CHP as part of the energy transition

The way forward

October 2014

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CHP as part of the energy transition – the way forward

A EURELECTRIC paper *October 2014*

KEY MESSAGES

EURELECTRIC sees Combined Heat and Power (CHP) as an important element of Europe's transition to a diverse and low-carbon energy mix. CHP is a mature technology that can achieve very high efficiency, and as a result save primary energy and contribute to low carbon dioxide (CO_2) emissions.

However, CHP plants today face serious difficulties because of conflicting policies, tax increases, high gas prices and low wholesale power prices caused by the economic downturn and the rapid increase of variable renewable power generation. There is a risk that ageing CHP plants will be replaced with less energy-efficient alternatives and that the opportunities of CHP remain untapped.

EURELECTRIC recommends six measures to improve the policy framework influencing CHP:

1. **Strengthen the EU ETS, it rewards the energy efficiency of CHP**: larger CHP plants fall within the scope of the EU Emissions Trading Scheme (EU ETS). Given its low emissions, CHP would be more competitive if EU ETS was the key driver for decarbonisation.

2. **The policy framework should drive CO_2 reductions in all sectors, including heat.** District heating is at a competitive disadvantage compared to other heating technologies, if the costs of CO_2 are not internalised. The extension of the EU ETS within the heating sector should be studied.

3. **Develop power markets to incentivise a more flexible energy system:** CHP plants can contribute to making the energy system more flexible, allowing it to adapt as decarbonisation progresses. The EU should strive to develop day-ahead, intraday and balancing markets in a way that incentivises CHP plants to provide such flexibility. Barriers for the participation of the aggregated flexibility from smaller plants in spot and intra-day markets, system balancing and constraints management should be removed. Capacity remuneration mechanisms, where applied, should be technology-neutral and open to all CHP plants.

4. **Avoid taxes on fuels for power generation:** the different levels of taxation across EU Member States undermine the EU's objective of creating a European-wide internal energy market. Power generators in the EU, including CHP plants, need to be able to compete on a level playing field.

5. **Ensure a secure, competitively priced and flexible supply of the fuels used for CHP:** Gas market flexibility should be increased, interconnections developed, and gas supply diversified. European and national regulation on waste fuels and biomass should provide stability and predictability, remove barriers to trade, and contribute to biomass sustainability.

6. **Ensure a stable and proportionate framework for other emissions:** The emission limits proposed in the Best Available Technique Reference Documents and for medium combustion plants should be proportionate and take account of factors such as load factor and age. This will enable CHP plants to reduce emissions cost-effectively without jeopardising investment.

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Introduction

CHP is an opportunity for the energy transition

Combined Heat and Power ("CHP", or "cogeneration" as it is sometimes called) has caught the interest of many politicians and stakeholder interest groups because of its potential to save fuels and reduce CO_2 emissions. A well designed CHP plant can reach up to 90%[1] overall efficiency in suitable applications. This means major improvement in the efficiency compared to separate production of electricity and heat. Saving primary energy not only reduces CO_2 emissions but also increases Europe's energy security. Previously CHP plants with a high and stable heat load have also been widely profitable in the EU due to their high efficiency.

CHP provides an energy-efficient opportunity to use renewable energy sources – mainly biomass – and waste for the production of electricity, steam, heat or cooling. Biomass CHP that produces district heat is an excellent option for increasing the share of renewable heating technologies in cities. When combined with heat storage, CHP can also provide flexibility to the power system.

So far the recent trend of increasing share of more decentralised power generation has been more focused on PV and wind power. However, CHP plants are also often comparatively small, and generate electricity for consumption on site. Micro-CHP extends the idea of cogeneration for homes and small office buildings.

… and goals have been set for its adoption

Increasing the penetration of CHP is one of the elements in the EU's strategy to decrease CO_2 emissions. More than fifteen years ago the European Commission set a goal to double CHP electricity production from 9% to 18% of total EU electricity production by 2010. More recently provisions aiming to promote CHP were included in the Energy Efficiency Directive. The target of 18% CHP production has not been reached and the current share is about 11% (2011).

Existing European and national energy, climate, environmental and fiscal policies support the political aims to increase the penetration of CHP to a varying extent. Several countries have chosen to promote CHP primarily with dedicated support measures. The design of the support systems varies from feed-in systems (FIT or FIP) to investment support, tax breaks or other benefits such as priority access.

…but the business environment is deteriorating

Obstacles to the development of CHP still exist. They include different connection fees to the grid, environmental fees, taxation and other institutional and financial obstacles. In the current challenging business environment it is important that policymakers assess and review the policies that influence CHP.

In recent years CHP has faced new challenges. Conflicting policies have had an adverse effect on the business environment of power generation in general. The massive introduction of supported, variable RES combined with economic downturn has led to low wholesale market power prices while the natural gas prices remain at high level. With an increased share of variable power generation as well as other supported production of energy the running hours for

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[1] up to 90%, or even higher if flue gas condensation is installed

CHP have in many cases decreased. Policy framework that focuses on promoting RES rather than driving decarbonisation distorts the energy market, and does not reward the energy efficiency of CHP.

Report Outline

The purpose of this paper is to show how the competitiveness of CHP can be enhanced by improving the policy and regulatory framework. The main focus of the report is on large-scale CHP that is in the scope of EU emissions trading, but it also takes a look at the participation of smaller CHP plants to the power market. The report introduces the current role of CHP in Europe and discusses its future potential and opportunities (Chapter 1). It describes how EU and national policy measures influence the competitiveness of CHP and provides examples of taxes and support measures for CHP in 7 Member States (Chapter 2). Finally, it recommends six measures to improve the regulatory framework for CHP and thus unlock its potential (Chapter 3).

EURELECTRIC's recommendations rely on the principle of technology-neutrality and do not compromise competition in the market. **The recommended measures increase the competitiveness of CHP without impinging on the following characteristics of a liberalised energy market**:

- **Mature technologies (such as CHP) should compete on the market with other electricity and heat production technologies based on their commercial and environmental merits.** Pricing of heat supply to end-customers from a district heating network competes with other technologies such as heat pumps and individual gas boilers etc. Especially regulation that leads to inefficient use of primary energy should be avoided.
- The distortive impacts of support should be minimised and support for mature technologies should be gradually phased out. Support should be focused on research and development, demonstration and early deployment of new technologies.
- Electricity is priced on competitive electricity markets where price formation is driven by market demand. Power generation is exposed to wholesale market price signals.

CHAPTER I Current Status and Future Opportunities

This chapter introduces CHP, shows how it is applied in Europe and discusses the future potential and opportunities for CHP.

What is CHP?

Combined production of power and heat, cooling or industrial steam

Combined Heat and Power is a process that transforms primary energy into both thermal and electrical energy. The generated electricity is used locally or fed into the grid, while the thermal energy is used in applications such as district heating or process heat for industry. The industrial process heat is usually distributed and used as low-pressure steam. In district heating systems it is most common to distribute the heat as pressurised hot water. There are also steam systems, which are however significantly less efficient, especially in case when the heat is distributed over long distances. In some countries district cooling has gained increasing interest and sometimes the chilled water is produced in a CHP plant.

Today CHP is mainly applied in three areas: district heating, industrial processes and small-scale CHP solutions. CHP is a mature technology and in most cases the same type of basic equipment such as boilers, steam turbines, combined cycles and gas engines are used for the separate production of electricity and heat.

A highly efficient production of heat and power

The overall efficiency of a CHP plant can be very high, because the residual heat released while producing electricity is utilised for heating. A well-designed CHP plant can reach up to 90% efficiency (or even higher if flue gas condensation is installed). Thus CHP leads to primary energy savings compared to separate generation of heat and power. Figure 1 illustrates the high efficiency of a back-pressure and extraction plant compared to a condensing plant.

The actual energy saving when running a CHP plant compared to separate production is strongly influenced by the presence of a high and stable heat demand that facilitates the use of all the available heat. A few CHP plants are operated, in effect, as a mixture of a classical condensing plant and an optimised back-pressure CHP plant. This means that the potential for fuel and CO_2 savings is not fully utilised. This has not always been visible in the CHP statistics. With the Cogeneration Directive[2] (2004/8/EC) and its definition of high efficiency CHP the statistics have improved. However, the ability of a CHP plant to produce electricity in condensing mode improves its flexibility.

Local heat load also influences the profitability of a CHP plant. Without adequate heat load and sufficient operation hours CHP is not economically justified. In addition to heat load, existing infrastructures such as a district heating network are a major factor in determining the economic potential for CHP.

