW capacities have used the major part of the budget available for supporting green electricity. This sort of discrimination also harmed the market interests of combined energy producing units with capacities over 50 MW, as they could sell their electricity only at a lower price. Furthermore, they had to increase the price of district heating. Tension was relieved by the government in the middle of 2011 by terminating the higher take-over price of electricity produced by combined gas turbine power plants below 50 MW. In the future the support of district heating will be prioritized.

The previous mandatory reception and price system (KÁT) of ‘green power’ is currently being reviewed by the government, and according to expectations the new system, called METÁR, will be introduced by the 1st of January 2013. METÁR intends to set out a take-over price differentiated by technologies and by size categories in alternative and renewable energy production. The motivation for CHP production will receive greater emphasis together with heat utilization. It is expected to set out stricter sustainability
criteria for biomass-based energy production, and it will also include criteria with regards to the regional production of energy.

Along with this energy policy concept it is expected that the capacity of CHP will increase again. Furthermore, these processes may also be influenced by the complete liberalization of the electricity and natural gas market, which will reform price conditions to a large extent. According to the objectives of the ‘National Action Plan 2020’ the ratio of RES in electricity production will increase by 6.7% from 2011 to 2020 – mainly in the biomass plants capable of combined energy production, and even new power plant blocks as well small power plants would be built.

The vast majority of energy policies that have been implemented take district heating systems into account. Previously, 80% of the heat energy produced here was supplied to the district heating networks. On the other hand, two-thirds of the district heat sold came from combined energy production. 20% of electricity was produced here. Unfortunately, the district heating service in heat supply of flats lately decreased from 19% to 14.9%. Therefore, the heating market of combined energy production also narrowed. This is due to the fact that in certain towns and districts the cost of district heating was higher than that of individual heating; hence, several flats and houses were disconnected from the district heating network. To stop this unfavourable process the present government focuses on motivating useful heat production when elaborating the new official electric power take-over price system. Instead of former unilateral electricity purchase supports they intend to implement combined heat and electric energy support through the METÁR system to become effective by 1st January 2013. The requirement to install combined energy production in newly planned, small and large power plant investments is of great importance – also with regards to GHG emission saving and efficiency increases.

Useful Links:
- Ministry of National Development
- Hungarian Energy Office
- Ministry of Rural Development
- J. Popp, N. Potori (editor) (2011): The production of biomass for energy purposes in Hungary, AKI (Research Institution of Agricultural Economics), Budapest

3.4.4. Feedstock

Nowadays, in Hungary the vast majority (81%) of power plants operate using natural gas. The ratio of coal and oil combustion is minimal, but oil combustion plants which are situated close to oil refineries also provide electricity and heat in cooperation with these combustion plants. Biomass is present as raw material in 6-7% of CHP plants. The number of biogas CHP plants is approximately 50. There is one power plant operating with communal waste and performing combined energy production in the country. There is also one biomass combined power plant with
major capacity in the country. In the future, great power plant developments can primarily be implemented based on natural gas. From the aspect of raw material availability, the present biogas production capacity in Hungary could be at least decupled, with approximately 400 plants and 300 MW installed electricity production capacity plus additional 450 MW combined heat production capacity. Also the number of small biomass power plants could be increased 3 to 4 times, mainly based on straw. Solid-fuel (Stirling-engine) or vegetable oil-powered (Elsbet-engine) CHPs, which are especially useful in homestead environments as the fuel can be produced on site are is becoming more common.

The Table ‘Biomass Potential’ displays the biomass potential and utilization opportunities for energetic purposes in Hungary.

The Table ‘Forestry Dendromass-Balance’ shows the Hungarian biomass potential and opportunities.

Useful links:
- Ministry of Rural Development
- Hungarian Academy of Sciences
- Association of Biomass plants
- Union of Biomass Product Line
- Hungarian Biomass Competence Center
- Hungarian Biomass Association

Table ‘Biomass Potential’: Hungarian biomass potential and utilization opportunities

<table>
<thead>
<tr>
<th>Line number</th>
<th>Biomass</th>
<th>Quantity 1000 Year</th>
<th>Energy content PJ/year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>I. Biomass for heating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Grain-straw</td>
<td>1.000</td>
<td>1.200</td>
</tr>
<tr>
<td>2.</td>
<td>Maize stalk</td>
<td>2.000</td>
<td>2.500</td>
</tr>
<tr>
<td>3.</td>
<td>Energy grass</td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td>4.</td>
<td>Grape cane, Fruit-tree trash/cuttings</td>
<td>300</td>
<td>350</td>
</tr>
<tr>
<td>5.</td>
<td>Energics tree plantation</td>
<td>3.800</td>
<td>2.500</td>
</tr>
<tr>
<td>II. Biofuel production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Maize</td>
<td>1.200</td>
<td>2.000</td>
</tr>
<tr>
<td>2.</td>
<td>Wheat/Rye</td>
<td>600</td>
<td>1.800</td>
</tr>
<tr>
<td>3.</td>
<td>Rape</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td>4.</td>
<td>Sunflower</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>III. Biogas production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Liquid manure, organic waste</td>
<td>6.000</td>
<td>10.000</td>
</tr>
<tr>
<td>2.</td>
<td>Maize silo, sweet sorghum</td>
<td>3.600</td>
<td>3.200</td>
</tr>
<tr>
<td>IV. Agriculture total:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>111.8</td>
<td>171.2</td>
</tr>
<tr>
<td>V. Forestry biomass</td>
<td></td>
<td>50.0</td>
<td>62.6</td>
</tr>
<tr>
<td>VI. Total</td>
<td></td>
<td>181.8</td>
<td>233.2</td>
</tr>
<tr>
<td>Total energy consumption 1120 PJ %-ban</td>
<td></td>
<td>14.4 %</td>
<td>20.9 %</td>
</tr>
</tbody>
</table>

Source: Hajdu (2009)
3.4.5. Business Case

In Hungary, the conditions of CHP production in large power plants and small power plants mainly depend on state preferences. This is true for maintaining and operating existing capacities, as well as for establishing new capacities. These are investments demanding capital. Large power plants can be constructed as outstanding state investments, and the state probably needs to take part also in reconstruction programmes. Small power plant cogenerations or trigenerations may in the future receive support not through selling electricity, but by heat production and realization. Biogas plants applying cogeneration established so far have almost without exception received state subsidy for the investment. In opposition to several European countries, biogas plants in Hungary are not supported through the take-over price of electricity,

Table ‘Forestry Dendromass-Balance’: Forestry dendromass-balance and energetic wood utilization in Hungary 2008

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting of wood</td>
<td></td>
</tr>
<tr>
<td>rest:</td>
<td></td>
</tr>
<tr>
<td>for felling</td>
<td>1.960,000 ha</td>
</tr>
<tr>
<td>ural increment of wood (biological)</td>
<td>1.180,000 ha</td>
</tr>
<tr>
<td>usual felling (gross)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 mill. m³ / 8 mill. ton/year</td>
</tr>
<tr>
<td></td>
<td>7.1 mill. m³ / 4.8 mill. ton/year</td>
</tr>
<tr>
<td>Wood utilization for energetic wood</td>
<td></td>
</tr>
<tr>
<td>- in detail:</td>
<td></td>
</tr>
<tr>
<td>fire wood</td>
<td></td>
</tr>
<tr>
<td>energy plant</td>
<td></td>
</tr>
<tr>
<td>heat plant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.6 mill m³ / 2.41 mill ton/year</td>
</tr>
<tr>
<td></td>
<td>1.9 mill m³ / 1.27 mill ton/year</td>
</tr>
<tr>
<td></td>
<td>1.6 mill m³ / 1.08 mill ton/year</td>
</tr>
<tr>
<td></td>
<td>100 thousand m³ / 67 thousand ton/ year</td>
</tr>
<tr>
<td>The largest users of wood energy plant</td>
<td></td>
</tr>
<tr>
<td>Péntek Zrt.</td>
<td>500 thousand m³ / 330 thousand ton/year</td>
</tr>
<tr>
<td>AES Borsodi Erőmű Kft.</td>
<td>300 thousand m³ / 200 thousand ton/year</td>
</tr>
<tr>
<td>Tiszapalkonyai Erőmű Kft.</td>
<td>270 thousand m³ / 180 thousand ton/year</td>
</tr>
<tr>
<td>lakonyi Bioenergia Kft.</td>
<td>240 thousand m³ / 160 thousand ton/year</td>
</tr>
<tr>
<td>dátka Erőmű Zrt.</td>
<td>180 thousand m³ / 120 thousand ton/year</td>
</tr>
<tr>
<td>lakonyi Erőmű Zrt.</td>
<td>82 thousand m³ / 55 thousand ton/year</td>
</tr>
<tr>
<td>vértesi Erőmű Zrt.</td>
<td>75 thousand m³ / 50 thousand ton/year</td>
</tr>
<tr>
<td>Albertson Green Kft.</td>
<td></td>
</tr>
<tr>
<td>hitting plant</td>
<td></td>
</tr>
<tr>
<td>zentendre (cogeneration)</td>
<td></td>
</tr>
<tr>
<td>kalassagyarmat (cogeneration)</td>
<td></td>
</tr>
<tr>
<td>izombathely (heat)</td>
<td></td>
</tr>
<tr>
<td>córmend (heat)</td>
<td></td>
</tr>
<tr>
<td>fáteszalika (heat)</td>
<td></td>
</tr>
<tr>
<td>zigetvár (heat)</td>
<td></td>
</tr>
<tr>
<td>nápdksző (heat)</td>
<td></td>
</tr>
<tr>
<td>30 thousand m³ / 20 ezer ton/year</td>
<td></td>
</tr>
<tr>
<td>18 thousand m³ / 12 ezer ton/year</td>
<td></td>
</tr>
<tr>
<td>12 thousand m³ / 8 ezer ton/year</td>
<td></td>
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<tr>
<td>9 thousand m³ / 6 ezer ton/year</td>
<td></td>
</tr>
<tr>
<td>9 thousand m³ / 6 ezer ton/year</td>
<td></td>
</tr>
<tr>
<td>3 thousand m³ / 2 ezer ton/year</td>
<td></td>
</tr>
<tr>
<td>1.5 thousand m³ / 1 ezer ton/year</td>
<td></td>
</tr>
</tbody>
</table>

Source: Hajdu (2009): Hungarian biomass potential and utilization opportunities
but through non-refundable subsidies gained in investment application, which may have a ratio between 40-50%. The desirable expansion of biogas plants in the future also requires state subsidy, which may even be bidirectional, first by directly supporting investments to a smaller degree than before, and second by increasing the take-over price of electricity related to the current price (11 eurocent/kWh). Several foreign investors are interested in possible investments in renewable energy production capacities in Hungary. But even though the reception is positive, due to low ‘green power’ take-over prices, the process is rather slow. This might be improved by the expectable increase in the take-over price of ‘green power’ among the near future measures of the government (METAR). In case of scattered rural settlements – homestead settlements – which are far away even from mains electric networks, besides solar energy, cogeneration equipment using locally produced fuel in island systems can be applied. These can also only be implemented by state subsidy. The concept of the government includes the improvement of the infrastructure in homestead settlements in order to improve the standard of living there. Energy supply is also an important part of this.

The Table ‘Comparison Energy Sources’ gives an overview of prices for different energy sources.

Useful links:
- Hungarian Development Bank
- Union of Biomass Product Line
- Hungarian Biomass Competence Center
- Green Investment System
- Association of Biomass plants

3.4.6. Market Environment

There is mains gas supply in 91.2% of the Hungarian settlements. The number of dwellings with mains gas supply is 3,396,000 (82.5%). The average monthly gas consumption of a dwelling is 89 m3/month. 33.9% of the total electric energy is consumed by households. The electric energy consumption per household is 181.1 kWh/month. The ratio of district heated dwellings is 14.9% related to the total number of dwellings. In Budapest this ratio is 26.6%, and in rural towns it is 18.6%, while in villages it is 0.22%. Two thirds of the district heat comes from combined energy production. The number of connected power plants participating in district heating is about 400. 70% of the district heated dwellings have a rather poor energy performance.

The operation and expansion of CHPs is mostly influenced by the limited heat market. Besides producing electricity, the main functions of large and small power plants are providing district heat, and heat for flats and plants connected to the district heating network. The ratio of district heating in the heating of flats has decreased during the past years. This was mainly caused by the fact that district heating had become expensive compared to individual heating systems.
Moreover, the inflexibility of heat utilization in a block of flats contributed to this change. Therefore, several owners and owner occupied blocks had themselves disconnected from district heating to switch to cheaper and more controllable individual heating. An additional point was the termination of gas compensation for combined energy producers selling district heat, while it partially remained on a social basis towards the population. In most of the biogas-fired cogenerations the utilization and realization of waste heat is a problem, especially during the summer period. Heat consumers which operate throughout the year have been constructed or connected only in a few plants. In case of CHP plants which are basically providing heat, it is typical that they operate on full capacity in heating periods, and during other periods they produce electricity and provide hot water only at reduced capacity. Those restricting factors may be changed by METÁR, which will replace KÁT, and which will include differentiated feed in tariffs, and will put an emphasis on heat utilization.

In Hungary the major part of CHP production is provided by public utility electric power plants and gas motor cogeneration heat centres. The share of electricity produced in CHP plants amounts to more than 20%. Furthermore, more than two-thirds of the district heat sold comes from combined energy production. The number of CHP plants exceeds 400 (including large power plants). The total electricity production capacity sums up to over 2000 MW, and the heat production capacity makes up approximately 3600 MW. 88% of all energy plants are capable of producing heat and power at the same time. Most of these are power plants operating with gas, gas turbine, or gas motors. CHP

### Table: ‘Comparison Energy Sources’: Comparison of energy sources in 2010

<table>
<thead>
<tr>
<th>Name</th>
<th>Average Unit Price [HUF/atroton, HUF/m³]</th>
<th>Specific Price [HUF/MJ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas*</td>
<td>100</td>
<td>2.94</td>
</tr>
<tr>
<td>Wood Pellets</td>
<td>50000</td>
<td>2.78</td>
</tr>
<tr>
<td>Wood Briquette</td>
<td>50700</td>
<td>2.26</td>
</tr>
<tr>
<td>Black Coal</td>
<td>47020</td>
<td>1.96</td>
</tr>
<tr>
<td>Lignite</td>
<td>31900</td>
<td>1.94</td>
</tr>
<tr>
<td>Sawed Dryed Firewood</td>
<td>20000</td>
<td>1.11</td>
</tr>
<tr>
<td>Wood Chips from Energy Plantations</td>
<td>17900-23200**</td>
<td>1.0-1.29</td>
</tr>
</tbody>
</table>

* consumer prices with VAT
** AKI (Research Institution of Agricultural Economics) based on BITESZ and Győri-Kert Agrárenergetikai Kft.

