

REPORT



# European Potential for Cogeneration

Progress against the Directive's objectives  
at European level



The European Association  
for the Promotion  
of Cogeneration

[www.cogeneurope.eu](http://www.cogeneurope.eu)



COGENERATION OBSERVATORY  
AND DISSEMINATION EUROPE

Cogeneration Observatory  
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COGENERATION OBSERVATORY  
AND DISSEMINATION EUROPE

# Member State reporting under the Cogeneration Directive - including cogeneration potentials reporting

**CODE project report**

**European Summary**

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December 2009

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## **CODE project**

### **The Cogeneration Directive**

The Cogeneration Directive 2004/08/EC outlines an enabling policy framework for the European Union to expand the deployment of cogeneration in Member States. The Directive was passed by the European Parliament in 2004 and encourages the use of cogeneration in the production of heat and power as a successful and well developed technique delivering primary energy savings. The background policy objectives in 2004 were security of supply and energy savings. The climate agenda which has grown in importance since 2004 has added further impetus to the wider use of cogeneration. Cogeneration is a highly energy efficient, technologically mature approach to generating electricity and providing useful heat. It is a key enabler for improving the efficiency of electricity production from fossil fuels.

One of the main achievements of the Cogeneration Directive has been to codify for Europe what is meant by high efficiency cogeneration. Any plant now carrying this status will in operation save a minimum of 10% primary energy compared to separate production of heat and electricity based on the same fuel. Using the framework of the Cogeneration Directive, promoting cogeneration to meet additional electricity needs gives a Member State a quantifiable primary energy saving per unit of electricity generated.

### **The CODE project**

The CODE project was established in October 2008 by COGEN Europe under the EU's Intelligent Energy Europe (IEE) programme. The objectives of CODE are to have stakeholders in the sector independently monitor the implementation of the Cogeneration Directive and to use stakeholder input to assess the progress being achieved through Member State initiatives. The project runs until 2011 and will report in sequence on 1) the identified European potential for cogeneration; 2) the barriers and support mechanisms for cogeneration existing across the Member States; 3) best practise and progress in Member States; and 4) a draft CHP roadmap for Europe.

## Executive summary

The guaranteed energy saving within the framework of the Directive makes cogeneration a uniquely quantifiable energy saving measure for Member States striving to improve overall energy efficiency and reduce CO2 emissions.

Considering the current state of transcription of the Directive and its final translation into member state law the CODE team considers the implementation of the directive to have been slow.

Reporting under the Directive is incomplete particularly in the area of Guarantees of Origin.

The 23 member states so far to report on their national potential for cogeneration have, used both bottom up and top down approaches to identify an additional 122GWe<sup>1</sup> of potential CHP capacity in Europe. Associated with this electricity generation is 1,000 TWh /annum of heat meeting heat demand in a range of applications across domestic, commercial and industrial sectors<sup>2</sup>. Most member states can increase their CHP capacity by a minimum of 50% and a doubling of the today's installed capacity is described as economic potential.

The member states who have reported on Barriers to the wider use of CHP have identified that significant barriers exist. Economic, administrative and procedural issues including connection to the grid have been specifically highlighted. Major technical barriers do not appear to exist.

Regional meetings of stakeholders have in general supported the reporting of the member states while focusing additional attention on immediate barriers and giving additional detail on the barriers highlighted.

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<sup>1</sup> This figure is heavily influenced by the very high potential reported in Germany. The German potential estimate is dependent on a very large expansion in district heating and finance being available to the public sector at 5% return.

<sup>2</sup> CODE project team suggest that the efforts made by Member States in assessing the potential are generally competent and that with only a few exceptions should be accepted as sufficiently good to act as the basis of energy planning.

## 1. Status of transposition of the Cogeneration Directive 2004/8/EC into Member State law in the European Union

With a few exceptions listed below, the EU Member States have confirmed transposition of the Cogeneration Directive into national law. The exceptions listed by the Commission are: Portugal, Slovakia, Finland and the United Kingdom. A reasoned opinion on the absence of proper reporting on the transposition status was sent to these Member States in November 2009 giving two months to the Member States to respond. Table 1 gives the European Commission's status on transposition at 1 December 2009.

Transposition of Cogeneration Directive 2004/8/EC (situation up to 05/10/2009)		
MS	MS - declaration on transposition	Commission - compliance evaluation
BE	Complete	
BG	Complete	
CZ	Complete	
DK	Complete	
DE	Complete	
EE	Complete	
IE	NO COMMUNICATION	
EL	complete	
ES	Complete	
FR	Complete	
IT	Complete	
CY	Complete	
LV	Complete	
LT	Complete	
LU	Complete	
HU	Complete	
MT	Complete	
NL	Complete	
AT	Complete	
PL	Complete	
PT	NO COMMUNICATION	
RO	Complete	
SI	Complete	
SK	Incomplete	
FI	Incomplete	
SE	Complete	
UK	Incomplete	

**Table 1 Status of transposition of Cogeneration Directive**

From stakeholder discussions at CODE Regional Workshops it is clear that parliamentary approval of the transposition into a national law does not necessarily mean that the provisions of the Directive are fully implemented or active in that Member State. There is frequently complexity in the detail of implementation into national law following the formal adoption and only when the full process is completed can the transposition be said to be complete.