[2] Now replaced by the Energy Efficiency Directive 2012/27/EU

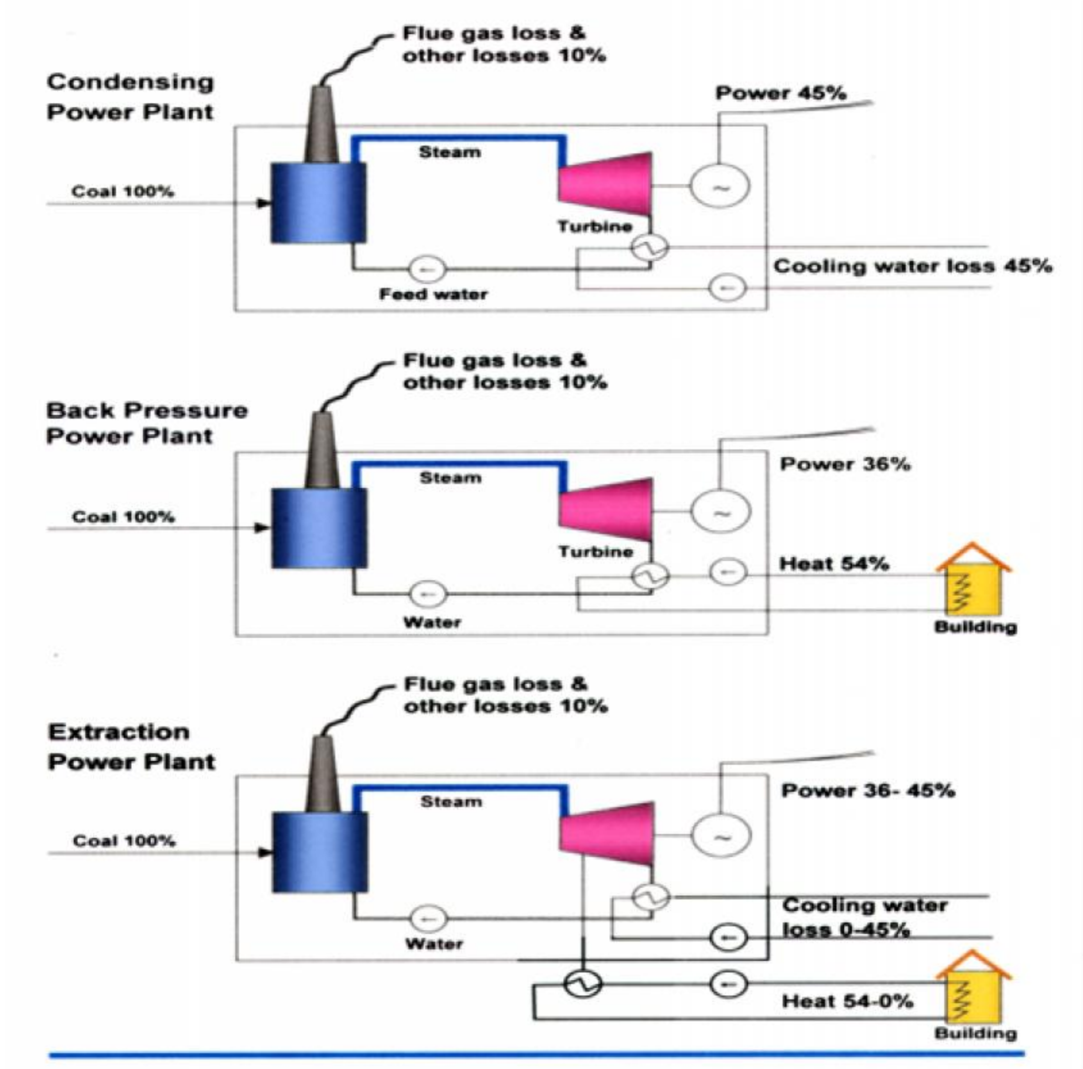

Figure 1: A comparison of a condensing power plant with two CHP technologies (back-pressure and extraction power plants): efficiency and main functions. The selected example describes a coal fired plant, but the principles apply to plants using other fuels as well.

Technology for fossil and renewable energy

Fuels used in CHP plants are basically the same as in condensing power plants: coal, natural gas, oil, biofuel, biomass, peat and waste. Some applied CHP technologies can use multiple fuel types, providing flexibility at a time of growing fuel insecurity and price volatility. For fuel cells, hydrogen can either be produced from water with the help of electricity or from natural gas. There are also examples of CHP plants that use geothermal energy for producing electricity and heat in countries with a high potential for geothermal energy (such as Iceland). Even the sun can be used in CSP-plants (CSP=Concentrating Solar Power) where the sun acts as “fuel” in the Rankine cycle.

Coal is generally associated with the benefit of availability and relatively low prices, while its environmental performance is weaker than other fossil fuels given its higher CO_2 and other emissions to air. Natural gas causes less CO_2 and other emissions than other fossil fuels and is thus a more environmentally friendly option. Moreover, it enables the use of efficient and flexible technologies, such as Combined Cycle Gas Turbines. CCGTs also have a significantly higher power to heat ratio than steam turbines. However, natural gas prices are typically higher than those of coal when compared in terms of price per energy content. Depending on the underlying scenario, the IEA expects gas prices in Europe to either slightly increase or decrease by less than 10% up to 2025[3]. Dependency on imported gas remains a concern for Europe, which has increased recently due to the crisis in Ukraine.

Biomass, biogas and, partly, waste provide an opportunity for renewable CHP, and CHP is the most energy efficient technology for energy use of bio-based fuels. Use of locally sourced solid fuels also contributes to decreasing dependence on imported fuels and increasing local employment. Despite efforts that energy companies and other actors of the supply chain have taken to ensure sustainable use of biomass, there are question marks over public and political acceptance in some countries. The demand for biomass as a fuel has been forecasted to increase, and this is likely to lead to upward price pressure.

Provider of flexibility

In order to increase the flexibility of a CHP plant heat storage (a tank with water or underground heat storages) and separate electric boilers can be installed. During periods with low heat demand, heat from the CHP plant can be stored and used later during peak hours. The electric boilers[4] can be used during periods with low electricity prices to produce heat and store it. The flexibility of CHP plants can also be increased by producing electricity in condensing mode.

Energy production with lower emissions

Due to its high efficiency CHP is associated with lower CO_2 and other emissions than the separate production of heat and power. The environmental performance of CHP plants varies according to the technology. For example modern gas turbines are usually equipped with low-NOx-burners as standard. Combined with natural gas as a fuel, this results in very low emissions of NOx, SO2 and dust. Technologies under development such as fuel cells can also achieve very good environmental performance.

Energy production in all sizes

Depending on the technology CHP plants can be built in all sizes, from less than 1 MW up to several hundreds of MWs per unit. Several units can be installed at the same site, resulting in more than 1000 MW electricity and heat capacity. A general technical advantage of especially small CHP units is that they can be located close to the heat load, thus reducing heat losses, and that the electricity can be inserted in the lower voltage network. Therefore there is no need to be located close to the transmission network and even electricity losses can be reduced. Land use issues or the environmental concerns of the public may prevent construction of CHP plants very close to the city centres. Large CHP plants benefit from economies of scale and are especially suitable for large district heating systems with high heat load density and low heat losses.

Strengths and weaknesses in a nutshell

As described combined heat and power is associated with both significant benefits and limitations. The table below summarises the main weaknesses and strengths of this technology, taking into consideration economic and technical aspects, security of supply, environmental

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[3] IEA. World Energy Outlook 2013.

[4] For example electric steam boiler is a type of boiler where the steam is generated using electricity, rather than through the combustion of a fuel source and electric water boiler is a type of boiler where hot water is generated by using electricity rather than through the combustion of a fuel source.

aspects, public acceptance, and power sector transition. Some characteristics do not apply to all sizes, for example micro-CHP units.

Table 1: Strengths and weaknesses of combined heat and power

	STRENGTHS	WEAKNESSES
FUEL EFFICIENCY	Reduced primary energy consumption because of high energy efficiency	Energy efficiency strongly depends on circumstances (size compared to load) that may change
CARBON EFFICIENCY	Low CO_2 emissions thanks to high efficiency and internalisation of CO2 costs	CO_2 policy sensitive if coal or gas fired
AIR QUALITY	Low pollutants emissions thanks to high efficiency	Not emissions free
BIOMASS	CHP is fully compatible with biomass use	Dust emissions. Sourcing (including price developments) of biomass.
NATURAL GAS	Gas is the cleanest fossil fuel and perfectly suited to operate in CHP	Relatively high gas prices and long term contracts for gas reduce the economical attractiveness. Security of gas supply to be improved, particularly in the most vulnerable regions.
COAL	Price competitive, easy to source, independent from politically unstable regions	CO_2 and other emissions. CO_2 price sensitive
DISTRICT HEATING NETWORKS	Legacy DH networks and small DH networks can be built in economical way	Where not existing DH networks are capital intensive
SITING ISSUES	CHP is located closer to customers: avoidance of costly grid and grid losses	CHP is located closer to customers (e.g. higher likelihood of complaints on pollution)
FLEXIBILITY	Well-designed plants can have a high degree of flexibility (e.g. when coupled to heat storage or additional electric heating such as heat pumps)	Reduced flexibility of average CHP plant because of heat requirements
DUAL USE	CHP can be adapted to provide both heat and cooling	Load factors determined by heating and cooling demand

CHP in Europe today

Used widely across Europe

Combined heat and power is widely used across Europe. The European Commission estimated in 2008 that by saving primary energy, CHP reduces CO_2 emissions within the European Union by 100 million tons/year[5].