Source: J. Popp, N. Potori (editor) (2011)
based on biogas is applied in 50 plants, with a capacity of 38 MW for electricity, and 56 MW heat capacity. The electric capacity of biomass plants capable of producing combined energy is 23 MW, and the heat capacity is 36 MW.

Several efforts have been made in the past to establish mainly straw-fired combined biomass plants with an electric capacity of 15-20 MW. However, partially due to the resistance of the population, and partially due to the unfavourable financial conditions these plans failed. From the aspect of raw material supply it is theoretically possible to establish 3-4 straw-fired CHP plants with a total capacity for each heat and electricity of 15 MW. At the moment one larger biomass power plant (with 20 MW electric capacities) is in operation, mainly using wood chips, but the selling of heat has not been solved yet.

Communal power plants established for the purpose of waste combustion are a good example for CHP. One such power plant operates east of Budapest. It would be desirable to have such power plants near several large towns in Hungary. It is producing electricity and heat from the fireable part of selective waste. Household-size cogeneration (using Stirling-engine powered by vegetable oil, natural gas, or solid biomass) small equipment producing electricity and heat energy have not yet spread among the population, because of their high investment costs on the one hand, and due to lengthy and complicated licensing procedures on the other hand. These decentralised plants which would be implemented directly on the site of consumption would help to avoid transportation losses.

**Useful links:**
- Union of Biomass Product Line
- Hungarian Biomass Competence Center
- Hungarian Renewable Energy Association
- Energy Centre Non-profit Ltd.

**3.4.7. Regulations**

The establishment and operation cogeneration plants, the conversion of the electricity produced, the realization of heat, the air-cleanness, and environmental norms to be complied with are regulated by certain laws and regulations.

The government decrees No. 66/2006 (III 27), 13/2008 (I 30), and 96/2009 (IV 24), and the government decision No. 2156/2008 (XI 5) include the National Allocation List on the emission units of GHG for energy producers.

The NFM decrees No. 50/2011 (IX 30), and No. 66/2011 (XI 30) detail the supporting of heat produced related to combined energy production, and the fee of the heat produced by district heat producers.

The NFM decree No. 83/2011 (XII 29) includes the regulations related to electric energy and natural gas supply, and to energy statistics tasks related to district heat price.
The NFM decree No. 2/2012 (I 31) unifies the regulations – partially modifying them – related to energy production and supply service.

**Useful links:**
- [Ministry of National Development](#)
- [Hungarian Energy Office](#)
- [Energy Centre Non-profit Ltd.](#)

### 3.4.8. Project Financing

Large power plants for CHP generation have been built over the past years or are currently being built mainly using foreign capital supported by Hungarian state guarantees. Most of these power plants in Hungary are owned by foreign private investors (mainly German and American). The state has usually issued a profit guarantee. The vast majority of gas motor cogenerations and district heating centres were built from private capital. Guaranteed and high electricity take-over prices bound to 75% efficiency resulted in a fast return on investment. Besides mandatory take-over and on guaranteed price electricity was directly sold to the electricity provider, heat produced was purchased by the district heating providers. These were almost risk-free investments. However, in 2011 the feed-in tariff for CHP plants smaller than 50 kW working on natural gas was no longer granted, which led to a higher risk on investments, and a lower profitability of the plants. Gas motor cogenerations of biogas plants were usually built with the help of 40-50% non-refundable subsidies given as a part in biogas plant investment support, and with own funding and bank sources. Due to the low ‘green take-over prices’ (11 eurocent/kW) in Hungary, the return on investment would have been unrealistically long without those state subsidies. The biggest (20 MW) biomass plant was supported by the realization of the CO₂ quota. This approach could be relevant also for future investments as Hungary has considerable CO₂ reserves. The realization could support the implementation of CO₂-neutral energy producing projects. Based on this approach, projects were launched for the establishment of straw-combustion power plants with private capital lined up in the background.

**Useful links:**
- [Hungarian Development Bank](#)
- [Hungarian Economic Development Centre](#)

### 3.4.9. Readiness for Uptake

The social acceptance of CHP in general can be considered favourable. Furthermore, there are several organizations supporting the sector, including the Hungarian Energy Association or the Professional Alliance of Hungarian District Heat Providers, and also the Hungarian Biogas Association.

The implementation of coal-combustion plants had to face the strongest resistance of the population. But also some biomass-combustion (straw) plants experienced strong opposition from the population, which led to
the failure of the investments. This opposition was concerned with the capacity (50 MW) in case of the larger plants, or with the location selected (e.g. the historical wine region of Tokaj as part of the World Heritage) in other cases. From a professional point of view, these were quiet reasonable concerns since the optimal location for small power plants combustion is in corn producing regions where the input material is directly available and long transportation is redundant. Small gas motor power plants erected in district heat centres, however, were supported by the population, as they kept the district heat prices on a favourable level due to the higher electricity feed in tariff prices applied to them. Gas motor CHPs implemented within biogas plants did not face resistance of the population or social opposition. Concerning these projects, however, it has to be noted that their licensing procedure takes a long period of time. Often 30 different authority licences need to be obtained, and furthermore the goodwill of environmental civil organizations and the population have to be gained.

**Useful links:**

- [Union of Biomass Product Line](#)
- [Hungarian Biomass Competence Center](#)
- [Hungarian Renewable Energy Association](#)
3.5. Denmark

Danish Bioenergy Association
(DI Bioenergi)
Kristine van het Erve Grunnet
H.C. Andersens Boulevard
DK-1787 Copenhagen V
Tel.: +45 3377 3369
Email: keg@di.de

3.5.1. Country Score

Country Score Central Denmark - CHP (November 2011)

In the general scoring for sector, Denmark - Central is rated place 36 out of total 81. The underlying categories that influence this result are displayed in the bar chart above.

3.5.2. Basic Data

The Kingdom of Denmark (excluding Greenland and the Faroe Islands) has a mainland area of 43 098 km² and shares a small land border with Germany to the south. Its closest Nordic neighbour is Sweden to which it is connected by bridge. The bulk of Denmark is the peninsula Jutland and the rest of the country consists of 406 islands, of which 78 are inhabited, and the largest two islands are Zealand and Funen. Denmark also exercises sovereignty over the Faroe Islands in the North Atlantic and Greenland, which is part of the North American continent, both of which enjoy autonomous self-rule. The topography of

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1 Energy Policies of IEA countries, Denmark 2011 review
Denmark is relatively flat with few hills, its highest point being no more than 173 metres above sea level. Of the total surface area, 62% is used for agriculture, which offers a great theoretical potential for agricultural feedstock supply for the biogas sector.

The population of Denmark was 5.5 million in 2010, with 126 inhabitants/km², almost half of whom live on the islands of Zealand and Funen. Almost 87% of the population lives in urban settlements.

3.5.3. Energy Policy

The Danish government aims at reaching a share of RES in the final energy consumption of approximately 30%. 50% of the energy consumption in the electricity sector is to come from wind by 2020. The RES-share in Denmark’s final energy consumption shall be rising to 100% in 2050. Due to its characteristics as a storable feedstock and a flexible energy supply, bioenergy will play a key role in this strategy. According to the NREAP, the solid biomass utilization for energy generation is expected to grow by 32 PJ or 8.9 TWh by 2020. Solid biomass will therefore continue to be the main RES in Denmark also in the future. A considerable contribution to the renewable energy sector comes and will continue to come from district heating and co-generation heat based on biomass. A number of conditions promote the use of renewable energy in district heating, e.g. biomass is non-taxable. However, the regulations are intended to ensure that a large part of district heat generation is via co-generation. Hence, it is not possible for separate heat plants to exchange taxable fuels for biomass (non-taxable). Therefore, expansion with biomass can only take place if biomass is used in co-generated heat.

Heating consumption must gradually be converted to using renewable energy. The energy agreement of the 22nd of March 2012 contains the following elements to reach the RES target in 2020.

- Converting the coal production at large-scale power plants to biomass will be made more attractive by amending the Act on Heat Supply.
- The CHP producers and heat consumers are allowed to enter into voluntary agreements where the tax benefit from switching from fossil fuels to biomass in the heat production can be split between the two parties.
- Furthermore 35 smaller open-field CHP plants that are struggling in the wake of high heating prices will be allowed to produce cheap heating based on a maximum of 1 MW biomass fired boiler.

The support scheme for the production of electricity and heat is regulated by the Promotion of Renewable Energy, Act on Electricity Supply and Act on Transmission Grid Operator Energinet.dk.

3.5.4. Feedstock

In 2009, biomass from domestic sources represented 58% of the total
renewable energy portfolio in Denmark and imported biomass an additional 14%. Woody biomass clearly dominates among the biomass assortments with a total share of 61%.\(^2\) It is followed by waste with a share of 21% and straw with 16%. Fish oil stands for the remaining 2% of the total.

In 1989, the government announced its intention to double Danish afforestation within a century. Various steps have been taken towards achieving this goal. For example, a government grant scheme has been established that supports private afforestation on agricultural land and the State has also been planting new forests. Recent data suggests that the forest cover in Denmark is larger (14%) than previously estimated (11%) and that these forests are older than previously thought. This could change the status of Danish forests from being a net sink to be a net source in the period from 2008 to 2012. An extensive survey of Danish forests will be conducted in 2011, improving the present estimates with up to date figures. The survey will be finalised in 2012.\(^3\)

The harvesting levels in Denmark are below the annual increment. However, increasing wood supply from domestic forests is a subject to mobilization constraints. Already today, Denmark is a net importer of woody biomass for energy end-use. Firewood is the single largest biomass assortment used with a total domestic demand of 6.9 TWh. It is consumed mainly by private households. Most of the firewood volumes are domestically sourced, but approximately 0.5 TWh are imported.\(^4\)

Denmark’s potential of producing bioenergy from biomass has not yet been exhausted. Without causing any particularly negative impact on the production of animal feed and food, estimates show that it is possible to raise Danish agricultural production of biomass for bioenergy four to five times. This increase could be accomplished through greater exploitation of straw at CHP plants, slurry for biogas, animal fat for biodiesel and the use of perennial energy crops as well as grass from low-lying areas. It will, however, be necessary to include parts of the land in the production of perennial energy crops that has formerly been set aside. The technical potential may not necessarily be realised within the economic framework that applies today.\(^5\) The Table ‘Energy Crops’ displays the financial results for energy crops in Denmark in recent years.

The Danish agricultural sector’s contribution to bioenergy production is already relatively high, as 12% of the Danish energy consumption is covered by the use of residual products, such as straw, wood chips, and slurry. This is, in particular, a result of the use of these

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\(^2\) PÖYRY MANAGEMENT CONSULTING, Evaluation of options to enhance the Nordic cooperation in the field of solid biomass for energy purposes

\(^3\) Energy Statistic 2010

\(^4\) PÖYRY MANAGEMENT CONSULTING, Evaluation of options to enhance the Nordic cooperation in the field of solid biomass for energy purposes

\(^5\) Ministry of Food, Agriculture and Fisheries, Report on Biomass
residual products in the CHP sector.

3.5.5. Business Case

The prices for wood pellets have increased significantly during the 1997-2010 period. This development has been driven by the increase in wood prices and also by increasing demand. Prices for straw and woodchips have been more stable. It can also be noted that woodchip prices have consistently been above straw prices (Figure ‘Biomass Prices’).

The price trends for the different biomass assortments are expected to be similar in the coming 20 year period (Figure ‘Biomass Price Prognosis’).

The generation of RES-H is supported through tax exemptions. In CHP plants, the heat produced from biomass and biogas is exempted from energy taxes. Biomass in general is non-taxable and since it is considered as being CO₂ neutral it is also exempted from CO₂ duty.\textsuperscript{6}

In Denmark the RES-E production is supported through price premiums that are paid on top of the market price but are mostly capped at a maximum amount of market price plus premium. The instruments are prepared and managed by the Danish Energy Agency.\textsuperscript{7}

\textsuperscript{6} ECOFYS, Renewable energy policy country profiles
\textsuperscript{7} www.ens.dk
Figure ‘Biomass Prices’: Historical biomass prices 1997-2010

Source: pöyry management consulting, evaluation of options to enhance the nordic cooperation in the field of solid biomass for energy purposes

Figure ‘Biomass Price Prognosis’: Biomass price prognosis 2010-2030

Source: pöyry management consulting, evaluation of options to enhance the nordic cooperation in the field of solid biomass for energy purposes
Some projects can be supported by more than one support measure. For example, in CHP plants, the heat produced using biomass is exempted from energy taxes, and electricity receives feed-in tariff premiums. RES-E producers receive a variable premium on top of the wholesale electricity price. The sum of the premium and the market price shall not exceed a certain statutory maximum, which depends on the date of connection of the system and the source of energy used. In certain cases, system operators are granted a guaranteed premium and are thus not subject to a statutory maximum. The persons entitled to the payment of a premium are owners of systems for the generation of electricity from RS.

New CHP units producing electricity by burning biomass will receive a guaranteed premium of €20.2/MWh (øre 15/kWh). Biopower production is subsidized in order to increase the use of biomass for electricity generation. All sizes of installations are eligible for the support, and there are no specific requirements for e.g. compliance with energy efficiency criteria. The subsidy was amended by the RE Act in 2009 and has no fixed end date at current time.\(^8\)

Since the open-field plants were built in the 1990s, some of them have fought with very high heating rates which concern about 1% of the district heating consumers. In the new energy agreement a help package gives 35 smaller open-field CHP plants that are struggling in the wake of high heating prices, the possibility to produce cheap heating based on a maximum of 1 MW biomass fired boiler.