The total installed CHP capacity in the EU-27 was 105.3 GW_e in 2011. Some 375.5 TWh of electricity, which represents approximately 11% of the total power generation, was produced in CHP plants. As shown in the figure below, the share of CHP varies considerably between European countries, with the largest share in Latvia, Denmark, Lithuania, Finland and the

5 Commission Communication COM(2008) 771 final. Europe can save more energy by combined heat and power generation

Netherlands. In absolute terms the largest producers of CHP electricity in 2011 were Germany (26.6 TWh) followed by the Netherlands (9.2 TWh) and Poland (8.8 TWh). These differences reflect different national policy regimes together with climate and other factors.

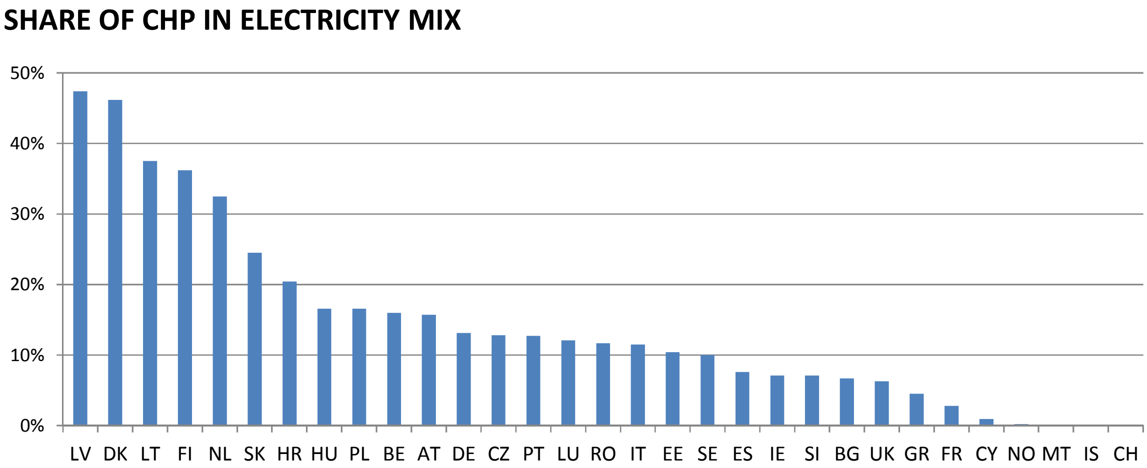

Figure 2: Share of CHP in EU27, Iceland, Norway, Switzerland and Croatia in 2011(Eurostat)

In Southern Europe combined heat and power is mainly used to produce industrial steam. In countries with a colder climate and larger heat loads, using CHP for both for industrial and heating purposes is common. In Finland, for example, more than one third of CHP electricity was generated in industrial CHP plants, implying that a significant amount of industrial steam is produced in CHP plants. In Poland approximately 60% of heat generated in combined heat and power is consumed in households, and the rest consumed in industrial processes. Countries that have built district heating (DH) networks in urban centres have an advantage in deploying CHP because constructing DH networks afterwards is often not economical.

In the EU, the share of district heating and cooling is highest in Denmark, Estonia, Lithuania and Latvia, where 60-70% of citizens were served by district heat in 2012. Chapter II takes a closer look at policy instruments in several European countries with very different shares of district heating: Austria (21%), Finland (50%), France (7%), Germany (12%) and Italy (5%). [6]

Natural gas is the predominant fuel

With a share of 59%, natural gas is the predominant fuel for CHP in Europe. It is followed by coal, renewable fuels and oil, as shown in the figure below.

[6] Euroheat&Power . DHC Statistics 2012. http://www.euroheat.org/Comparison-164.aspx

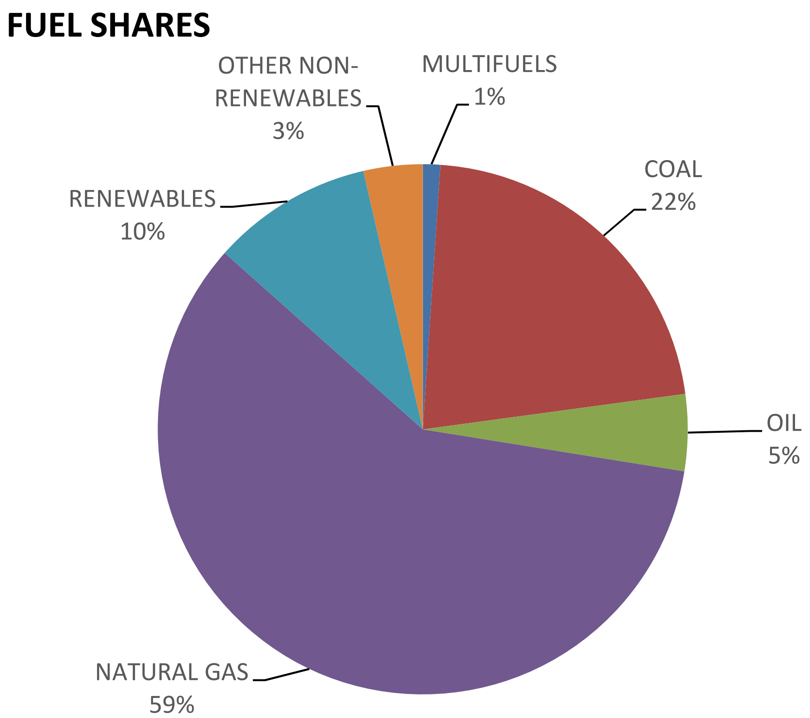

Figure 3: *Share fuels in CHP in EU27, Iceland, Norway, Switzerland and Croatia in 2010 (Power Statistics & Trends, 2012 Edition)*

District cooling increasing

CHP installations are also evolving and adapting to the emerging challenges of the heat and electricity markets. Growth in demand for cooling is now being met with units that can supply buildings or industry with cooling as well as electricity and heat.

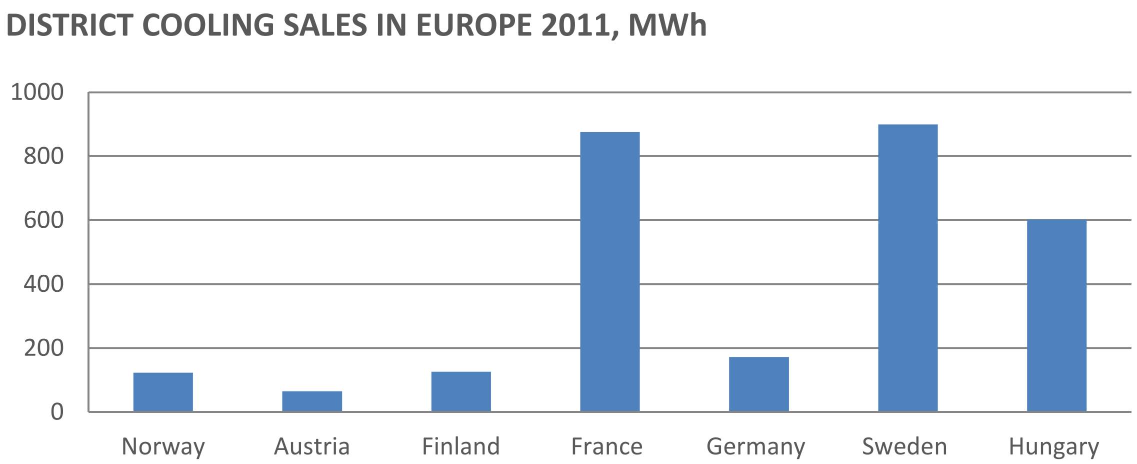

Figure 4. *European countries with largest district cooling sales in 2011 (Euroheat and power[7])*

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[7] Euroheat and power 2014. District heating and cooling, statistics

Potential for new CHP capacity

Several estimates exist as to the potential for CHP capacity growth in Europe. Based on estimates by 22 Member States[8], the total economic potential for CHP electricity in 2020 is approximately 1.7 times that of 2007/2008[9]. The corresponding European Commission modelling with Primes shows an increase of approximately 100%[10]. The CODE project[11] came to the conclusion that CHP could by 2020 contribute 455 TWh of electrical energy to Europe's energy flows and at least 1,000 TWh of useful heat supply from an estimated 122 GWe of generating capacity (economic potential). This represents a minimum primary energy saving of 46 TWh and 20.5 million tonnes of avoided CO_2 emissions. The International Energy Agency (IEA) refers to a number of European studies citing CHP potential in the range of 150-250 GW and expecting a more than doubling of CHP capacity by 2025.[12]

While the exact assessments vary, there is an agreement that the share of CHP in Europe can be further increased. However, countervailing effects exist: the improved energy efficiency of buildings, for instance, reduces the demand for heat, thereby limiting the technical potential for district heating. The demand for space heating in the EU is expected to be stable or decline, but the overall outlook for district heating is slightly different due to policy measures to advance it. Total demand for district heat is expected to be more stable or even to increase in a few countries due to extensive promotion.
As already pointed out the economic crisis and the increasing share of variable renewable power generation have changed the power market dynamics, decreasing the economic potential for installing new CHP capacity. These factors have rapidly altered the business environment, and CHP potential would probably be estimated lower today than in the estimates above. Regarding industrial CHP, the competitiveness of the energy intensive industry in Europe will greatly influence the role of CHP in power systems. Recently the growth in CHP has been moderate: some CHP markets have stagnated or declined.[13]

Energy transition on the way

The European electricity and heat markets are going through major changes. The Commission's Energy Roadmap 2050 endorsed a goal to reduce GHG emissions by 80- 95% by 2050 compared to 1990 levels, which would mean a 96-99% decarbonisation of the power sector by 2050[14] and strong efforts to reduce CO_2-emissions from heating and cooling processes, which make up 40% of energy consumption. In January 2014 the European Commission presented new proposals aiming to ensure that the EU is on the cost-effective track towards meeting its 2050 emissions reduction objective. The Commission proposed reducing EU domestic greenhouse gas emissions

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8 AT, BE, BG, CY, CZ, EE, FI, DE, GR, HU, IT, LT, LV, MT, NL, PL, PT, RO, SK, SI, SE, UK

9 Member States national reports on the implementation of the CHP Directive combined with EC Primes analysis for missing countries. Brussels, 8.1.2014, SWD(2013) 541 final. Progress Report on energy efficiency in the European Union

10 EC Primes analysis and for missing countries Member States national reports on the implementation of the CHP Directive. Brussels, 8.1.2014, SWD(2013) 541 final. Progress Report on energy efficiency in the European Union

11 http://www.code-project.eu/wp-content/uploads/2011/02/290110-CODE-European-summary-report.pdf Partners: COGEN Europe, HACHP – Hellenic Association for the Cogeneration of Heat and Power, Greece, CHPA – Combined Heat and Power Association, United Kingdom, JSI – Jozef Stefan Institute, Slovenia and FAST – Federazione delle Associazioni Scientifiche e Techniche, Italy. Cofunded by the Executive Agency for Competitiveness & Innovation (EACI).

12 "Combined Heat and Power: Evaluating the Benefits of Greater Global Investment" (2008)

13 COGEN Europe

14 European Commission 2011. Energy Roadmap 2050

by 40% below the 1990 level and increasing the share of renewable energy to at least 27% of the EU's energy consumption, both by 2030. The Energy Efficiency Communication that was published in July 2014 builds on that framework by introducing the 30% energy efficiency target for 2030.

CO_2 reductions can be achieved through technology development as well as fuel switching and energy efficiency improvements. This development includes major expansion of renewable energy technologies both in the heating and electricity sector. Energy efficiency improvements can be achieved both at the end user side and in the facilities producing heat and electricity. In this aspect CHP can play an important role by increasing the overall efficiency for producing electricity and heat.

Major changes and new opportunities

According to EURELECTRIC's Innovation Action Plan report industry experts considered the introduction of renewable energy sources the most significant change affecting the power sector in recent years. Even more significant changes are expected for the coming years, especially in utility scale renewables, smart grids and smart cities, distributed generation, and new downstream. Industry expects further negative effects on conventional generation due to these disruptions, while the potential for value capture varies from one trend to another. The continued rapid change brings with it a significant and challenging need for innovation.

Changing trends in demand for heat and power

There are significant contradictory trends influencing the future power demand. While new appliances and increasing use of electricity, for example in the transport sector, increase power demand, improvements in energy efficiency and the possible relocation of manufacturing industries' activities outside of Europe decrease power demand.

The heat market is also facing major changes and challenges. Energy efficiency measures will reduce the demand for space heating. At the same time there is still a potential for district heating, e.g. by increasing demand in existing district heating networks or by investing in short-distance networks (for residential areas or single buildings). New district heat networks are costly and rarely an economically viable option. District heating competes with new and renewable heating technologies, e.g. heat pumps.

Demand for more flexible power generation

The last 10 years have seen a large expansion of electricity capacity in the form of wind and solar power plants in many European countries, driven by energy policies and reduced costs of such technologies. This is a positive development from an environmental point of view, since it can result in lower CO_2 emissions. But at the same time new challenges are emerging due to the variable nature of wind and solar power. In 2011, the share of wind and solar power in power generation was 7% in the EU-27[15]. With a larger fleet of wind and solar power plants there must be enough back-up and flexible power generation capacity combined with demand response and possibly also storage technologies to meet demand. The running hours of thermal generation are reduced, and it is needed more and more often as back-up for variable renewable power generation rather than as baseload generation. In addition, sudden and massive requests for power, so-called power ramps, create new requirements for conventional power generation.

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[15] EURELECTRIC 2012. Power Statistics and Trends 2013

Whilst traditional variability of demand or load has always required a certain amount of flexibility, power ramps will introduce a step change in the way electrical systems are operated. At the same time peak and reserve power plants can be difficult to justify from an economical point of view due to their short operation hours.

The Role of CHP in the new power system

CHP can be flexible…

CHP plants are usually used as baseload plants with power generation depending largely on the demand for heat/steam, but they can also provide more flexible capacity to the power system. A pure back-pressure CHP plant has a fixed ratio between heat and electricity production, so if the electricity or heat output has to be adjusted, both electricity and heat production is changed. An extraction CHP plant is much more flexible and the ratio between heat and electricity can vary significantly. In some cases it is even possible to operate the CHP plant in condensing mode (see Figure 1 in Chapter I). Combining such a plant with heat storage can allow a very flexible production of electricity and heat.

To further increase the flexibility a CHP plant can be divided into several smaller units. By starting and stopping some of the units the output can vary in a large range. In this case the units do not have to be operated at low capacity when its performance is lower. However the investment cost is significantly higher for several small units compared to one big unit.

A CHP plant that has been built to meet a high heat load and that combines a technology and size allowing flexible operation can be an attractive solution. Heat supply can form the basis of the income, but combined with heat storage the plant can quickly increase production of electricity and take advantage of price peaks. With a large number of wind and solar power plants in the system there might be periods when the electricity price is very low. A flexible CHP plant that can vary its ratio of electricity and heat production can produce mainly heat during those moments and store it. If the electricity prices become extremely low or even negative it might be profitable to install a separate small electric boiler that can use the cheap electricity to produce heat that can be stored and not to operate the CHP plant.

The flexibility of a CHP plant not only depends on its ability to vary the ratio between heat and electricity production but also on ramp rates. CCGTs are associated with high ramp rates, allowing the plant to decrease or increase power generation quickly.

Even if CHP plant is built with flexible technology and equipped with electric boilers and heat storage, it is still important to optimise the size of the CHP plant on a case by case basis according to the heat load in order to achieve a high overall efficiency.

Also smaller CHP units have flexibility potential, and aggregation, which means pooling of de-centralised generation and/or consumption to provide energy and services, offers an opportunity to exploit it. Aggregation allows better access to the spot and intra-day markets, system balancing and constraints management for small scale actors. As CHP units are located often close to consumption, the total flexibility potential of the site can also include demand response.

District cooling can stabilise the heat sales in summer when the heating demand is usually low and reduced to meet the demand for warm water and steam used in industrial processes. District cooling from CHP works with absorption chillers that need heat to generate cold. Absorption chillers are available on the market but they are usually more complex and more expensive in terms of investment costs. However, they are a cheaper option than conventional chillers in terms of generating cold.

…renewable…

CHP provides a good opportunity for introducing renewable energy sources such as biomass and also waste for electricity and heat production. Using biomass CHP together with district heating is an excellent option to increase the contribution of biomass to meeting the heat demand in urban areas. Large CHP plants usually have to meet stricter limits for emissions and noxious substances than smaller CHPs and heat-only boilers. However, the cost of electricity produced in a biomass fired CHP is relatively high compared to costs of producing heat from biomass in heat-only boilers.

Other potential renewable heat sources include geothermal heat and solar thermal heat (low temperature heat from flat panels and high temperature heat from concentrated solar power).

…and distributed

A possible future trend among CHP technologies is micro-CHP. Micro CHP refers to the small scale production of heat and power for commercial and public buildings, apartments and individual houses with an electrical power output less than 50 kWe. At the moment solutions based on Stirling engine, organic Rankine cycle and internal combustion engine are available in the market. However, micro-CHP has not yet reached cost competitiveness in most cases. Newer technologies like fuel cells are currently being introduced in a large field trial in Europe.