In the new energy agreement of the 22\(^{nd}\) of March 2012 several initiatives to promote the use of district heating will be taken.

- An implementation for an expansion of the biogas sector has been agreed upon. The overall support for biogas used for co-generation is being increased to €15.46/GJ (115 DKK / GJ) in 2012.
- From 2016 onwards, it will no longer be possible to install boilers in existing buildings in areas with district heating or natural gas as alternative.
- A fund will be established to promote efficient use of renewable energy in production processes in the industry. The aid is given as grants for projects that replace fossil fuels with renewable energy or district heating and energy efficiency improvements directly related to these conversion projects. Companies that currently use DH in their process may instead choose to continuously receive a grant for their additional costs of up to €5.68/GJ (42 DKK/ GJ) if cogeneration is converted to biomass and assuming that the scheme is approved by the EU under State aid rules.
- The Danish government will set aside €33.78 million (DKK250 million) in 2013 and €67.57 million (500 million DKK) annually from 2014 to 2020. The scheme will be evaluated during the first half of 2015.
- A subsidy of €4.05 million (DKK30 mil-
lion) is introduced annually from 2013 to 2020 to maintain and promote industrial cogeneration in the industry and gardening sectors which are financed through a supply fee.

- The funding for expanding renewable energy that is supplied to the electricity and gas grids is to be financed via the PSO (Public Service Obligation) schemes and thus by the energy bill. A security of supply taxes on space heating is to be introduced to cover government funding for biogas, industrial CHP, energy savings packages in privately owned rental properties, renewable energy in businesses, as well as the government’s loss of taxes due to lower consumption of fossil fuels.

**Useful links:**
- [Danish Energy Agency](#)
- [Danish ministry of Climate, Energy and buildings](#)
- [Danish District Heating Association](#)

### 3.5.6. Market Environment

The total primary energy supply (TPES) in 2010 was 19.7 million tonnes of oil equivalent (Mtoe). Energy production amounted to 23.2 Mtoe, which was below 2009 levels and indicative of falling oil and natural gas production over the past six years.

Denmark is a net exporter of oil and natural gas and can be expected to remain so at least until the end of 2018 for oil and 2020 for gas. Energy exports were 17.2 Mtoe in 2010 while imports were 13.8 Mtoe, making Denmark a net exporter of energy. The share of renewables in TPES is relatively high at 20.7%, largely wind and biomass. In 2010, oil accounted for over half (54%) of Denmark’s indigenous energy compared to 64% in 2004 when domestic oil production peaked. The share of natural gas in total energy production was 31% in 2010 compared to 34% in 2008. In 2009, the remaining 15% of indigenous energy production came mainly from biomass (12%) and wind power (3%). Denmark generated 38.6 TWh of electricity in 2010, largely from coal (44%), natural gas (20%) and wind power (20%). In 2010, Denmark imported 10.6 TWh of electricity mostly from Norway and Sweden, and exported 11.7 TWh mostly to Germany.

Denmark has one transmission system for gas, owned and operated by Energinet.dk, on behalf of the Danish State. Transmission tariffs are based on an entry-exit model and the same tariffs apply to all entry and exit points. The natural gas transmission system consists of upstream pipelines in the Danish part of the North Sea and onshore transmission pipelines. The transmission pipelines go north-south (Aalborg-Ellund) and west-east (Nybro-Dragør). The natural gas transmission system also includes a gas treatment plant (Nybro) and two underground gas storage facilities (Stenlille and Lille Torup). The Danish gas transmission grid is connected to the German gas transmission grid at Ellund on the Danish/German border and to the Swedish gas system at Dragør. Sweden is solely supplied with gas via the Danish
gas system.

The electricity transmission system in Denmark is separated both operationally and geographically into two parts, the west (Jutland and Funen) and the east (Zealand). In 2005, Energinet.dk was established, as a single state-owned transmission system operator, by merging two system operators: Elkraft in western Denmark and Eltra in eastern Denmark. Geographical separation ended in 2010 when the Great Belt Power Link connecting western and eastern areas with 400 kV direct current (DC) cables was commissioned. Despite separation within Denmark, the eastern area was already connected with Sweden and the western area was connected with Norway and Sweden. Therefore, both areas had been able to trade electricity through the Nordic market even without the Great Belt Power Link. The 6 300 km long Danish transmission system consists of 400 kV and 150/132 kV lines. Energinet.dk is the owner of the 400 kV facilities, as well as part of the 132 kV facilities, the Great Belt Power Link and interconnection lines with Norway, Sweden and Germany. Most of the 150/132 kV transmission facilities are owned by nine regional grid companies.

The significant changes in the composition of energy consumption reflect changes in the composition of heating installations in homes over time (Figure ‘Heating Installations Homes’). Until the mid-1980s, oil-fired boilers clearly dominated the market, after which district heating became the most common source of heat. In the late 1980s and during the 1990s, the number of district heating installations and natural gas boilers continued to increase substituting oil-fired boilers.

As of the 1st of January 2011, the total of 2.75 million heating installations are as follows: District heating installations 61.7%, natural gas boilers 15.2%, oil boilers 13.3%, and other installations, including log wood boilers and electric heating, 9.8%.9

In 2010 district heating amounted to 35.5% of household energy consumption. District heating production is generated at large-scale CHP units (46%), small-scale CHP units (19%), district heating units (19%) and by autoproducers, such as industrial enterprises, horticulture and waste treatment enterprises (15%). About 62% of the Danish housing is

9 Statistics Denmark
supplied with district heating. The 55 to 60 largest enterprises supply 60% of district heating. In 2010, 77.2% of the district heating was produced together with electricity. The corresponding figures in 1990 and 1980 were 58.8% and 39.1%, respectively. The remaining 22.8% is produced at smaller plants which primarily produce heat. There are about 600 suppliers of DH of which 200 district heating plants and 15 CHP plants are fuelled by solid biomass and 30 biogas-fired CHP plants.\textsuperscript{10}

Figure 'Producer Type' displays that since the late 1980s and during the 1990s, the share produced at small-scale units increased as purely heat-generating district heating units were converted to small-scale CHP generation. The same period saw an increase in production by private CHP units. Total district heating production was 150.0 PJ in 2010. This constituted an increase of 14.9% compared to 2009, caused by the considerably colder weather. Compared to 1990, the production of district heating has grown by 62.3% resulting in an increase of 90% compared to 1980.

District heating is a large end-user of biomass to energy in Denmark. In 2010, solid biomass and biogas contributed 52,085 TJ to renewable heat production, representing 39% of total renewable energy production. Biomass-fuelled DH and CHP plants have been a common part of the Danish electricity and district heating supply for decades. In 2010, 39% of the fuel mix was biomass mainly consisting of straw (9%), woody biomass (18%), and waste (10%).

Figure 'Fuel Consumption DH' shows that there was a significant change amongst the fuel used in the production of district heating in the period from 1980 to 2010. In 2010 the distribution was: biomass 38.7%, natural gas 29.6%, coal 18.9% and oil 4.5%. Consumption of natural gas and renewable energy etc. has increased year by year. In 1990, the share of natural gas and biomass etc. was 17.4% and 24.9%, respectively. The percentage of oil fell sharply from 1980 to 1990, and has subsequently remained more or less constant. Consumption of coal decreased significantly from 1990 to 2010. In 1990, this constituted 44.2% of the total consumption of fuel for district heating.

\textsuperscript{10} Energy Policies of IEA countries, Denmark 2011 review
An analysis of the future role of district heating in the energy supply will be prepared and presented by the end of 2013. The government has set aside €0.4 million (DKK3 million) for this analysis. Moreover, an analysis of the development of bioenergy in Denmark will be prepared. This analysis will focus on whether there are appropriate conditions in place that ensure an efficient and environmentally sustainable use of biomass resources in the Danish energy supply. The analysis must assess the CO₂ displacement as well. A total of €1 million (DKK7.5 million) in the period from 2012 to 2015 will be set aside for this analysis by the Danish government. The analysis will be presented by the end of 2013.

**Useful links:**
- Danish Energy Agency
- Ministry of food, Agriculture and Fisheries, Report on Biomass
- Annual statistic

### 3.5.7. Regulation

CHP plants are regulated by the Act on Electricity Supply and by the Act on Heat Supply, because the plants produce both electricity and heat. The plants vary in size and production methods and are as such regulated differently. The centralized CHP plants are exclusively subject to the Act on Electricity Supply, while the district heating transmission pipelines must be approved by the Act on Heat Supply. The large decentralized CHP plants (over 25MW) are also subject to the Act on Electricity Supply and the district heating transmission and distribution pipelines are regulated by the Act on Heat Supply. The small-scale CHP plants (below 25 MW) are regulated...
only by the Act on Heat Supply.\textsuperscript{11}

The DEA has set the general conditions for the establishment and operation of district heating. These conditions are intended to ensure that both cost-effectiveness and consumers' heating costs are taken into consideration. The Danish Energy Regulatory Authority (DERA) and the Energy Supplies Complaint Board monitor the district heating sector and handle complaints regarding prices and conditions. The district heating sector is owned and operated in various ways. There are cooperatives, joint-stock companies, and local authority companies (often interest group companies and local authority supply bodies). In the district heating market, both production and network companies are monopolies and regulated as non-profit undertakings. DERA monitors their prices and their terms of delivery, and takes regulatory action if the prices and terms of the network companies are not in line with the non-profit regime.\textsuperscript{12}

Danish local authorities are the central players in the public heat supply; they develop heating plans and are responsible for expanding district heating and for implementing any changes made necessary by amendments to the regulations in the Act on Heat Supply.

The obligations to use RES in new buildings are applied not on the building level, but on the energy system level. Municipalities are obliged to set up heat plans based on feasibility studies. The heat supply system for a building is chosen according to the heat plan of the area. The rules concerning the feasibility study of alternative/RES systems are determined by the Act on Heat Supply. The objective of this Act is to promote the most socio-economic and environmentally friendly utilization of energy for the supply of heat and hot water to the buildings and reduce the dependency of the energy system on oil. In certain areas there is an obligation for buildings to connect to a district heating system. Only new low energy buildings are dispensed from this obligation.\textsuperscript{13}

Energinet.dk supervises all important procedural steps related to the promotion of RES-E. Furthermore, renewable energy is subject to the general statutory provisions related to the supervision of the electricity market. The electricity market is supervised by an independent commission (EnergiTilsynet - Danish Energy Regulatory Authority), which was established by the Ministry of Environment and Energy. The instruments are revised from time to time, according to the situation in the market. Historically the level of support has changed numerous times, but it is a general rule that the support scheme which was in place when a production unit was connected to the grid, applies for the lifetime of the production unit. As a result there is a high level of certainty about future support at the time of investment.

\textsuperscript{11} Danish Energy Agency
\textsuperscript{12} Energy Policies of IEA countries, Denmark 2011 review
\textsuperscript{13} ECOFYS, Renewable energy policy country profiles
Denmark followed other Nordic countries and commenced the process of electricity supply-market liberalisation in the early 1990s. Nord Pool was established in 1996 and became the integrated regional electricity market for the entire Nordic region. Partial retail competition commenced in 1998 and was followed by full market opening in 2003. DERA is the independent regulatory body that oversees the electricity market. DERA regulates network tariffs for transmission and distribution and determines the level of obligation to supply tariffs (a last-resort service).  

According to the Act on Electricity Supply, the grid operator is statutorily obliged to expand the grids in order to guarantee the efficient transmission of electricity. Whenever possible, the national target of increasing the competitiveness and use of RES is given special attention. The connection policy is shallow with well established and transparent rules for calculating costs. RES projects only pay the cost that would have incurred in case of being connected to the (local/nearest) grid irrespective of whether the grid company selects another connection point. The costs for grid reinforcement are met by the DSO and TSO. In cases where the RES project wishes to connect at a higher voltage level (than 10-20kV), the additional connection costs have to be paid by the project, but not the reinforcement costs.  

Since Denmark is located at the interface between the Nordic region and Germany, it is impacted not only by the Nordic market but also by the Central-Western European (CWE) market. Accordingly, in November 2009, the European Market Coupling Company (EMCC) on the Danish-German border coupled the Nordic and German day-ahead markets at two interconnections.  

The determination of emission limits are regulated by the Environmental Protection Agency. For combustion installations with a rated thermal input exceeding 50 MW, emission limits are set by the ordinance on limitation of certain atmospheric pollutants from large combustion plants (Bekendtgørelse om begrænsning af visse luftforurende emissioner fra store fyringsanlæg). This ordinance sets limit values for SO$_2$, NO$_x$ and dust. The Order distinguishes between existing and new facilities. The ordinance will be replaced by the Industrial Emissions Directive, which will be implemented in Denmark in January 2013.  

All installations that are covered by specific regulations and those that are not must comply with the limits in the Danish air quality guideline.  

**Useful links:**
- Ordinance  
- Environmental Protection Agency  
- Department of Environmental Science at the university of Aarhus  

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14 Energy Policies of IEA countries, Denmark 2011 review  
15 Energy Policies of IEA countries, Denmark 2011 review
3.5.8. Project Financing

Investments in Danish markets are considered to be ‘safe’ from a country risk perspective, according to established rating agencies. Reliability and credit worthiness of the Danish economy is rated with best scores at Standard & Poor’s\(^{16}\) and Moody’s. COFACE country risk rating sees Denmark at the top of the score.\(^{17}\) The same holds true for the Corruption Perception Index measuring the level of transparency.\(^{18}\) The ease of doing business is seen to be quite favourable in Denmark by the IFC World Bank.\(^{19}\)

The Danish Krone has remained within the EMS and has been part of the new exchange-rate mechanism (ERM II) since the introduction of the Euro. It may fluctuate within a 2.25% range of the Euro.\(^{20}\) The average inflation rate in the period from 2006 to 2010 was 2.1%. Inflation is not expected to stay within the Euro target area of just below 2% in 2011. For 2011 and 2012 inflation is expected to be at 2.6% and 1.8% respectively.\(^{21}\)

3.5.9. Readiness for uptake

Key institutions\(^{22}\)

The Danish Ministry of Climate, Energy and Building (previously known as the Ministry of Climate and Energy), established in November 2007, was created as a part of the government's increased efforts to promote a greener and more sustainable society. The ministry is responsible for national and international efforts to mitigate climate change, as well as for energy, national geological surveys in Denmark and Greenland, and for meteorology.