Chapter II Policies are the key

Policies are transforming the energy sector and its business environment. Energy, climate, environmental and fiscal policy and measures have had a significant impact on the competitiveness of combined heat and power solutions. Decisions that significantly influence the competitiveness of CHP are being taken both on European and national level, and in some cases even by member states' regional administrations.

The impact of policy measures ranges from specific impacts on combined heat and power to more general impacts on the business environment for the power or heating sector. Policies are making CHP less or more competitive against alternative solutions such as other power generation technologies, production of district heat or process heat in heat-only plants or competing heating technologies, e.g. gas heating, heat pumps, pellets, electric heating, etc.

EU regulatory framework: 2020 targets and measures dominate

The EU 2020 targets as well as key directives influencing the power sector have had a larger impact on CHP than EU measures targeting specifically CHP. The Renewables Directive and its implementation, the EU Emissions Trading Scheme (depending on the emission allowance prices) as well as legislation on emissions to air (LCP, IED) have had important consequences on the profitability of specific plants and investment decisions as well as closures.

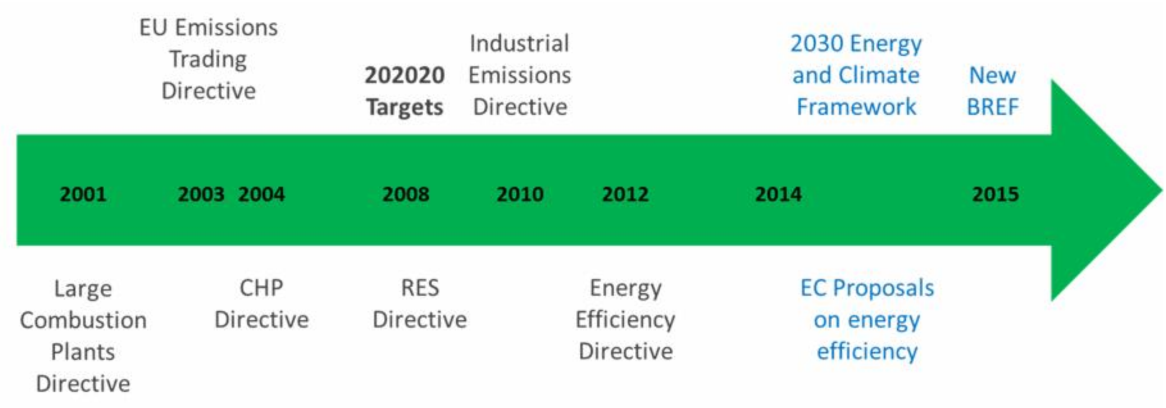

Figure 5: Development of key EU legislation

RES support: pros and cons

Extensive RES support schemes have introduced new capacity into the market. This applies especially to the power market, but in some countries support for renewable heating technologies have also had considerable market impacts. While a growing use of renewable energy sources is a welcome development, an increasing share of power generation capacity is now operating outside wholesale markets, reducing market liquidity and undermining the business case for thermal generation such as CHP, because running hours have been reduced and average wholesale power prices lowered. At the same time the costs of many support schemes have been escalating. In district heating networks the dispatch order can be distorted, for example by providing support to small-scale units that supply district heat to the network.

In April 2014, the Commission issued new Guidelines on state aid for environmental protection and energy 2014-2020. The guidelines are expected to contribute to reducing distortive impacts of support in the European energy market, but the actual impact remains to be seen. A lot depends on how the Commission will interpret the guidelines, and whether Member States modify their support schemes in the coming years to such an extent that the schemes have to be notified and consequently meet the new requirements.

The Potential of EU Emissions Trading

The EU Emissions Trading Scheme (ETS) is important for CHP – not so much because of its current impacts, but because of its potential role. For CHP, it makes a crucial difference whether RES support is used to promote renewable heating technologies and power generation or if policies focus on emission reductions. Policies focusing on energy sources, for instance RES support or priority access for RES electricity or RES heat, often distort the market and do not take into account efficiency of primary energy use. In contrast, EU emissions trading provides a technology-neutral and EU-wide measure to reduce emissions for power generation and heating in its scope. The energy efficiency of CHP is favourably reflected in lower demand for emission allowances.

The EU ETS is delivering the expected emissions reductions in the sectors under its scope. However, largely because of the economic recession, carbon prices are currently at a low. This has prompted criticism that the EU ETS is not providing adequate incentives to invest in or switch to lower-carbon options. In addition to the economic crisis, the extensive RES support schemes have a dampening effect on emission allowance prices. Recently a few member states have introduced carbon taxes, carbon price floors and coal taxes to compensate for the low carbon prices. This is further distorting the EU carbon market. Measures to strengthen the EU ETS are currently under discussion in the EU and may eventually lead to higher allowance prices.

Competitiveness of CHP also depends on whether economic instruments such as taxes or EU emissions trading are used to reduce the emissions of other heating technologies. Emissions trading only applies to installations with fuel input exceeding 20 MW. Thus a large share of CHP plants are in the scope of the EU ETS, whereas for example single boilers and heating of individual houses with fossil fuels are outside the scope of the EU ETS. If the costs of carbon emissions are not internalised for competing heating technologies, CHP is at a disadvantage.

Tightening Emission Limits

The Industrial Emissions Directive (IED) from 2010 sets maximum limits to atmospheric emissions from large combustion plants. The Commission is currently preparing the new BREF (Best Available Techniques Reference Document) - a document that introduces Best Available Techniques that serve as a reference point for authorities when setting permit conditions. Prior to the adoption of the IED, the Directive on Large Combustion Plants was applied in the energy sector.

It is not possible here to assess the impacts of the IED especially from the perspective of CHP, as they vary from member state to member state and plant to plant, ranging from no impacts to large investments and in some cases closures of especially older plants. In the current economic situation mothballing and plant closures may also result from the combination of high costs associated with environmental legislation and low power prices.

While it is beneficial to ensure a high level of environmental performance, the requirements are changing fast from the IED to the new BREF, leading to uncertainty and high costs in cases where companies have recently invested to meet the earlier requirements. The IED has been applied to new installations since the beginning of 2013, and will be applied for existing installations from the beginning of 2016. Environmental permits will be required to be in line with the new BREF in 2019 (assuming it is completed on schedule), and the content of the BREF is still open to debate.

It is essential that the BREF incorporates realistic and cost-effective requirements and that industry stakeholders are fully engaged in this process. The BREF should also take into account the changing operating patterns of power generation. Older plant operating on relatively low load factors is unlikely to be able to recover the cost of expensive emission control measures and may therefore shut down, with damaging impacts on security of supply and cost to consumers.

The Commission has also made a proposal to regulate emissions (SO_2, NOx and dust) from medium combustion plants below 50 MW. The proposed emission limits would require adoption of secondary abatement in some cases. It is essential that the final Directive contains realistic limit values and takes a proportionate approach to regulation of these relatively small installations. Otherwise the development of small-scale CHP could be adversely affected.

Minimum Requirements on Taxes

The Energy Tax Directive[16] regulates taxation of energy in the EU by providing for example minimum levels of taxes for heating fuels and electricity. The directive requires the member states to exempt fuels for power generation from taxation with the exemption of reasons of environmental policy. Taxes have a huge impact on competitiveness of CHP, but as the EU tax directive leaves a lot of room for member states to decide on their tax framework, its impacts are minor.

The Commission issued a proposal to revise the Energy Tax Directive in 2011. The objective was to divide the energy taxes into energy and CO_2 components. The latter would not be applied in the EU ETS sector. The proposal could have benefitted CHP in some member states that apply overlapping CO_2 taxes on CHP plants that are in the scope of EU ETS. However, several member states have been critical towards the proposal, and as tax directives have to be accepted unanimously, finding an agreement has proved to be very difficult.

Directives targeting promotion of CHP

The Energy Efficiency Directive (EED) aims to promote CHP by requiring member states to assess every five years the potential for high-efficiency cogeneration and efficient district heating and cooling in their territory. This will include a detailed cost-benefit analysis and requirement to implement policies that promote the use of high-efficiency cogeneration. Moreover, for each new investment in a power plant, its operator has to assess the potential use of CHP. However, most member states have not yet implemented the directive. During the negotiations on the content of the EED concerns were voiced about the additional administrative burden and inflexible regulation used to promote CHP.

Member states influence through taxes and support

Taxes and support are the member states' main policy tools influencing the attractiveness of CHP. Taxes on fuels, produced heat and power, plant specific taxes and environmental taxes on emissions all influence the competitiveness of CHP. Support that directly influences CHP includes both RES support to increase the use of bioenergy and specific support for CHP.

Recently the economic downturn has caused many member states to make sudden changes in energy taxes and support. New taxes have been introduced and existing ones increased. RES

[16] Article 14 Directive 2003/96/EC

support has in many countries been cut or reduced, providing little stability for companies seeking to invest.

In addition, member states influence CHP for example through environmental legislation, regulation on heating, and grid fees. Even though EU directives regulate emissions from CHP plants, member states including regional and local administration have a say in requirements on environmental performance and especially siting. The permit processes can be a barrier for carrying out a CHP project in case they are prolonged or cannot be described as fair. This report focuses on the impacts of taxes and support.

Survey: Taxes in 7 Member States

Taxes on fuels, produced heat and power, plant specific taxes and environmental taxes on emissions influence the competitiveness of combined heat and power. In addition to the taxes that apply to CHP, taxation of competing heating technologies also matters.

Information on taxation of CHP was collected from nine countries to get an overview of taxes and their impacts on CHP plants. The surveyed countries included: Austria, Belgium, Finland, France, Germany, Italy, Portugal, Sweden and United Kingdom.

Based on the survey, Belgium, France, Germany and Italy tax the fuels used in power generation. The tax levels vary considerably between countries. For example, the tax for gas varied from 0 to 5.5 €/MWh in Germany. The member states apply the same tax levels on power generation in separate generation and in combined heat and power generation. It was not possible to confirm within the scope of this paper whether environmental policy reasons are the basis for taxing the fuels used in power generation.

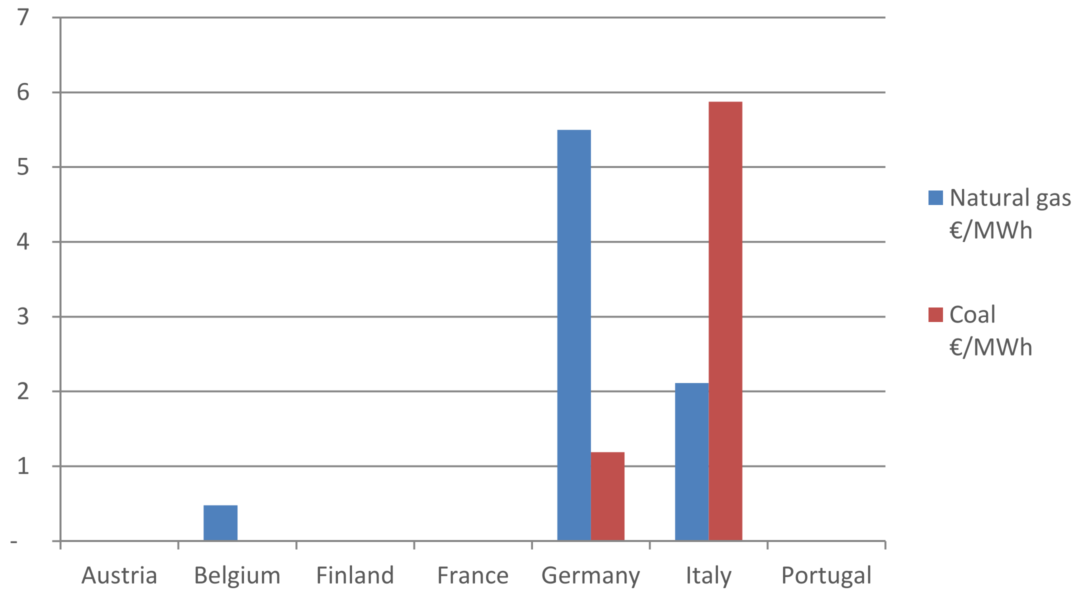

Figure 6. Taxation of fuels used in generation of CHP electricity

The taxation of fuels used to produce heat in combined heat and power generation also varies considerably between member states. The taxes are highest in Finland. Three countries apply exemptions on CHP: Belgium, Portugal and Finland. Belgium applies taxes on natural gas, Portugal does not apply excise taxes on any fuels used in CHP while in Finland CHP heat enjoys a 50%

discount on fuel taxes. However, the Finnish tax cannot be considered as a preferential treatment of CHP, because the CO_2 tax is an overlapping instrument with the EU emissions trading and the lower tax level is applied to compensate for this. The Belgian policy clearly promotes CHP. The rest of the surveyed countries do not differentiate between tax rates of heating fuels for heat-only and for combined heat and power.

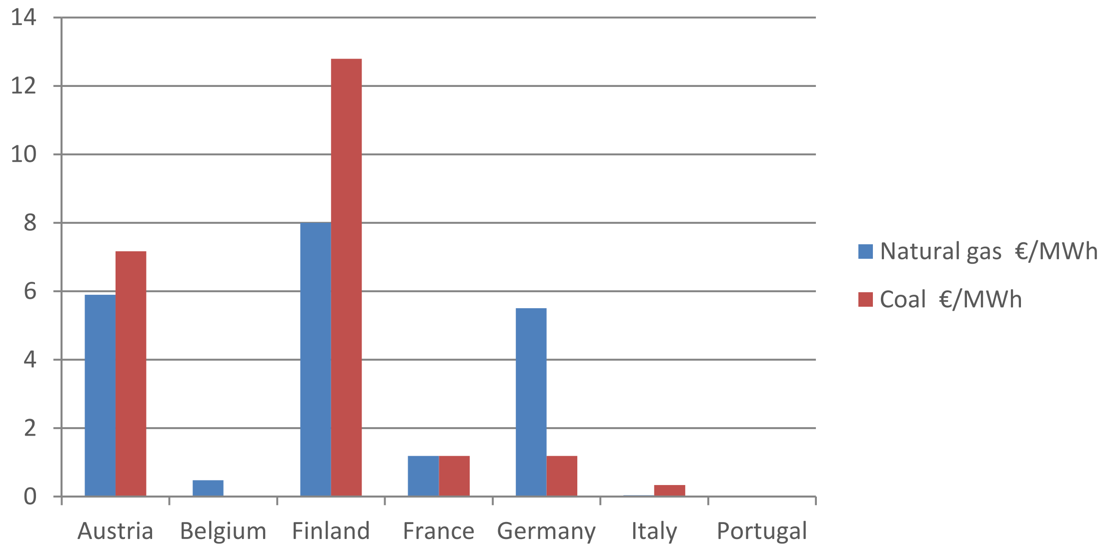

Figure 7. Taxation of fuels used in generation of CHP heat (all these figures will be checked with the members who provided the information.)

A few countries differentiate between the taxation of fuels used to generate heat according to the end use. France does not tax natural gas used in households at all, and Italy applies lower natural gas tax rates for households. These policies favour individual heating with natural gas compared to district heating.

Only one country applies specific tax rates for products of combined heat and power: France applies lower (5.5% versus 19.6%) VAT on district heat produced with at least 50% from biomass, geothermal, waste or energy recovery than for industrial steam.

Survey: Support schemes for bioenergy and CHP in 7 Member States

Based on information collected on support schemes in Austria, Belgium, Finland, France, Germany, Italy, Portugal, Sweden and United Kingdom, member states' support for CHP varies considerably. Some member states support CHP regardless of the fuel used, while others support only CHP using renewable fuels. Both investment support and different types of operating aid are used.

Table 2. Support for measures for CHP[17]

	FIT/ guaranteed price	Certificate scheme	Capital grants	Energy tax exemption	Accelerated fiscal allowance for investment	Business tax exemption
Austria				+		
Belgium		+	+			
Finland			+			
France	+			+	+	+
Germany		+				
Italy						
Portugal	+					

Support for bioenergy is focused especially on renewable electricity in the form of feed-in tariffs (FIT), feed-in premiums (FIP) or green certificates, while renewable heat has received less attention. In some countries support for biomass is limited to smaller installations and/or biomass-only solutions. In addition, in some countries CHP is given priority access to the grid. Table 3 provides examples of support schemes. The influence of RES support on the competitiveness of CHP depends on the support levels for other power generation technologies and heating forms, including support for small-scale power generation and heating technologies. Some countries provide RES support in the heating sector mainly for individual heating solutions, reducing the competitiveness of CHP.

Table 3. Support for biomass[18]

Country	Support measures for biomass
Austria	• FIT for CHP with an overall efficiency of at least 60%, depending on the efficiency and the type of biomass
Belgium	• Main support instrument in all 3 regions (FL, WA, BXL): green certificates for RES-electricity and CHP incl. from biomass and biogas but conditions differ between regions • All 3 regions: technology-specific support (banding of certificates) • In Brussels and Wallonia: support only for biomass/biogas CHP (in Flanders support for biomass also without CHP) • In Wallonia: max. size limit à no support for installations > 20 MW • In Brussels and Wallonia: investment support for small-scale biomass/biogas CHP under certain conditions (in Flanders investment support only for biomass heat which is not in scope of the green certificates scheme) •
Finland	• FIP for woodchips fired power generation • FIP is dependent on emission allowance prices, maximum value being 18 euros/MWh_e • Smaller scale units (max 8 MVA) using wood chips and industrial residual wood CHP receives feed in premium that guarantees 103,5/MWh euros income
France	• FIT for biomass plants < 12 MW • FIT for biomass CHP > 2 MW

[17] Source: Brussels, 8.1.2014 SWD(2013) 541 final Progress report in energy efficiency (with the excetion of support measures in Austria)
[18] Source: EURELECTRIC

	• RES heat: support only for household scale solutions
Italy	• Tenders for biomass fired power generation > 5 MW • FIT up to 5 MW
Netherlands	• FIP for biomass plants < 100 MW (no size limits for biogas) • Level of support is dependent on plant size • Support has characteristics of tendering schemes • FIP to promote RES heat

Minimising distortive impacts of support

Like any other support scheme, support for CHP and biomass causes market distortions. In EURELECTRIC's view Member States should gradually remove support for mature technologies, including CHP, district heating and most technologies for energy use of biomass, and use the EU Emissions Trading Scheme (ETS) as the driver for CO_2 reductions[19].