The Danish Energy Agency (DEA) was established in 1976, and is an agency under the Ministry of Climate, Energy and Building. It is responsible for all tasks related to the production, transmission and utilisation of energy, and its impact on climate change. Its principal function is to ensure the legal and political framework for reliable, affordable and clean supply of energy in Denmark.

Energinet.dk, the transmission system operator, is an independent public enterprise owned by the Danish State represented by the Ministry of Climate, Energy and Building. It owns the natural

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\(^{17}\) COFACE: http://www.coface.com/CofacePortal/COM_en_EN/pages/home/risks_home/country_risks/rating_table?geoarea-country=COUNT AREA_04&rating=&brating
\(^{19}\) IFC, Doing Business Index: http://www.doingbusiness.org/rankings

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\(^{22}\) Energy Policies of IEA countries, Denmark 2011 review
gas transmission system and the 400 kV electricity transmission systems and is the co-owner of the electricity interconnections to Norway, Sweden and Germany. It is responsible for maintaining security of supply and ensuring the smooth operation of the market for electricity and gas. Energinet.dk was established in 2005 following a merger between Eltra, Elkraft System, Elkraft Transmission and Gastra.

The Danish Energy Saving Trust is an independent body established in 2010 as a trust under the auspices of the Ministry of Climate, Energy and Building, replacing the Danish Electricity Saving Trust. The scope of the previous organisation’s work has been expanded from electricity savings to cover savings and more efficient use of all forms of energy in every sector other than transport.

The Danish Energy Regulatory Authority (DERA) oversees the electricity, natural gas and district heating markets. DERA is an independent authority and its board members are appointed by the Minister of Climate and Energy. Its decisions can be appealed to at the Danish Energy Board of Appeal.

The independent Danish Commission on Climate Change Policy was established by the government in 2007 and was charged with the task of identifying the long-term climate and energy policies needed to achieve independence from fossil fuels. The Climate Commission’s proceedings were attended by the Ministry of Economic and Business Affairs, the Ministry of the Environment and the Ministry of Finance. The Commission published its findings in September 2010 and ceased its activities in November 2011.
3.6. Sweden

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3.6.1. Country Score

Score Sweden Middle Norrland - CHP

In the general scoring for sector, Sweden - Middle Norrland is rated place 52 out of total 81. The underlying categories that influence this result are displayed in the bar chart above.

3.6.2. Basic Data

Sweden is one of the most northern states of the EU. Since its lands are stretched over the Arctic Circle, the agricultural gradient of the country is a steep one. Sweden consists of eight NUTS2 regions. With a surface of 450,295km², Sweden is the third largest country in the EU; however, with a total population of about 9.4 million it is only the fourteen most populated one. On average, 21 inhabitants live per square kilometre whereas the population is mostly concentrated in the southern half of the country. About 85% of the population lives in urban areas. Sweden's capital city is Stockholm, which is also the largest city. The country is characterised by its long and narrow shape with the main part of the population spread over the middle and southern parts of the country.
3.6.3. Energy Policy

The Swedish government aims at reaching a share of RES on final energy consumption of 50% in 2020, and a balance of zero net CO$_2$ emissions by 2050. Due to its characteristics of storable feedstock and flexible energy supply, bioenergy will play a key role in this strategy. Sweden has had targets and policies in place to support renewable energy for a long time and since 1980 it has focused on the development of bioenergy and hydro energy. Only the last ten years have moved a larger focus on wind and solar energy. Today, bioenergy is the largest energy source in Sweden, and the third largest electricity source after hydro and nuclear power. The renewable energy share in 2011 amounted to 48.9% putting Sweden well ahead on its way to meet the 2020 target. With the introduction of the carbon tax in 1991, Sweden has installed a strong policy instrument that, supported by the high and fluctuating fossil fuel prices, has lead to a large market gain for the cheaper domestic bioenergy. These two points combined with high political ambitions triggering investments in district heating systems in many municipalities in the period of 1980-1990, has lead to a large heat market for bioenergy. The introduction of green electricity certificates also introduced a large investment trend in CHP facilities.

Swedish energy policies are unique in the EU, as there are no feed-in tariffs or mandates in place. The incentives and support systems are designed to be very general in accordance with PPP. Fossil energy is taxed higher than renewable energy in order to make the latter competitive on the market. The taxation combined with investment support for emerging technologies has been very successful, and created a strong market growth. Sweden has no binding or dedicated targets on specific energy forms. All policies are set to be technology neutral. There are therefore no specific targets for CHP in Sweden and no specific measurements included in the nREAP plans, apart from the general incentives for renewable energy. Renewable electricity is, apart from the general incentive structure, also supported by the use of green electricity certificates.

Electricity from CHP is the third largest electricity source in Sweden today. CHP is a profitable energy solution on the market without any bioenergy dedicated support.

There are no announced policy changes for this market and the market actors view the policy conditions as stable.

Useful links:
- Energy Tax Law
Green electricity certificates

- **Lag (2011:1200) om elcertifikat**

Institutions:

- **Swedish Energy Agency**
- **Swedish Board of Agriculture**
- **Swedish Board of Forestry**

Associations:

- **Swedish bioenergy association**
- **Swedish district heating association**
- **Swedish energy association**
- **Swedish waste association**

### 3.6.4. Feedstock

The Figure ‘Potential Biomass’ at the bottom of the page give an overview over the potentials of Swedish biomass supply. As Sweden is a forest rich country, forest biomass has traditionally been used for energy production. There is only a minor use of agricultural crops. Waste has also increased as an important feedstock for energy production. Used wood materials also constitute a growing market in Sweden. The feedstock for CHPs are mainly made up of residues from forest industries, wood pellets, wood briquettes, waste and in some cases recycled wood. The use of perennial energy crops is minimal in Sweden (SRC Willows on 13000 ha). Also the use of more grassy energy crops is only in the pilot stage. For relatively large CHP plants wood pellets are not that common as a feedstock. Peat is also used in some plants as a fuel additive, most commonly with a mix up to 10%. The majority of woody biomass is made up of residues from forest industries or GROT (Branches, wood tops left from clear fellings). Fellings of mature forest in order to obtain biomass for energy generation do not exist.

Fuels are not believed to be limiting for

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**Figure 'Biomass Potential': Potentials for biomass (TWh)**

Svebio has estimated potentials for the supply of bioenergy available in 2020, here compared to the utilisation in 2009. The largest remaining potentials are in agriculture and in forestry.
the development of district heating in Sweden; however, the main hindrance for the further development are large investment costs relative, the uncertain policy situation, as well as a shortage in heating and/or cooling demands. Regarding the future development of the CHP market, there is a large focus on small-scale CHP solutions and combined solutions, such as various forms of biorefineries.

Although the demand for wood chips has increased over the last years, Swedish forests are far from overexploitation. The supply of wood chips is sufficient for a stable supply of CHP-plants for a couple of years, even in the case that the number of plants was to increase. Nevertheless, suppliers of raw materials have been exploring alternatives for several years, especially SRC with salix or willow. The potential to increase the availability of biomass remains to be large, in particular with regards to the agricultural sector. Svebio has estimated the potentials for bioenergy supply available in 2020 and compared them to the already used amount in 2009. Figure 1 shows that the largest remaining potentials lie in the agricultural and forestry sector.

**Useful links:**
- [Swedish Energy Agency](#)
- [Swedish Board of Agriculture](#)
- [Swedish Board of Forestry](#)
- [Official Swedish Statistics](#)
- [EUROSTAT](#)

### 3.6.5. Business Case

Due to their great profitability, all larger biomass-based energy production plants have installed electricity generation. Electricity from biogas as well as green electricity from other RES is eligible for green electrical certificates.\(^1\) Whereas producers of renewable electricity are issued green electricity certificates that they can then choose to sell on the open market, other electricity providers or buyers have to buy a certain amount of green electricity certificates. The price for the certificates is determined by the market. So far, the green certificates have added 50 – 100% to the actual market price. As the prices of these green electricity certificates are set by the market instead of being fixed by legislation, they might fluctuate over time. However, the prices tend to be relatively stable over longer periods and predicted values of a green certificate are regularly published on Nordpoolspot.com.\(^2\)

All bioenergy fuels are exempted from the energy as well as the carbon tax (see Figure ‘Carbon Tax’). Biomass is furthermore viewed as carbon neutral in the ETS system. There is, however, a general electrical tax that differs regionally and which is dependent on usage. Industries and sea transports pay 0,05 SEK/KWh, whilst other consumers pay 0,292 SEK/KWh. Some regions have

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\(^1\) Law on green electricity certificates (2011:1200), in Swedish - [http://www.notisum.se/rnp/sls/lag/20111200.htm](http://www.notisum.se/rnp/sls/lag/20111200.htm)

a rebate on these taxes, with a reduced electricity tax of 0.192 SEK/KWh. All of these regions are municipalities located in Norrbottens län, Västerbottens län, and Jämtlands län. In Västernorrlands län the municipalities of Sollefteå, Ånge, and Örnsköldsvik pay a lower electricity tax. In Gävleborgs län it is the municipality of Ljusdal that pays a lower electricity tax. In Värmlands län, the municipality of Torsby, and in Dalarnas län the municipalities of Malung-Sälen, Mora, Orsa, and Älvdalen have this rebate.

Due to the steady increase of the carbon tax, bioenergy has become cost competitive in all markets outside of the ETS (see Figure ‘Carbon Tax’). Unfortunately the loss of the carbon tax for this sector could not be compensated since the value of carbon emission rights have been too low and because emission rights have been given out too freely. Another sector where bioenergy has not yet become the most commonly used fuel is the one of midsized industries that benefit from a reduction of the carbon tax. However, as the carbon tax for these instalments was raised in 2011 (up to 30%), and will be raised again in 2015 (up to 60%), it is expected that these companies will also show an increased market interest for bioenergy.

As industries and district heating systems that are included in the ETS system do not have the same incentives to change to renewable heat, the degree of biomass use varies. Whereas industrial applications still rely on fossil fuels, district heating plants targeting the consumer markets tend to have a much higher share of biomass usage.

The bioenergy market with its trading of green electricity certificates is a stable one, with a stable price situation for biomass and several trading actors. The quarterly price indexes from the Swedish energy agency\(^3\) are helpful when assessing future bioenergy prices. One interesting market development comes from one of the participating companies in the Crossborder Bioenergy Project: ENBIO just introduced a biofuel trading

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3 One example of a price sheet: SVERIGES OF-FICIELLA STATISTIK STATISTIKA MEDDELANDEN EN 0307 SM 1202 se more on http://energimyndighetens.se/sv/Statistik/Energipriser/
market where bioenergy actors can trade and market their biomass volume on an open and public site, even further increasing the market’s transparency. Although investments in CHP plants are not subject to direct support, low bioenergy prices and green electricity certificates make these projects fairly easy to finance.

**Useful links:**
- Energy Tax Law
- **Green electricity certificates: Lag (2011:1200) om elcertifikat**

### 3.6.6. Market Environment

Worldwide, the use of solid biomass is of key importance in the supply of energy. Solid biomass is still by far the most utilized form of renewable energy in Sweden. At the end of 2011, electricity produced from biomass added up to 9% of the total electricity mix. Whereas most CHP plants that have been built so far operate on a rather large scale, a growing interest for smaller CHP technologies amongst industrial and smaller district heating companies is evolving.

All developments of CHP in Sweden are dependent on the heat demand close to the plant. The highest electricity gains are found where the heat demand is constant, as the energy outtake from a boiler as well as net income from electricity production is constant. Nevertheless, CHP in district heating systems serving private households with varying loads, temperatures and seasons can also be profitable, but require a more advanced market model.

The biggest market concerns for increased market growth of CHP in Sweden is the future development of the prices of green electricity certificates, as well as the price development of small and medium-scale CHP technologies. As the installation rate of large district heating systems in areas where there exist none today is expected to decline, new CHP installations will probably be in existing industries or as a part of further developments of currents district heating systems or through the connection of smaller district heating systems in to larger. The latter option as well as the upgrading of installations are the two most common developments for CHP that are currently being observed. Also the price of biomass is monitored closely; however, it is not projected to increase significantly as biomass prices in Sweden are balanced by pulp wood prices and the international biomass trade.

Svebio yearly produces a map (see Figure ‘Biopower’) displaying all bio-power production units in Sweden. The map from 2011 shows biopower production at 172 locations, and another 39 units that are at the planning stage. This includes 83 CHP plants in district heating, 39 units in industries, and 50 small plants using biogas for electricity.

**Useful links:**
- Svenska Kraftnät (Swedish national grid)
- **Green electricity trading market**
3.6.7. Regulation

The approval of solid biomass plants by authorities is not perceived as a barrier. Nevertheless, approval periods can vary from authority to authority, depending on their work load, skilled personnel and local conditions. For the approval, several emission and noise thresholds have to be fulfilled.

Emission thresholds and regulations differ according to the size of the installations. The larger the plant, the stricter are the environmental demands. The Swedish Environmental authority provides local and regional authorities with recommendation of how to set environmental permit thresholds. The constraints (permit provisions) in environmental permits also vary to great extent dependent on the feedstock used. Here, waste incinerations plants and operations based on used wood have much stricter operation conditions. All permitting authorities in Sweden are knowledgeable of bioenergy installation as these are very common in all regions of the country. The general public is also used to bioenergy installations.

Hence, the permitting process is often a relatively straight forward process, even though permit provisions, especially with regards to air and water emissions...
are being tightened and thresholds are being lowered. As in all permitting processes, it is generally beneficial to initiate a dialog with stakeholders and neighbours early in the process.