Where support is applied, its distortive impacts should be minimised and the supported generation should be integrated into the market. Support for constructing a district heating network is less distortive than support for power generation or investment support for the plant because it does not distort competition in the electricity market. However, it does distort competition in the heat market. When comparing the varying distortive impacts of investment aid and operating aid as support for CHP or biomass, investment aid does not distort short-term market signals. Tools used by investment banks (specific loan products etc.) can be considered as less distortive than subsidies.

EURELECTRIC welcomes a shift from feed-in-tariffs towards the relatively less distortive feed-in-premiums (FIP). FIP generally allow for more market integration (i.e. obligation to find a seller for the electricity production), but the effectiveness of FIPs in terms of market exposure varies depending on the specific design. Especially in cases where variable costs are comparatively high and premiums are used to incentivise generation operating aid can cause disruptive changes in the merit order. However, the main aim of operating aid to CHP or biomass is often to ensure that these units run.

To minimise distortions and avoid high levels of operating aid, new investments in CHP plants should be driven by a combination of investment aid and operating aid. Support schemes should avoid incentivising generation at moments when power demand is low, and support should definitely not be provided when market prices are negative. The level of the premium should also be regularly revised for new installations in order to adapt the support levels to technological evolution and market prices and avoid excessive costs for society. This process has to be transparent to investors from the start.

The new state aid guidelines allow state aid for both biomass and CHP. Starting from January 2017 biomass fired power generation should generally participate in technology-neutral tendering for operating aid and support should be provided in the form of a premium. CHP is only eligible for state aid in case it meets the criteria for high efficient CHP and energy efficient district

[19] In the context of energy efficiency of buildings EURELECTRIC sees a need for fiscal/financial incentives by member states in order to encourage the renovation of private buildings.

heating and cooling. CHP should also participate in tendering for premiums. FIT are only allowed for small-scale generation. Investment aid is allowed both for biomass and CHP.

Other means to promote CHP

Combined heat and power is promoted in some countries through priority access to the grid or through mandatory or prioritised heat off-take[20]. While these policies favour energy efficient CHP, they distort the merit order in the power market or the heat network. Priority dispatch for electricity from CHP should only be envisaged in exceptional circumstances, e.g. during high-demand periods where a CHP plant has to be in operation for technical and social reasons. In EURELECTRIC's view, CHP should compete with other sources of heat and power based on its commercial and environmental merits. This applies to other technologies as well.

In Germany, CHP can be promoted by regional/spatial planning, forcing owners of new buildings to use CHP for heating and to connect to a district heating system.

In some countries regulators and customers expect operators to use revenues from CHP power generation to lower the heat prices. This practice is common especially in Eastern Europe. Some regulators even set regulative caps on return (e.g. Latvia, partially Poland, Romania) or regulative heat price caps for CHP. This means that heat pricing is determined by ex-ante price regulation.

[20] Heat off-take refers to mandatory / prioritised access to the heat network.

CHAPTER III The Way Forward

Opportunities and threats

Combined heat and power, like other thermal generation, is facing major challenges today. Previously profitable CHP plants are struggling amid conflicting policy measures, sudden tax increases, high natural gas prices and the economic crisis. Extensive support schemes have led to the positive and rapid development of renewable generation, but have also had distortive impacts in the market. Retail prices, which cover the costs of such policies, have increased while wholesale prices have decreased. Demands for support for certain power generation technologies have been growing. A number of member states have introduced or are considering introducing capacity remuneration mechanisms to ensure that sufficient capacity is available to ensure an adequate level of back-up and meet peak demand.

In the current market conditions, CHP seems to have become less attractive. In fact, due to the difficult business environment CHP capacity in some member states has recently decreased. The risk is that opportunities of CHP will remain untapped and that ageing CHP plants will be replaced by less energy-efficient alternatives. However, the benefits of CHP remain, and compared to alternatives, CHP is often a cost-efficient option for reducing CO_2 emissions when applied in a location with adequate heat load.

A SWOT (strengths, weaknesses, opportunities and threats) analysis for CHP reveals considerable opportunities for CHP (Annex 1). Its energy efficiency is an asset, especially if the policy framework focuses on CO_2 reduction and relies on economic instruments in the heating sector as well. By improving the flexibility of CHP plants energy producers can find a new role for their assets. Plants equipped with heat storage or extraction turbines that allow condensing generation are more flexible. District cooling is another opportunity for new use of CHP plants. Biomass plants can provide renewable power and heat by using resources in the most energy efficient manner. Plants that can use multiple fuels are more prepared to face variation in fuel prices and availability.

Key threats for CHP include a continuation of current policies that focus on selective promotion of energy sources rather than CO_2 abatement, competition from other heating forms especially when they are subsidised, constantly changing emission limits and public acceptance issues related to fossil fuels, biomass or emissions to air.

This chapter introduces six recommendations for smart policies that avoid the threats to CHP and unlock its opportunities.

Six measures to improve the competitiveness of CHP

1. *Strengthen the EU ETS, it rewards the energy efficiency of CHP*

EURELECTRIC believes that CO_2 reductions should primarily be driven through the EU Emissions Trading System. As a technology-neutral and European-wide policy instrument, the EU emissions trading market is suitable for driving investments in mature low carbon technologies. Carbon markets are the cost-effective way to drive investment choice in CO_2 reduction. Moreover the EU ETS is fully compatible with the Internal Energy Market. A reformed ETS should therefore be the main driver for the low carbon transition. EURELECTRIC supports measures to strengthen the ETS soon and effectively.

Due to its distortive impacts, support for mature technologies should be progressively phased out moving towards 2020 and beyond. Prior to that, the design of subsidy schemes should be improved to reduce the distortive impacts of support.

Support should focus on fostering RD&D. RD&D support should be available for technologies throughout the entire innovation cycle as well as for improvement of mature technologies such as CHP. The needed policy change is currently underway and warmly welcomed by EURELECTRIC (e.g. Energy Technology Communication, Horizon 2020, but also EURELECTRIC's Innovation Action Plan Report).

How does this recommendation enhance the competitiveness of CHP?

Given that the CO_2 emissions from CHP are relatively low due to its high efficiency, CHP benefits from emission reduction measures, like the EU ETS and RD&D support that do not risk the functioning of the power market (assuming that costs for CO_2 are internalised both for electricity and heat). In contrast, measures focusing on energy sources, such as RES support, priority access to RES electricity or prioritised access to heat network distort the market and do not take into account emission reductions gained through efficient use of primary energy. For this reason they are not beneficial for CHP.

2. *The policy framework should drive CO_2 reductions in all sectors, including heat*

The policy framework should drive emission reductions in all sectors, including heat: because CHP is in the scope of EU ETS it is at a disadvantage if the costs of carbon emissions are not internalised for competing heating technologies. Outside the scope of emissions trading CO_2 taxes can be used to reduce emissions. The European Commission's proposal on the Energy Tax Directive would drive development of CO_2 based taxation in the EU. EURELECTRIC is also generally in favour of extending the scope of EU emissions trading and calls on the Commission to carry out a feasibility study on the extension of the EU ETS within heating.

Renewable and low carbon heating solutions such as renewable district heat and CHP, heat pumps, pellet heating and solar heating can be advanced by applying economic instruments on heating rather than providing support for renewable heating technologies.

In the EU ETS sector overlapping policy instruments such as subsidies and carbon taxes disturb the functioning of the carbon market and lead to inefficiencies. Consequently, there should be no national carbon taxes or other overlapping instruments in the emissions trading sector, including CHP.

How does this recommendation enhance the competitiveness of CHP?

Given that the CO_2 emissions from CHP are relatively low due to its high efficiency, CHP benefits from emission reduction measures, like the EU ETS and RD&D support that do not risk the functioning of the power market (assuming that costs for CO_2 are internalised both for electricity and heat). In contrast, measures like focusing on energy sources, RES support, priority access to RES electricity or prioritised access to heat network distort the market and do not take into account emission reductions gained through efficient use of primary energy. For this reason they are not beneficial for CHP.