Biomass plants in Sweden are encouraged to return the clean biomass ashes to the forest for nutrient cycling. This is supported by very high deposition cost for these ashes in landfills. The conditions for spreading of ashes are, however, relatively strict, and the process is also costly. Hence, markets for the alternative usages of ashes, as filling material in landfills, in the field of road constructions, and as fertilizer in plant soils, have been developed. Further information and advice on this matter can be obtained from Svenska energiaskor (Swedish EnergyAshes), an organisation helping biomass plants with the handling of their bioash, as well as from Avfall Sverige, the Swedish Waste Management.

**Useful links:**

Facts and figures:

- Miljöbalken, Swedish environmental law
- Swedish Environmental protection agency
- Laws in the internet

### 3.6.8. Project Financing

According to established rating agencies, investments into Swedish markets are ‘safe’ from a country risk perspective. Reliability and credit worthiness of the Swedish economy is rated with best scores at Standard & Poor’s and Moody’s. Also COFACE country risk rating sees Sweden at the top of the score. The same holds true for the Corruption Perception Index measuring the level of transparency. Whilst the ease of doing business in Sweden is regarded as quite well by IFC World Bank, starting a business is ranked relatively low due to high administration and regulation requirements.

Although Sweden is not a member of the Eurozone and therefore currency exchange risk have to be taken into consideration, the Swedish krona and the Swedish state budget follow the ordinances of the EU leading to only minor currency fluctuations.

Banks are familiar with financing bioenergy projects with view on solid biomass plants and biomass projects. Improved profitability due to carbon and energy taxation generally make these investment easy to finance.

The market perspectives, political framework conditions and economic parameters are usually well-known to decision makers. A special focus when deciding about credits and loans is put on the reliable, sustainable and long-

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7 IFC, Doing Business Index, [http://www.doingbusiness.org/rankings](http://www.doingbusiness.org/rankings)
term availability of feedstock supply, as well as a sound concept for the sales of the product.

Useful Links:
Facts and figures:
- Svenska Kraftnät (Swedish national grid)
- Green electricity trading market
- Swedish Energy Agency
- Swedish Board of Agriculture
- Swedish Board of Forestry
- Official Swedish Statistics
- Swedish bioenergy association
- Swedish district heating association
- Swedish energy association
- Swedish waste association

Rating agencies:
- Standard & Poor’s
- Moody’s
- COFACE
- Corruption Perception Index
- IFC Doing Business

Project financing institutions:
- Swedish Board of Agriculture

3.6.9. Readiness for Uptake

As bioenergy is the largest energy source in Sweden, the market is well aware of the importance of bioenergy. However, customers of district heating and green electricity are rarely aware of the fact that they are actually buying district heating or green energy. Annual surveys conducted by the Swedish Energy Association on the share of bioenergy used in Swedish energy system shows that this share has been consequently drastically underestimated.

District heating accounts for more than half of the heating of buildings in Sweden. In the beginning, the reason for the large investments in this infrastructure was the aim to build large heat plants with efficient flue gas cleaning in order to reduce air emissions caused by the large number of individual furnaces and boilers. Thousands of chimneys in a city were replaced by one single smokestack. The result has been very positive. Air quality has improved drastically in the cities, particularly in winter time. District heating and CHP are therefore being perceived as environmentally friendly. The largest barrier for new connections is the instalment fee that is sometimes perceived as high relative to other energy options.

Being Sweden’s third largest energy source, one would expect biomass to play a major role in the green electricity supply of the country; however, there are only two providers of locally produced biomass electricity on the market. Electricity trading companies frequently explain this situation with the argument that bioelectricity is too complex to explain to the market compared with wind, hydro and solar electricity.

In Sweden, the forest industry has
been the major producer of bioenergy which has been used as a domestic fuel for a long time. The historic debate and concerns from the forest industry regarding the price effects emanating from the bioenergy development is minor in Sweden. Bioenergy is actually seen as a profitable side market for forest owners, paper and saw mills. However, lately there has been a public debate regarding Swedish forestry which might affect the public perception of bioenergy.

**Useful links:**

**Associations:**
- Swedish bioenergy association
- Swedish district heating association
- Swedish energy association
- Swedish waste association

**Institutions:**
- Svenska Kraftnät (Swedish national grid)
- Green electricity trading market
- Swedish Energy Agency
- Swedish Board of Agriculture
- Swedish Board of Forestry
- Swedish Environmental protection agency
3.7. Latvia

Latvian Biomass Association (LATbio)

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3.7.1. Country Score

Country Score Latvia - CHP (November 2011)

In the general scoring for sector, Latvia is rated place 81 out of total 81. The underlying categories that influence this result are displayed in the bar chart above.

3.7.2. Basic Data

Latvia, officially the Republic of Latvia, is a country in the Baltic region of Northern Europe. It is bordered to the north by Estonia, to the south by Lithuania, to the east by the Russian Federation, to the southeast by Belarus and has a maritime border with Sweden to the west. Latvia is a unitary parliamentary republic and it is divided into 118 administrative divisions of which 109 are municipalities and 9 are cities. The capital of Latvia is Riga; about one third of the country’s population lives there. The official language is Latvian and the currency is called Lats (Ls).

Latvia has a humid semi-continental climate characterized by warm summers, freezing winters and frequently high levels
with more than 50,000 inhabitants.

### 3.7.3. Energy Policy

The Energy section of Latvia’s Sustainable Development Strategy 2030 identifies several goals: renewable and safe energy, reduced dependency on energy imports, the use of local RS, increased energy efficiency and the formation of a joint regional energy market.

Pursuant to Annex I(A) to Directive 2009/28/EC, Latvia’s target is to increase the use of RES from 32.6% of GFEC in 2005 to 40% in 2020. The total amount of RES to be utilized in 2020 is 1918 ktoe. Latvia’s RES targets by 2020 and beyond are the following:

1) By 2020, the share of renewable energy in the total gross final energy consumption shall be increased to at least 40% and then increased gradually thereafter;

2) By 2020, the share of renewable energy in the transport sector must reach at least 10% of the gross final energy consumption for transport and then increased gradually thereafter.

The Law on Renewable Energy still has not been passed by the Saeima. The draft Law on Renewable Energy specifies measures and targets for renewable energy generation and the total final energy consumption that must be achieved by 2020, and provides for financial instruments to promote the use of renewable energy.

Although since 2000 equal distribution of cogeneration power plants has been
observed in Latvia, one of the goals of the Latvian power policy as currently defined by the guidelines, is to increase energy generation using effective cogeneration. Hitherto the main cogeneration potential was observed in the existing district heating that quickly developed in the last years, while the amounts of power generated by boiler houses of district heating systems decreased gradually.

Latvia is aware of the need to satisfy the existing demand for energy using the maximum possible amount of local energy resources as well as eco-friendly and sustainable technologies. Therefore it is still essential to replace existing thermal energy generating units by cogeneration units using local energy resources. The assessed replacement possibilities, together with the use of effective energy resources, make a significant contribution to the reduction of GHG emissions.

The implemented energy policy has set the increase in efficiency of energy generation as one of the priorities, which has been achieved already, in parts at least. Since 2000 the ratio of district heating energy generated by boiler houses to district heating energy generated by cogeneration plants has changed and the amount of thermal energy generated by cogeneration increased in district heating from 12.03 PJ (37.8%) in 2000 to 16.82 PJ (58.7%) in 2010, while the amount of thermal energy generated by boiler houses decreased from 19.83 PJ (62.2%) in 2000 to 11.84 PJ (41.3%) in 2010.

In Latvia cogeneration of energy is regulated by the Energy Law, the Electricity Market Law and Cabinet Regulations No. 221 ‘Regulations Regarding Electricity Production and Price Determination Upon Production of Electricity in Cogeneration’ of the 10th of March 2009 and according to them, as well as the Law ‘On Regulators of Public Utilities’. Furthermore, the Electricity Market Law adopted on the 5th of May 2005 provides that the merchant generating electricity in cogeneration may acquire rights to sell generated electricity within the framework of a mandatory procurement.

As to cogeneration, in accordance with Section 28(2) of the Electricity Market Law the Cabinet of Ministers sets the following criteria:

- Qualification criteria to acquire the right to sell generated electricity within the framework of mandatory procurement;
- The procedure for the mandatory procurement and its supervision;
- The procedure for pricing electricity depending on electrical power and fuel used;
- The procedure for covering expenses of the mandatory procurement and the procedure for refusing from the right to sell generated electricity within the framework of mandatory procurement.
- The guaranteed fee for the electrical power of the cogeneration plant.

If a producer wishes to sell generated electricity within the framework
of mandatory procurement, and its cogeneration plant complies with the criteria set by the Cabinet of Ministers, the remaining amount of generated electricity left after consuming it for own auxiliaries, is purchased by a public merchant in the manner and for the price set by the Cabinet of Ministers.

In accordance with the Electricity Market Law Cabinet Regulations No. 221 ‘Regulations Regarding Electricity Production and Price Determination upon Production of Electricity in Cogeneration’ were adopted on the 10th of March 2009 providing for the mandatory procurement of electricity generated by cogeneration for a set price, as well as envisaging rights to receive a guaranteed fee for electrical power from the cogeneration plant.1

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1 CM Regulations No.221 replace Cabinet of Ministers Regulations No. 921 ”Regulations Regarding Electricity Production in Cogeneration” of 6 November 2006

3.7.4. Feedstock

Latvia is characterised by its fertile lowland plains and moderate hills. A typical Latvian landscape is a mosaic of vast forests alternating with fields, farmsteads, and pastures. Agricultural land occupies 39% of Latvia’s territory. Available farmland is 2,429,800 hectares: 1,805,500 hectares are cultivated and 624,300 hectares is abandoned land.2 Forests cover approximately 55 % of Latvia’s territory.3

Latvia has a high potential of solid biomass fuels (Figure ‘Potential Solid Biomass’). The main solid biomass source is wood. In 2006 it has been estimated that approximately 55% of the total area of Latvia is covered by woods.

Although Latvia is a comparatively small

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country in terms of area – Latvia is the fourth most forested country in Europe, outpaced only by Finland (77%), Sweden (76%), and Slovenia (63%). According to the data of the Central Statistical Bureau, the area taken by forests in Latvia in 2008 was 3,221,000 ha, 1,522,000 ha of which were national forests. About 50% of Latvian forests belong to the state, 47% to private owners, 2% to municipalities, and 1% to other owners.

5,030,000 m³ of firewood were used for energy generation in 2010 (data of the Central Statistical Bureau). As forest areas have been constantly increasing in Latvia in the last 20 years, the amount of wood accumulated in forests or the wood yield has grown significantly. 93% of forested areas corresponding to 3,155,000 ha, with a total wood yield of 592 million m³, were available for wood production in 2010.4

The Figure ‘Wood Increase/Felling’ shows the annual natural increase in wood and felling volumes by years (in million m³).

If we summarize the energy wood potential in Latvia, the forecast sums up to 30 TWh per year.

Following types of wood are currently used for energy production in Latvia:

- Wood logs (chopped and spited firewood);
- Forest residues (branches, tops, stumps, etc.)
- By-products of wood processing industry (woodchips, barks, chips, wood dust)
- Refined wood fuels (pellets, briquettes, charcoals).

The volume of production of wood chip pellets continues to increase year after year. It is promoted by the commissioning of new production facilities. A major part of the produced amount is exported to other countries. About 650,000 tons of pellets were produced in 2010, and about 800,000 tons in 2011.

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3.7.5. Business Case

The rate of increase of the use of high-efficiency cogeneration units in district heating is held back by large volumes of investments required, limited opportunities of local governments to get loans, as well as slow capital turnover. Due to these reasons local governments are still operating low-efficiency units causing increased fuel consumption and failure to ensure heat supply in the required quality. The power generation process may be optimized and heat losses in the transmission system may be reduced by complex renewal of the system. However, the average level of efficiency of thermal energy generation units in Latvia has been evaluated as high.

Special attention in Latvia is currently drawn to the use of such cogeneration technologies that use RS for energy generation. Based on the natural conditions in Latvia this is mainly woodfuel. One of the current priority directions is the implementation of measures that promote the increase in the share of energy generated from RS in the total gross end use of energy, which means that the efficient use of biomass is supported not only in the generation of thermal energy, but also in the generation of electricity.

A significant cogeneration potential is also present in local and individual heating, the development of which however has no significant impact on the existing heat loads of district heating. Along with promoting the development of cogeneration plants and power generation from renewable resources, the potential of electricity grids must be increased both in the transmission and distribution system.

Three support instruments were selected for this purpose:
1. The mandatory electricity procurement;
2. The guaranteed fee for the set electric power;
3. Target subsidies are envisaged to promote the development of cogeneration power plants using energy from renewable sources for the construction of power plants, apart from that also using funding from the Structural Funds of the European Union for this purpose.5

The support programme – Development of Cogeneration Power Plants Using Renewable Energy Sources – is aimed at significantly increasing the volumes of electricity and heat generated from renewable energy sources. Support is provided to the construction of new cogeneration power plants using RES. Activity is financed from the Cohesion Fund in the period from 12th of March 2009 to 21st of December 2013. The maximum permissible Cohesion Fund

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funding intensity is 50% of the total eligible expenditure regardless of the technology applied.

The Figure ‘Price Comparison’ illustrates the change in prices for gas and wood in the last years.

3.7.6. Market Environment

The share of RES has traditionally been significant in Latvia’s energy supply and in 2008 it comprised 29.9% of the total final energy consumption. In the consumption structure for electricity, the RES segment is made up of hydropower plants, wind power plants, biogas power plants, and biomass power plants, as well as cogeneration stations utilizing RES.

Latvia mainly uses the following cogeneration technologies:
- Combined cycle gas turbine with heat recovery;
- Back pressure steam turbine;
- Internal combustion engine
- Gas turbine with heat recovery.

In 2010 86.3% of electricity generated by high-efficiency cogeneration plants were generated using combined cycle gas turbines (CCGT) with heat recovery, 12.8% – using internal combustion engines, 0.7% – using back pressure steam turbine, and 0.2% – using gas turbine with heat recovery.

A range of cogeneration plants with the set power of 1 MW are operating in Latvia. Operation of these pants does not require a license, and they sell generated electricity in accordance with the agreement with a transmission system operator and thermal energy – in accordance with the agreement with a local heat supply company.
Since 2000 the Latvian energy sector has seen a drastic increase in the share of high-efficiency cogeneration. 71 cogeneration plants with the total electrical power of 947.5 MW operated in Latvia in 2010 generating 3,050 GWh of electricity which accounts for 40.7% of the total electricity supply. And cogeneration plants (excluding power generated by water-heated boilers) generated 4673 GWh of district heating power in 2010 which constitutes 58.7%.6

Heat supply to Latvian consumers is ensured by district heating systems, local heating and individual heating.

The consumption of primary energy resources decreased significantly from 333.2 PJ in 1990 to 200.5 PJ in 2010. In 2010, 24.9 PJ of energy resources were used for power generation in high-efficiency cogeneration. 0.26 PJ of the resources were of renewable nature.

Currently petroleum products (33.9% in 2010) and woodfuel (24.6% in 2010) are mostly used for the end use of energy. Natural gas is mostly used as fuel at Latvian cogeneration plants. Fuel oils, peat, coal and biofuel (fuel wood chips, fuel cut-offs, biogas, and biodiesel) are used in small amounts. The Figure ‘Consumption Cogeneration Plants’ displays the structure of fuels used in all cogeneration plants which has remained unchanged since 2000.

About 22% of thermal energy required by users is generated by district heating systems, while 78% of thermal energy is generated by heat supply systems other than district (local and individual) (2009, Eurostat). In 2010 about 70% of the end use of district heating was consumed by households. Amounts of energy generated by boiler houses of district heating systems gradually

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Figure ‘Consumption Cogeneration Plants’: Energy resources consumed by cogeneration plants in the transformation sector in 2010

Source: Latvian Energy in Figures, Ministry of the Economy, 2011
increased in the last years as shown in Table ‘Generated Energy’ of this report. In 2010 the gross national electricity consumption was 7500 GWh. 2402 GWh were generated by large cogeneration plants (Riga TPP-1 and Riga TPP-2), while other cogeneration plants generated 648 GWh. The share of cogeneration plants in the gross national electricity consumption in 2010 constituted 40.7%. The above mentioned yield of large cogeneration plants increased from 19.6% in 2000 to 32.0% in 2010. At the same time the share of other cogeneration plants increased from 2.5% in 2000 to 8.6% in 2010.

If we look at the structure of district heating supply, 28.66 PJ of thermal energy were generated in 2010. 16.82 PJ were generated by cogeneration plants and 11.84 PJ – by boiler houses, therefore cogeneration plants generated 58.7% of thermal energy and boiler houses – 41.3% of thermal energy from the whole district heating supply.

The proportion of electricity generated in cogeneration increased by 132.3% in 2010 compared to the levels of 2000. In 2010 the gross electricity consumption of Latvia was 7.5 TWh, whereas 2.98 TWh were generated in high-efficiency cogeneration, as indicated in Table ‘High Efficiency Cogeneration Plants’ of this report.\(^7\)

In 2010 cogeneration plants generated 4673 GWh (16.82 PJ) or 58.7%, while boiler houses accounted for 3289 GWh (11.84 PJ) or 41.3% of district heating thermal power. As indicated in Table ‘Cogeneration Plants’ effective

\(^7\) Ministry of Economics. www.em.gov.lv
Cogeneration provided 2981 GWh (10.73 PJ) of electricity in 2010, which constitutes 63% of the total amount of electricity generated by cogeneration plants.\(^8\)


In 2010 for the production of heat energy and electricity CHP plants mainly used natural gas (98.1%), as well as biogas, fuelwood, coal, residual (heavy) fuel oils and bio-diesel oil.

The Table ‘Overview Latvia’ shows the number of plants, the capacity installed, and electricity and heat produced.

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**Table ‘High Efficiency Cogeneration Plants’**

<table>
<thead>
<tr>
<th>Number of high-efficiency cogeneration plants</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of high-efficiency cogeneration plants</td>
<td>30</td>
<td>35</td>
<td>46</td>
<td>55</td>
</tr>
<tr>
<td>Set electrical power (MW)</td>
<td>553.1</td>
<td>676</td>
<td>891.4</td>
<td>898.3</td>
</tr>
<tr>
<td>Set thermal power (MW)</td>
<td>603.3</td>
<td>971</td>
<td>990.4</td>
<td>997.6</td>
</tr>
<tr>
<td>Generated electricity (GWh)</td>
<td>1911</td>
<td>1634</td>
<td>2000</td>
<td>2981</td>
</tr>
<tr>
<td>Generated thermal energy (GWh)</td>
<td>2568</td>
<td>2059</td>
<td>2029</td>
<td>2790</td>
</tr>
</tbody>
</table>

**Table ‘Cogeneration Plants’**

<table>
<thead>
<tr>
<th>Number of cogeneration plants, set power and generated energy</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cogeneration plants</td>
<td>43</td>
<td>48</td>
<td>56</td>
<td>71</td>
</tr>
<tr>
<td>Set electrical power (MW)</td>
<td>593.3</td>
<td>587.7</td>
<td>933.6</td>
<td>947.5</td>
</tr>
<tr>
<td>Set thermal power (MW)</td>
<td>3021.1</td>
<td>2737.3</td>
<td>2737.2</td>
<td>2856.6</td>
</tr>
<tr>
<td>Generated electricity (GWh)</td>
<td>1935.9</td>
<td>2103.6</td>
<td>2057.2</td>
<td>3049.9</td>
</tr>
<tr>
<td>Generated thermal energy (GWh)</td>
<td>4606.9</td>
<td>3990.2</td>
<td>4076.1</td>
<td>4730.8</td>
</tr>
</tbody>
</table>

* The set thermal power is displayed including the set power for thermal energy generation of water heated boilers

** The generated thermal energy is displayed including thermal energy generated by water heated boilers

3.7.7. Regulation

In Latvia cogeneration of energy is regulated by the Energy Law, the Electricity Market Law and Cabinet Regulations No. 221 “Regulations Regarding Electricity Production and Price Determination Upon Production of Electricity in Cogeneration” of 10 March 2009 and according to them, as well as the Law “On Regulators of Public Utilities” and herewith the Electricity Market Law adopted on 5 May 2005 provides that the merchant generating electricity in cogeneration may acquire rights to sell generated electricity within the framework of mandatory procurement.

As to cogeneration, in accordance with Section 28(2) of the Electricity Market Law the Cabinet of Ministers sets the following criteria:

- Qualification criteria to acquire the right to sell generated electricity within the framework of mandatory procurement;
- The procedure for the mandatory procurement and its supervision;
- The procedure for pricing electricity depending on electrical power and fuel used;
- The procedure for covering expenses of the mandatory procurement and the procedure for refusing from the right to sell generated electricity within the framework of mandatory procurement.
- Guaranteed fee for the electrical power of the cogeneration plant.

If a producer wishes to sell generated electricity within the framework of mandatory procurement, and its cogeneration plant complies with the criteria set by the Cabinet of Ministers, the remaining amount of generated electricity left after consuming it for own auxiliaries, is purchased by a public merchant in the manner and for the price set by the Cabinet of Ministers.

In accordance with the Electricity
Market Law Cabinet Regulations No. 221 ‘Regulations Regarding Electricity Production and Price Determination Upon Production of Electricity in Cogeneration’ were adopted on the 10th of March 2009 providing for the mandatory procurement of electricity generated by cogeneration for a set price, as well as envisaging rights to receive guaranteed fee for electrical power of the cogeneration plant.  

3.7.8. Project Financing  
High investment costs and problems raising funds are the most significant obstacles especially for local governments. There are three support instruments to promote the development of cogeneration plants and energy generation using energy from RS:  
• The mandatory electricity procurement;  
• The guaranteed fee for the set electric power;  
• Target subsidies are envisaged to promote the development of cogeneration power plants using energy from renewable sources to be invested into the construction of power plants using funding of Structural Funds of the European Union for this purpose.  

The possibility of a mandatory procurement and a guaranteed fee set forth in applicable laws and regulations is a significant support for the promotion of development.

Cabinet Regulations No.165 Regulations on the Activity 3.5.2.2 ‘Development of Cogeneration Plants Using Energy from Renewable Sources’ of the supplement to the operational program ‘Infrastructure and Services’ entered into force on the 17th of February 2009 to ensure implementation of the activity 3.5.2.2 ‘Development of Cogeneration Plants Using Energy from Renewable Sources’ of the supplement to the operational program ‘Infrastructure and Services’. The purpose of the activity is to significantly increase the amount of electrical energy and thermal energy generated using energy from renewable sources, thus reducing Latvia’s dependence on the import of primary energy resources. The activity envisages support for the building of cogeneration plants using energy from renewable sources. On the 1st of June 2011 contracts for 10 projects in respect of funding from the Cohesion Fund in the amount of Ls 21,365,499.55 were concluded within the framework of activity 3.5.2.2.

The ease of getting a loan from banks is very much dependent on individual project designs as they assess reliability of the chosen technology as well as feedstock supply security and price risks etc. Each bank in Latvia has different credit conditions. In general the interest rate for bioenergy projects equals general average interest rate on the market. The interest rate of each project is influenced by several risk factors, the key is definitely not the purpose of loan.

9 CM Regulations No.221 replace Cabinet of Ministers Regulations No. 921 “Regulations Regarding Electricity Production in Cogeneration” of 6 November 2006  
3.7.9. Readiness for Uptake

During the last four years only one CHP project was declined due to public opposition.

The Latvian Association of Heating Companies (LSUA), a professional organization uniting district heating companies, manufacturers of heating equipment, advisors and mounting companies, suppliers of heating units and equipment, as well as individual members, has been operating in Latvia since 1993.

Firstly, LSUA’s goal is to develop heat supply, and to introduce more progressive technologies, experiences as well as modern power-saving equipment. Furthermore, LSUA promotes the use of local fuel, and the development of local heating equipment manufacturing. Finally, LSUA aims at participating in the development of heat supply development plans and proposals of laws and regulations. At the moment, LSUA is uniting 64 members that generate about 95% of Latvian district heating.11

The Investment and Development Agency of Latvia (LIAA) is a state institution subordinate to the Ministry of Economics of the Republic of Latvia. LIAA offers assistance throughout the process of setting up operations in Latvia, acting as a first point of contact and as a ‘one-stop-shop’ in assisting investors by developing tailored solutions to meet their specific needs. LIAA has its own regularly updated database of Latvian enterprises to facilitate partner searches for investment projects and for exporting or subcontracting businesses. LIAA offers a matchmaking service, enabling potential investors and project partners to find suitable Latvian companies interested in M&A and joint venture opportunities.12

The Latvian biomass association ‘LATbio’ was established on the 25th of February in 2008 as a nonprofit organization. The main aims of the association are the advertisement of local RES in order to achieve higher economic and energetical independence of Latvia. LATbio’ spreads information about the availability of local RES and usage aspects, and promotes the development of scientific work in the field of renewable energy and harvest technologies.13

Founded in 1946, Latvian State Forest Research Institute (LSFRI) ‘Silava’ is main centre of forest science in Latvia and one of the leading establishments of scientific ideas in forestry and the related research and development in the country. LSFRI’s principal task is to research forest ecosystems and their components, and to work out recommendations for the sustainable and rational management and use of forests and its products.14

14 Latvian State Forest Research Institute "Silava". http://www.silava.lv
3.8. Finland

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3.8.1. Country Score

In the general scoring for CHP sector, Finland - South is rated place 31 out of total 81. The underlying categories that influence this result are displayed in the bar chart to the left.

3.8.2. Basic Data

Finland is a democratic republic in Northern Europe between 60 and 70 degrees north latitude. It is the seventh largest country in Europe with a total territory area of 338,424 km² (of this 69% forest, 10% waterways, 8% cultivated land and 13% other). The total population is 5.4 million. The capital and largest city is Helsinki (in capital area 1 million inhabitants). The population is mostly concentrated in the southern and central part of the country. About 80% of the population lives in urban areas.

Finland is the coldest country in the EU. Latitude is the principal influence on the country’s climate. On average, winter with snow lasts from mid December to mid March in the south, and from October to early May in the north. The vegetation zone is mainly characterised by boreal forest. The mean daily temperature in the capital Helsinki is minus 4 °C in
January and plus 18 °C in June. In Northern Finland - also called ‘Lapland’ - temperatures may fall to minus 25-35 °C in mid winter. However, because the Gulf Stream and the North Atlantic Drift Current moderate the climate, and because of the relatively low elevation of the land area, Finland contains half of the world’s arable land north of 60° northern latitude.

Finland is world famous for its large boreal forest and peatlands, and its global forest industry that comes therewith. Forestry land (incl. protected areas) is 228,000 km², of which 52% is owned by private families, 35% by the state, 8% by companies and 5% by others. The total volume of growing stock is 2,205 million m³ (solid), of which 50% is pine, 30% spruce and 20% non-coniferous. The annual growth is over 100 million m³ (solid) and annual fellings for industry purposes is 55 million m³ (solid). Total drain is 71,5 million m³ (solid). These numbers are industrial round wood contents, without branches, tree tops, unmerchantable round wood and stump and root wood, which adds volumes around 20-40% more. Peatlands cover about 30% of Finland’s territory. Peat is growing more annually than it is used for energy purposes, about 25 TWh per year. Most often peat is mixed with wood based fuels or coal at power or CHP plants. It is good quality, indigenous and low price fuel. Companies also import raw wood.

There are 2.3 million hectares arable farm land in Finland. Wheat, barley and oats are the most produced crops in agriculture, but also potato and other root vegetables are very common. About 0.5-0.7 million hectares can be used for energy purposes.

The road- and railway network is quite large (main roads 460,000 km, also dense forest road network, railroad net is 5,800 km). The maximum total weight for trucks is 60 tonnes on public roads. Also dense water transport systems and routes on the seashores and lakes exist.