CHP competes with heating technologies that are not within the scope of EU emissions trading. For example natural gas used by households is provided at lower tax levels in some countries. This provides perverse incentives and does not encourage efficient emission reductions. CHP is at a disadvantage if economic instruments are not used to reduce CO_2 emissions from other heat sources and if mature technologies receive support.

3. Avoid taxes on fuels used for power generation: Tax electricity at the point of consumption instead

Electricity should be taxed at the point of consumption, allowing power generators in different European countries to operate on a level playing field. Although the Energy Tax Directive limits the taxation of fuels for power generation, many countries have adopted taxes on power generation. We also recommend limiting the application of technology specific taxes on power generation as they also distort competition.

How does this recommendation enhance the competitiveness of CHP?

CHP benefits from a well-functioning internal electricity market and a reduced tax burden on power generation.

4. Member States should develop power markets that allow operators to explore opportunities to develop flexible operation of CHP

CHP plants can react more effectively to the power market signals if they are more flexible between production of heat and electricity. Member states should strive to develop integrated day ahead, intraday and balancing markets in order to reveal the price for flexibility and thus meet the demands in changing power systems.

For smaller scale CHP units aggregation offers an opportunity to exploit their flexibility potential. In order to allow aggregated flexibility to participate in spot and intra-day markets, system balancing and constraints management, the following issues need to be addressed:

- Market rules should be brought in line with the characteristics of aggregated demand response and generation. The European network code on electricity balancing should provide a level playing field for all balancing services providers.
- Balancing responsibility on a connection should be clearly defined and consistently metered. There should be no gaps or overlaps in the balancing responsibility of different actors on a connection.
- Smart meters with a reading interval corresponding to the settlement time period are a technical prerequisite for participation of such users in balancing markets.

- Constraint management and balancing are separate system operational issues. However, the aggregated flexibility services for both purposes could be delivered by the same resources. Close coordination between constraint management and balancing will allow for higher liquidity and exchange of data between all relevant parties. This is necessary for safe operation and security of supply and for non-discriminatory access of flexibility to markets.

Capacity remuneration mechanisms (CRMs), which are now becoming a de facto reality in many EU Member States, influence the attractiveness of investments in CHP plants that can provide firm capacity. In EURELECTRIC's view CRMs should only be introduced as a means of ensuring security of supply, not to achieve other policy objectives. CRMs should remunerate generation adequacy service that is not properly valued in the energy-only market. They should be technology neutral and non-discriminatory i.e. give equal treatment to existing and new units for generation, storage, demand and cross-border participation, and should be coordinated at regional level to ensure consistency and minimum distortion to the internal energy market.

How does this recommendation enhance the competitiveness of CHP?

Remuneration of reliable capacity and flexibility in the power market influences the profitability of investments to facilitate more flexible operation of CHP plants. This will help CHP to adapt to the changes to the power system brought by increased variable generation.

5. Ensure a competitively priced, flexible and secure fuel supply

Alongside well-functioning electricity markets, flexible and competitive gas markets can strongly contribute to a cost-efficient transition towards a low-carbon economy. Taking into account that more than half of CHP electricity is produced with natural gas, it is important for the future of Europe's CHP fleet to continue improving security of gas supply. The EU has in recent years taken many steps to this direction, including the Gas Security Regulation of 2010. EURELECTRIC supports the implementation of existing requirements on reverse flows, functioning regulators, and sound energy policy to improve security of gas supply. Europe should strive to develop an integrated EU gas market with improved interconnection.

Strengthening the diversity of pipeline connections within and towards the EU ensures that gas can flow where it is needed. Implementing physical reverse flows – as envisaged by the Security of Supply Regulation – should be done systematically and especially at key interconnection points. Diversification of both sources (LNG, unconventional gas) and routes of supply is needed. The Third Energy Package and the related network codes should be implemented as a matter of priority. Changing operation characteristics for CHP plants, with shorter operation times and more fluctuating loads, creates a need for more flexible gas market.

In order to realise the potential of biomass, biogas and waste Europe needs a stable and reliable EU and national regulatory framework that supports the use of these fuels, and contributes to ensuring sustainability of biomass. The Commission has decided not to propose further EU measures on sustainability of biomass that would be applicable before 2020. In these circumstances EURELECTRIC supports the Commission's recommendation that member states align their existing and future national sustainability schemes in order to remove barriers to trade. However, alignment of schemes should avoid causing major regulatory uncertainty that influences the supply chains. We welcome the Commission's plan to monitor the situation and carry out a review the biomass sustainability issue for the post-2020 period. A possible EU framework for sustainability of biomass beyond 2020 should be based on reliable science and focus on major environmental concerns.

How does this recommendation enhance the competitiveness of CHP?

Take or pay contracts for gas hinder flexible operation of CHP plants. High gas prices reduce the competitiveness of CHP.

Uncertainty about regulatory requirements can be a barrier to increasing utilisation of biomass and waste in CHP plants.

6. Implement a stable and proportionate framework for emissions from CHP

It is essential that the BREF (Best Available Technique Reference Documents) being developed under the Industrial Emissions Directive take full account of inputs from industry stakeholders. Emission limit values for CHP and other thermal plants should be realistic and proportionate and should take account of factors such as differing plant load factors and ages. Future regulation of small and medium combustion plants should also be cost-effective and proportionate. Requirements on environmental performance should be stable enough to allow companies to plan their investments well in advance.

Annex I

SWOT analysis for CHP

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
FUEL EFFICIENCY	Reduced primary energy consumption because of high energy efficiency	Energy efficiency strongly depends on circumstances (size compared to load) that may change	1) Maximise the potential of the forthcoming heating/cooling plans 2) Taxes on use of primary fuels can benefit CHP because of higher efficiency	1) Despite high efficiency, competition from passive houses,heat pumps, solar thermal, gas heating can be strong 2) Support schemes bring supported heat production that competes with CHP heat 3) taxes often distort the market and involve political unstability
CARBON EFFICIENCY	Low CO_2 emissions thanks to high efficiency and internalisation of CO2 costs	CO_2 policy sensitive if coal or gas fired	Strengthened ETS – e.g. increased linear reduction factor post-2020 – can render CHP more attractive	1) If policies focus on RES instead of CO2 abatement CHP is at disadvantage 2) If competing heating technologies do not face CO2 costs CHP is at disadvantage
AIR QUALITY	Low pollutants emissions thanks to high efficiency	Not emissions free	Provides a low emissions alternative among thermal generation technologies	Stricter emission limits and growing cities may force plant closure or refurbishment
BIOMASS	CHP is fully compatible with biomass use	Dust emissions. Sourcing (including price developments) of biomass.	1) Increased use of biomass in both stand-alone and co-firing plants for political reasons. 2) Strengtened ETS also promotes biomass CHP.	1) Missing regulatory framework for sustainability may influence negatively public opinion 2) Availability of biomass (also ill-designed sustainability criteria) 3) Support schemes distort the market and involve political unstability
NATURAL GAS	Gas is the cleanest fossil fuel and perfectly suited to operate in CHP	Relatively high gas prices and long term contracts for gas reduce the economical attractiveness. Security of gas supply to be improved, particularly in the most vulnerable regions.	Competitive gas markets bring along lower prices, power-to-gas. Flexibility of CCGTs	1) 'No fossil fuels' policies 2) Focus on promotion of certain technologies rather than CO2 abatement
COAL	Price competitive, easy to source, independent from politically unstable regions	CO_2 and other emissions. CO_2 price sensitive	Higher efficiency compared to coal fired condensing plants	1) Sensitive for environmental and political decisions and public opinion 2) Focus on promotion of certain technologies rather than CO2 abatement
DISTRICT HEATING NETWORKS	Legacy DH networks and small DH networks can be built in economical way	Where not existing DH networks are capital intensive	Replace heat-only boilers in DH systems with CHP	Disconnection from DH networks because of heightened competetion from other heat sources
SITING ISSUES	CHP is located closer to customers: avoidance of costly grid and grid losses	CHP is located closer to customers (e.g. higher likelihood of complaints on pollution)	Fits with progressive decentralisation of the energy systems and intelligent grids programs	Growing cities may force plant closure and retirement

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
FLEXIBILITY	Well-designed plants can have a high degree of flexibility (e.g. when coupled to heat storage or additional electric heating such as heat pumps)	Reduced flexibility of average CHP plant because of heat requirements	Increase flexibility (operation between heat and power, ramping up/down) to benefit of power markets' trading and cash flows, and possible CRMs.	1) Competition with other sources of back up and flexible capacity. 2) Power market does not provide adequate compensation for flexible and back-up capacity.
DUAL USE	CHP can be adapted to provide both heat and cooling	Load factors determined by heating and cooling demand	District cooling (DC) can increase CHP load factors during summer	Load management affected by local heat production (i.a. solar thermal, etc.)

EURELECTRIC pursues in all its activities the application of the following sustainable development values:

Economic Development

- Growth, added-value, efficiency

Environmental Leadership

- Commitment, innovation, pro-activeness

Social Responsibility

- Transparency, ethics, accountability

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