Finland’s economy provides reliable frameworks for living and business. Living standards are high. GDP per capita is 38,000 € (2011). Finland is:
- Number one in World Economic Forum 2005 Competitiveness Rankings.¹
- One of the Least Corrupted Nations in the World (number one in 2007 and number two in 2011 / Transparency International).
- The Best Country in 2010 by Newsweek (indicators: education, healthiness, quality of life, economical dynamics and political frames).

Usefull links:
- Finland Statistics
- Common information
- Energy Statistics
- Bioenergy Statistics: [www.finbioenergy.fi](http://www.finbioenergy.fi) and [www.bioenergia.fi](http://www.bioenergia.fi)

¹ www.weforum.org
The objective of the national energy and climate strategy is to increase the use of RES and their share of energy consumption. In addition to energy conservation, this is one of the most significant means by which Finland’s climate targets can be reached. In use, RES do not increase carbon dioxide emissions, but they create employment, promote regional policy goals, and enhance the security of energy supply. The strategy also supports technology exports for the industry, which are already becoming an important part of Finnish exports.

Finland’s national target is to increase the use of renewables by 9.5% units to totally 38% in 2020. Bioenergy has a major role. Achieving the target 38% entails an increase in the use of renewable energy of approximately 40 TWh compared with 2005, when renewable energy use accounted for 28.5%. One particular target within this national action plan is for renewables to account for at least 20% of transportation fuels by 2020, taking into account the double counting referred to in the RES Directive. Total renewable energy target in 2020 is 124 TWh (85 TWh for heating and cooling, 33 TWh for electricity and 6.5-7 TWh in traffic) of which bioenergy is 105 TWh. Other targets are to decrease the greenhouse gas emissions at least 16% until 2020 and to increase energy efficiency 20% by 2020.

In order to promote CHP production using biogas (reactor plants), wood fuels and wind energy a market-based new feed-in tariff for electricity scheme...
was introduced, financed from the State budget. In the feed-in tariff system, an electricity producer whose power plant is approved in the system will receive a subsidy (feed-in tariff) for a maximum of twelve years. The feed-in tariff will be equivalent to the difference between the target price and the market price of electricity. The tariff will be paid only to new plants. The purpose of the subsidy at hand is the promotion of investments in wind power plants, biogas power plants and power plants fuelled with wood-based fuel, and it is dimensioned so as to have the total amount of subsidies paid to the power plant for the feed-in tariff periods to compensate for investment costs. One purpose of this subsidy is also to promote the replacement of peat and coal with forest chips and other biomass. More about feed-in tariff and investment grants in the chapter Regulation.

### 3.8.4. Feedstocks

The main biomass fuels for CHP and heat-only plants are wood based fuels, often mixed with peat. Industrial by-products like black liquor, bark, cutter shavings and some saw dust are almost totally used for energy purposes. The black liquor from pulp mills is the most important forest industry by-product that is used in soda recovery units in energy production. Bark is created in the forest industry. Sawmills provide sawdust, bark, industrial as well as energy chips. Saw dust and dry cutter chips are used as the raw material for pellets. In the future, sawdust will also be used for production of transportation biofuels.

Forest wood fuels transported directly to the energy plants have the greatest potential to increase the biomass use for energy. In the year 2010, a total of 85 TWh wood based fuels were used (liquid 37 TWh and solid 49 TWh), one fifth of the total energy consumption in Finland. Finland is the forest and peatland country. Almost 70% of the area is covered by forest. The total volume of growing stock is 2,205 million m³ (solid), of which 50% is pine, 30% spruce, and 20% non-coniferous. The annual growth is over 100 million m³ (solid) and annual fellings for industry purposes is 55 million m³ (solid). Total drain is 71.5 million m³ (solid). These numbers are industrial round wood contents, without branches, tree tops, unmerchantable round wood and stump and root wood, which adds volumes around 20-40% more. Companies also import raw wood.

According to the estimation reports, the theoretical maximum production potential of forest wood chips is 45 million m³ per annum. This potential corresponds to approximately 90 TWh. However, the practical target is that the use of wood chips in CHP production and separate heat production will be increased to 13.5 million m³ by 2020 (nREAP). This is equivalent to at least 28 TWh/90 PJ of fuel. Some 7 million m³ (solid) of wood chips were used in 2011. So, there is still a large unused potential for the generation of energy. Forest chips consist of logging residues (36%), small-diameter energy wood (29%), stumps (15%) and roundwood (20%).
Heat and power plants used 16 million m$^3$ (31 TWh) solid wood fuels in 2010. The amount increased 2.6 million m$^3$ from the year 2009. 6.7 million m$^3$ (17 TWh) went to the small houses for energy purposes. 6.2 million m$^3$ of the fuels used was forest chips and 9.2 million m$^3$ forest industry’s by-products.

Most of the forest chips was produced from small-sized trees and logging residues. Also the amount of wood chips made from stumps and roots increased. Biorefinery plants also use logging residues as raw material in liquid biofuel production. The first so called the second generation biorefinery plant is planned and coming near future in Finland. One large plant needs wood material around 0.5-1.5 TWh annually as a raw material.

Peatlands cover about 30% of Finland’s territory. Peat is growing annually more than used for energy purposes, about 25 TWh per year. Most often peat is mixed with wood based fuels or coal at power or CHP plants. It is good quality fuel, indigenous and low price fuel.

Finland has 2.3 million hectares arable farm land, of which 1.17 million hectares are used for food crops and 0.64 million hectares for fodder. Approximately 0.1 million hectares are used for cultivating oil plants. About 0.5-0.7 million hectares could be used for energy purposes without posing a threat to food production. If 0.5 million hectares is, thus, used, and assuming that the harvest yield is 20 MWh/ha, this would correspond to a potential of 10 TWh. Currently, agricultural residues are only marginally used for energy production. Up today a maximum of 20,000 hectares are used (reed canary grass and straw). However, the potential is quite large. It is estimated that 2.5 TWh can be easily taken and 7 TWh when taking 20% of

**Use of wood biomass 26-27 TWh/a**
- Bark, wood residue chips, sawdust, stumps, recovered wood, forest chips
- District heat and municipality CHP 7 TWh/a
- Industrial heat and CHP 18 TWh/a
- Condensing power 1 TWh/a

**In addition**
- Black liquor 40 TWh/a (pulp industry)
- Small combustion of wood in households 13 TWh/a
- Peat 25-30 TWh/a

**Energy industry’s wood supply still much dependent on forest industry**
straw potentials into energy use. Reed canary grass grown in the fields is harvested dry in the spring, and usually compressed into large bales. These and also straw bales are stored with care to wait for transportation to the power plant where they are crushed and then combusted amongst wood chips or peat.

3.8.5. Business Case

There are over 400 medium and large scale CHP plants in Finland. CHP produces 75% of the heat needed for district heating and generated 35% of electricity production. CHP is the most common way to produce also district heat in Finland, more than 70% of DH was generated in CHP plants (27 TWhth). The length of the district heating networks is 12,550 kilometres and increases annually by about 4%. The CHP and heat-only plant investments continues.

Today, wood based energy is the most important renewables and it is growing also in the near future. Wood energy usage today is almost as large as oil. In total, 86 TWh wood energy was used in 2011 (liquid 37 TWh and solid 49 TWh). 32 TWh (often mixed with peat) solid wood fuels were used in energy plants and 17 TWh in small houses. Carbon dioxide emissions from the production and use of energy is today 50 million tons (almost 70 million tons in 2002). Total energy consumption by sources in 2011: oil 24%, wood fuels 22%, nuclear energy 18%, coal 11%, natural gas 10%, peat 6%, net imports of electricity 4%, hydro and wind power 3% and others 3%.

Fuel procurement for major biomass CHP plants of the forest industry and cities is a demanding logistical entity which is managed by forest machinery and transport companies specialized in the field. The forest industry receives its timber and energy biomass as so-called integrated procurement. This means that industrial pulp wood and energy biomass are harvested and transported to the plants using mainly the same equipment. Major CHP plants buy their fuel through logistics companies, while the fuel for heat entrepreneurs’ plants is procured from nearby forests and delivered stakeholders.

So far, all forest chips and other material from the forest sites have been transported by truck (maximum brutto weight on public roads 60 tonnes), expect in trials with railway and waterway vehicles. A winter season with iced-over lake areas (3-4 months) will decrease the logistical effectiveness of waterway systems. In contrast, railway logistics offers more route options and year-round operation possibilities. The terminal operations are an essential part of railway logistics for keeping the train capacity in use. Public and forest road density is quite optimal in Finland and serves operating possibilities almost year-around.

Thus, also biomass production, handling technologies, and logistic system markets will serve huge possibilities to the stakeholder’s business over the
renewable energy plants are co-financed by the government with grants of up to 40% (new technology). For the plants using BAU technologies, the co-financing can be up to 30%. This financing applies to companies. Also there exists the feed-in tariff is paid only to new power plants. A power plant benefiting from the feed-in tariff would not be eligible for any other State aid.

Usefull links:

- Finnish Energy Industry Association
- Bioenergia Association with its members
- Ministry of Employment and the Economy - Energy
- Ministry of Agriculture and Forestry
- Statistics Finland

3.8.6. Market Environment

The total energy consumption in Finland was 1 386 PJ or 386 TWh in 2011. Consumption of electricity amounted to 84.4 TWh (16% of the electricity consumed in the country was covered with imported electricity). Already today, nearly 30% of the total energy consumption is being produced by RES. Bioenergy is the most significant source of renewable energy, accounting for approximately one-fifth of Finland’s total energy consumption. Today, wood-based energy is the most important RS and it will grow further in the near future. Wood energy usage today is almost as large as the one of oil. In 2011, 86 TWh wood energy was used (liquid 37 TWh
and solid 49 TWh). Solid wood fuels were used in energy plants 32 TWh (often mixed with peat) and in small houses 17 TWh. Carbon dioxide emissions from the production and use of energy is today 50 million tons (almost 70 million tons in 2002). Total energy consumption by sources in 2011: oil 24%, wood fuels 22%, nuclear energy 18%, coal 11%, natural gas 10%, peat 6%, net imports of electricity 4%, hydro and wind power 3% and others 3%.

Finland is one of the world leaders in the utilization of wood based energy, the development of biomass combustion technologies, and the creation of efficient fuel supply chains from farm-size up to the world’s biggest biomass plant. The cold climate, long distances and an energy intensive industry explain why Finland has a relatively high demand for energy. The specific energy consumption per capita is high; industry uses about half of the energy generated. An efficient and balanced energy system is crucial. Today, significant indigenous energy sources are limited mainly to wood fuels, peat and hydropower, but the range will be widened with wind, biogas, agricultural biomass, biofuels for transport, and heat pumps. The use of wood fuels is growing the most. The use of wood chips in CHP production and separate heat production will be increased to 13.5 million m³. This is equivalent to at least 28 TWh of fuel. In 2011 some 7 million m³ of wood chips were used.

For biofuels, the availability and prices of biomass raw materials, logistics and other production costs play an important role when competing with fossil fuels.
The efficiency of wood sales will be improved by the development of up-to-date, precise, and comprehensive price statistics systems. Market information will be produced through a portal, so that parties will be able to access almost in real time price information on raw wood. The most effective incentive for innovation is a market where broad diffusion of new solutions happen quickly and open-mindedly. In addition to promoting research and development activities, innovation policy aims to boost demand for innovations thereby encouraging companies to develop more advanced products and services.

About half of Finland’s population lives in houses heated by district heat. Consequently, 55% of district heat is used for heating homes. Heating of industrial buildings accounts for 10% of annual consumption of district heat, and the remainder 35% is used by public buildings, offices and shops. Almost 95% of apartment buildings and most public and commercial buildings are connected to the district heating network. In single-family houses, a good 7% of the heating energy comes from district heat. In larger towns, the market share of district heating is more than 90%. The average price of district heat (value-added tax included) was 6.39 euro cents per kilowatt hour in 2011.

Finland is a long country between the 60 and 70 degrees north latitudes (length 1150 km) and one third is called North Finland, of which almost half part is over the Arctic circle (see areal map).

Because of the cold weather, good insulation of CHPs and heat-only plants district heating pipes improve the energy efficiency. The pipelines used in Finland consist of two service pipes made of steel, surrounded by polyurethane thermal insulation. The insulation layer is protected by an outer casing made of polyethylene plastic. A similar structure is currently used also elsewhere in Europe, but the two-pipe design is a Finnish and Swedish speciality. The structure of district heating pipes is standardised by means of European EN standards. However, at present all one-pipe and two-pipe structures use the maximum insulation thickness, the so-called series 3 specification. So, the thermal insulation on Finnish district heating pipes is thicker than in other European countries.
3.8.7. Regulation

In Finland, there is feed-in tariff for renewable electricity, which is annually financed by the State budget. The Act on Production Subsidy for Electricity Produced from Renewable Energy Sources (1396/2010) lays down provisions on a feed-in tariff system for which power plants fuelled with wind, biogas, forest chips and wood-based fuels meeting the prescribed preconditions could be approved.

In the feed-in tariff system, an electricity producer whose power or CHP plant is approved in the system will receive a subsidy (feed-in tariff) for a maximum of twelve years. The subsidy varies on the basis of a three-month electricity market price or the market price of emission allowances. The producer is paid a feed-in tariff, which is the difference between the target price and the spot market price (last 3 months’ average) in accordance with the amount of electricity produced in a wind, biogas or wood-based power plant, approved for the feed-in tariff system. The tariff will be paid only to new power plants or CHP plants. The target price for electricity produced from biogas, wood fuels and wind covered by the feed-in tariff scheme is €83.50 per megawatt hour. In CHP production, in addition, a heat premium of €50/MWh is paid for electricity produced from biogas and €20/MWh from wood energy by way of a supplement to the feed-in tariff. The cost of the biogas electricity support scheme is estimated at around €2 million in 2011 and around €10 million in 2020 if the market price for electricity is €50/MWh. If the electricity producer is
not using feed-in tariff system, the plant owner can get fixed subsidy of €6.90 per MWh for wood fuels and €4.20 per MWh for biogas in power production.

The purpose of the subsidy in question is to promote investments in wind power plants, biogas power plants and power plants fuelled with wood-based fuel, and it is dimensioned so as to have the total amount of subsidies paid to the power plant for the feed-in tariff periods to compensate for investment costs. One purpose of this subsidy is to promote the replacement of coal and peat with wood based fuels and other biomass.

A power plant benefiting from the feed-in tariff would not be eligible for any other State aid like the construction investment costs of renewable energy plant are co-financed by the government with grants of up to 40%, new technologies. For the plants using BAU technologies, the co-financing can be up to 30%. This financing applies to companies.\(^2\)

The Energy Market Authority approves power plants and CHP plants for the feed-in tariff system, pays the feed-in tariff upon application, and manages other official tasks in the feed-in tariff system.

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3.8.8. Project Financing

Finland is a member of the Eurozone; hence, currency exchange risks for investors from other Eurozone countries are low. Finland’s economy is rated with one of the best scores at Standard & Poor’s and Moody’s.\(^3\) In addition, Finland was number one in World Economic Forum 2005 Competitiveness Rankings\(^4\) and one of the Least Corrupted Nations in the World: number one in 2007 and number two in 2011.\(^5\) Finland’s credit rating is AAA.

There are plenty of international and national banks situated in Finland. Loan interest levels are rather low but variable. The easiness of getting a credit from banks is very much dependent on individual projects. Common VAT is 23% but companies have possibilities to be rebated.

In the EU, the competition rules are generally divided into two parts: regulations applying to the use of public support (government support) and regulations related to the conduct of businesses. Investments between the OECD member countries are regulated by the organisation’s so-called National Treatment Instrument, Code of Liberalisation of Current Invisible Operations and Code of Liberalisation of Capital Movements, and the Guidelines for Multinational Enterprises, of which the latter still only comprises

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\(^3\) [www.standardandpoors.com/home/en/eu](http://www.standardandpoors.com/home/en/eu) and [www.moodys.com](http://www.moodys.com)

\(^4\) [www.weforum.org](http://www.weforum.org)

recommendations. The Ministry for Foreign Affairs of Finland provides knowledge and information about trade and partnership possibilities for national and international business cases. By international comparison concerning the number of investment agreements, Finland ranks among the middle group together with Sweden, Denmark, Austria and Belgium. At the moment, the number of valid agreements is somewhat over 50. Germany, Great Britain and Switzerland have the most comprehensive networks of agreements, each with well over one hundred agreements.

The partnership with Finnish companies is also worth while. Finpro trade supporting organization has 400 professionals in almost 50 countries. It opens up future business opportunities by understanding changes in international markets. It serves clients by enabling them to be in the right markets at the right time with a competitive concept.

The specific energy project financing institution is the Ministry of Employment and the Economy. It offers different kinds of support in financing, investing and developing projects of renewable energy projects in Finland. The maximum energy subsidy per cents granted by the Ministry of Employment and the Economy are 40% when investments are targeted at new technologies or energy saving appliances at plants using renewables. The subsidy is at 30% when investments flow into ordinary technologies or technologies that decrease environmental damages. Typical public energy grants range from 10-15% for heating plants, from 15-20% for landfill gas plant, and from 10-20% for wood chips or industrial waste wood production machineries etc.

Usefull links:

- **Ministry for Foreign Affairs of Finland**
- **Ministry of Employment and the Economy**
- **Finpro**
- **Bioenergia Association with its members**

### 3.8.9. Readiness for Uptake

Finland is one of the world’s leading users of RES, especially bioenergy. For instance, the production of food based fuels with different kinds and sizes of machinery fleets, logistic systems and operation education, a high level of practical knowledge exists. Also fuel procurement technology, boiler design and manufacturing are globally well-known.

Today, over 400 medium and large scale biomass CHP and heat-only plants are operating in the country. You can see modern bioenergy plants and technologies everywhere in practice, from farm size up to the world’s biggest biomass power plant. Many universities, institutes, schools and private companies provide education and training in energy and bioenergy know-how and technology, from the practical field courses to the
highest level of scientific research. Finn-made CHP plants, and modern harvesting and transport technologies for biomass are known worldwide. It is easy to contact companies and public authorities when you are planning cross border project into Finland or partnership possibilities with Finnish companies for global business.

**Usefull links:**

**Associations:**
- Finnish Energy Industry Association
- Bioenergia

**Institutions:**
- Ministry of Employment and the Economy - Energy
- Ministry of Agriculture and Forestry
- Ministry for Foreign Affairs of Finland
- Finnish Forest Research Institute
- VTT Technical Research Centre of Finland
- Motiva

**Companies:**
There are hundreds and hundreds energy and bioenergy CHP and heat-only plant companies and manufacture companies. Internet addresses exist under Associations links.
Leading questions of the CHP-market handbook:

1. Country profile (geography, demographics, logistics, etc.)

1.1 Geography and Climate

- Total land area
- What is the average winter temperature across regions in target country over the last 10 years?
- What is the average summer temperature across regions in target country over the last 10 years?
- Total number of inhabitants
- Total number of households in the country
- Population density
- Household density

1.2 Wealth/economic status of population

- What was the average GDP real growth rate between 2008 - 2010?
- GDP per capita for 2010

1.3 Logistics - road and rail network

- What is the density of rail-network?
- What is the density of road-network?
- What is the density of water ways-network?
- What is the density of the electricity transmission and distribution networks?
- What is the density of the gas transmission and distribution networks?

2. Energy Policy (political will, nREAP, etc.)

2.1 The nREAP is ambitious and proposes appropriate measures

- There are high-volume targets for RES
- There are high-volume targets for solid biomass for heat
- There are high-volume targets for solid biomass for electricity
- There are high-volume targets for electricity from CHP
- Proposed measures for CHP electricity in nREAP are appropriate and convincing
2.2 A political will to develop the RES-sector is clearly recognisable and stable

- Does the government provide an appropriate budget for the targeted market growth for DH and CHP?
- Have the support schemes/framework conditions for investments in heat changed within the last 2-4 years?
- Have the support schemes/framework conditions for investments in renewable electricity changed within the last 2-4 years?
- Is a revision of the framework conditions announced, which could affect the small-scale heat market development?
- Is a revision of the framework conditions announced, which could affect the electricity market development?
- What is the period of time before the next general (national) elections.

3. Feedstocks

3.1 The solid biomass potential is sufficient to realise small scale heat/CHP/DH projects?
- To what extent will the domestic availability of wooden biomass of forestry change by 2020?
- How large is the wood for energy potential from forests today?
- How large is the wood for energy potential from industrial residues today?
- How large is the wood for energy potential based on waste wood today?
- What is the total forest wood potential (irrespective of use)?
- What is the % of forest area owned by public bodies?
- What is the difference between fellings and increment (net growth)?
- What is the % of fellings dedicated to energy purposes?
- How much of the wood for energy potential from forests is already utilised?
- How much of the wood for energy potential from industrial residues is already utilised?
- How much of the wood for energy potential based on waste wood is already utilised?
- What is the amount of solid biomass feedstock used in competing sectors (e.g. fiber board industry) currently?
• Share of the total yearly wood demand fulfilled by imports on latest available year
3.2 Feedstocks are available for biofuel production
• Area of fallow/abandoned land available for agricultural expansion

4. Economic instruments (prices, support schemes/guarantee, subsidies, etc.)
4.1 Financial support schemes can be claimed for investments
• What proportion of the investment in CHP can be claimed in subsidies (cumulative, including tax advantages)?
• When does the scheme end granting funding for CHP?

4.2 Financial support schemes can be claimed for operation
• <500kW capacity: How high is the legally guaranteed feed-in tariff for electricity for solid biomass CHP in 2010?
• 501kW - 2MW capacity: How high is the legally guaranteed feed-in tariff for electricity for solid biomass CHP in 2010?
• 2.1MW - 10MW capacity: How high is the legally guaranteed feed-in tariff for electricity for solid biomass CHP in 2010?
• How long is the guaranteed duration of the CHP support scheme?
• Is the CHP support schemes threatened by a maximum public spending budget?

4.3 Prices of biomass fuels/raw material are reasonable and stable
• What is the price for a kWh(th) for a tonne of wood chips
• What was the price volatility of wood chips over 1 year period?

4.4 Prices of fossil fuels are high and heavily taxed
• What was the average price of coal for households over the last year (2010)?
• What was the average price of coal for large scale consumers over the last year (2010)?
• What is the commodity price development of coal over the last 4 years?
• What is the tax on coal?
• Is the use of coal supported e.g. by tax incentives, obligations, free delivery of CO2-allowances etc.?
Market Handbook CHP

1. Market aspects (volume, access to grid, etc.)

5. Market aspects (volume, access to grid, etc.)

5.1 The energy sector is large and expected to grow

- Amount of coal used by medium and large-scale consumers (2010)?
- Expected growth in large-scale use of coal from 2009 to 2020
- Amount of gas used in medium and large scale consumers (2010)?
- Expected growth in large and medium-scale use of gas from 2009 to 2020
- Amount of total national electricity consumption
- Expected growth in national electricity consumption from 2009 to 2020
- What is the average age of the stock of power plants (coal, natural gas, nuclear)
- Has the region decided to phase out nuclear energy providing potential for RES?

5.2 Access to the electricity grid is guaranteed

- Is there in general an electricity grid available with sufficient capacity?
- Is there in general an electricity grid available with regulated grid access?
- Is there in general an electricity grid available with regulated costs for grid connection?
- Is there in general an electricity grid available with priority for RES?
- Is the grid operator obliged to connect all renewable energy installations?

5.3 Is access to the heating grid ensured?

- Are there priority rules for renewable energy in the DH sector?
- What is the average age of the stock of domestic heating appliances
5.4 Produced energy can freely be marketed
- Is the electricity market liberalised and private firms are free to participate in any part of the supply chain?
- Is the heat market liberalised and private firms are free to participate in any part of the supply chain?

5.5 The electricity market in the target country provides promising growth perspectives
- What is the rate of additional electricity demand until 2020 (overall, not only RES)?

5.6 The heat market in the target country provides promising growth perspectives
- What is the rate of the additional heat demand until 2020 (overall, not only RES)?

5.7 The Framework conditions for fossil fuels do not impair market development
- What is the contribution of imported coal to primary energy supply in real terms?
- What is the percentage contribution of imported coal to primary energy supply?

5.8 Bioenergy is already implemented with a strong growth
- What is the share of biomass CHP compared to all CHP (in terms of electricity)
- What is the growth rate of biomass CHP electricity output over the last 4 years (CAGR)

5.9 An intense competition is not recognisable
- Number of competitors providing (manufacture or sale) large-scale biomass-fired facilities
- Total amount of CHP capacity sold (by existing competitors) over the last 4 years

6. Regulations (laws/mandatory targets for bioenergy, permitting, emission thresholds, etc.)
6.1 Regulatory instruments to support bioenergy markets have successfully been introduced
- How large is the quota for RES electricity in absolute terms?
- How large is the quota for RES heat in absolute terms?
6.2 The approval procedure by the authorities is adequate in terms of time

- How long does an average permitting procedure for CHP/DH projects (<500kW) take in the target country (Only the duration of the permission by the authority; finished plan of the plant and without negotiations of support scheme)?
- How long does the approval process last in average for large scale (>2MW) CHP/DH plants

6.3 Are criteria for efficiency required?
- Is there a fuel efficiency requirement for biomass in CHP plants?

6.4 Existing emission thresholds can be fulfilled with the applied technology

500kW - 2MW CHP: Dust emission limits for heating systems based on solid biomass (in mg/Nm3)

- 2MW - 5MW CHP: Dust emission limits for heating systems based on solid biomass (in mg/Nm3).
- >5MW CHP: Dust emission limits for heating systems based on solid biomass (in mg/Nm3).

500kW - 2MW: CO emission limits for heating systems based on solid biomass (in mg/Nm3).

- 2MW - 5MW: CO emission limits for heating systems based on solid biomass (in mg/Nm3).
- >5MW: CO emission limits for heating systems based on solid biomass (in mg/Nm3).

500kW - >5MW: NOx emission limits for heating systems based on solid biomass (in mg/Nm3).

- >5MW: NOx emission limits for heating systems based on solid biomass (in mg/Nm3).
- Organic Carbon emission limits for heating systems based on solid biomass (in mg/Nm3).
7. Project financing context (economic situation, loan, banks, etc.)

7.1 The country has a solid financial position
- Standard and poors rating

7.2 Export friendliness
- Euler Hermes rating
- Corruption perception index
- Country risk as reflected by the @rating country of COFACE
- Ranking of feasibility of “starting a business” in the IFC-World Bank Doing Business Index
- Ranking of Feasibility of “getting credit” in the IFC-World Bank Doing Business Index

7.3 The banks are familiar with bioenergy technology and support its development
- Is the support of bioenergy projects highlighted in official papers of the banks, like annual reports etc.?
- Are Governmental guarantees for loans for bioenergy investments in place?

7.4 Foreign investments are supported in the target country
- Are there any programmes implemented in the region to attract foreign investments?

7.5 The banks in the target country provide attractive conditions for bioenergy projects
- Can bioenergy plants benefit from interest rates for credits lower than usual in the market?
- Are the support conditions feasible in an adequate scope?

7.6 The market is liquid and transparent
- Biomass fuel prices (wood chips, pellets, etc.) are published on market places
- Financial market instruments (e.g. hedging, futures) are available to lower the biomass fuel price risk
7.7 The value of the investment is stable due to a low currency exchange risk

- Is the market part of the Euro Zone?
- Was the inflation rate of the country more or less stable within the last 4 years (CAGR)?

8. Readiness for uptake (public acceptance, stakeholder networks, etc.)

8.1 Efficient networks and information are accessible

- National and regional agencies are providing effective help to foreign companies wishing to invest
- Is there a CHP association assisting the market?
- Public web sites/information/market reports on bioenergy

8.2 Public acceptance/knowledge of technology

- Is CHP known to and well-regarded by general public?
- Have any CHP project permissions been declined due to public opposition in the last four years?
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