In Italy for example:

*Legislative Decree 20/07 creates new provisions for the future dispositions for the cogeneration development, according to the Cogeneration Directive:*

- *possibility to have access to white certificates for all the high-efficiency cogeneration plants and gradual extension to the right of white certificates access also to players that are different from the current ones, referring to criteria fixed in the future Ministry Decree (art. 6, points 1-5);*
- *possibility for the Authority to consider special operative conditions for high-efficiency cogeneration plants when it will define charges related to transmission and distribution cost (art. 7, point 4);*
- *simplification of administrative procedures for the authorisation for construction and management of cogeneration plants, especially regarding small and micro cogeneration units (art. 8).*

*The first and third bullet points above white certificate support schemes for cogeneration and simplified administrative procedures are at December 2009 still waiting for a special Ministry Decree that could implement these. So, while the Cogeneration Directive is formally implemented in Italy, for the time being, the status of cogeneration in Italy is left in a “vacuum”, while the government aligns the framework conditions for cogeneration with the provisions of the Cogeneration Directive.*

In Greece:

*the Cogeneration Law 3734 of 2009 has been adopted by the parliament. Article 7, Para 4 of this law states that in order to safeguard the transmission and the distribution of electricity produced from high efficiency cogeneration, the provisions of the Grid and Market Code are applied including the necessary amendments of the Code in order to ensure the participation of the cogeneration units in the Greek electricity market. The Grid Code when first published for consultation made no reference to cogeneration at all. Several stakeholder approaches have been launched to correct this.*

To varying degrees the CODE project team has been notified of existing gaps in the implementation of the Cogeneration Directive through the absence of secondary or other legislation specifically in Hungary, Latvia, Lithuania, Italy, Greece, France, Romania, Germany, Netherlands, Malta, Luxembourg. The transposition and implementation of the Directive has been slow. Due to the lack of progress in several Member States it is quite possible that full implementation at national level will not be concluded in all Member States until late in 2010:

six years after the acceptance of the legislation by the European Parliament. For details of the implementation see individual regional reports (Annexes 4.1, 4.2, 4.3 and 4.4).

## **2. Status of implementation of the Cogeneration Directive by EU Member States concerning analysis, structures and reporting**

Under the Cogeneration Directive the Member States are asked to assess their national potential for cogeneration and to carry out various enabling assessments (barriers support mechanisms verification through Guarantees of Origin) and then update the Commission on progress towards achieving the potential. The Directive uses a reporting and self analysis mechanism intended to drive continuous improvement towards a higher level of cogeneration in the economy.

Member States were required to produce the following reports

- Analysis of the national potential for cogeneration (21/02/2006)
- Review of barriers to the wider use of cogeneration (21/02/2006)
- Review of the support mechanisms for cogeneration (21/02/2006)
- Progress Report on Cogeneration Directive (21/02/2007)

Apart from the Progress Report which was requested by the European Commission in a modified questionnaire format, Member States were left free to choose the format of the reports with the content guided by the Directive and its Annexes. As a result the Member States reports vary considerably in depth and content.

In general reporting by Member States under the Directive has been slow and is still not complete as can be seen in the table 2 below. Only 12 Member States have completed all reporting under the Directive more than two years beyond the last deadline. All Member States should have delivered a report on the national potential for cogeneration to the European Commission by the 21<sup>st</sup> of February 2007. At the time of writing there are 23 National Potentials Studies in the public domain, covering over 80% of Europe's current cogenerating capacity.

Likewise, in reporting on barriers to the wider deployment of cogeneration and on the creation of a scheme for guarantees of origin, there are still reports missing from Member States. Luxembourg, Hungary and Portugal have not yet reported on barriers and eight Member States have not reported on their scheme for guarantees of origin (Czech Republic, Spain, Greece,

Ireland, Cyprus, Luxembourg, Hungary and Portugal) although both the Czech Republic and Estonia appear in practise to have operational GoO systems.

#### Discussion

The reporting mechanism of the Directive was foreseen as both the stick and the carrot of this legislation. Knowing the economic and social benefits of improving energy efficiency in the generation of electricity, it was foreseen that Member States would move rationally towards promoting investment in cogeneration propelled by the logic of the reporting process: potentials, barriers and support mechanisms. However, few Member States have moved quickly<sup>3</sup> to implement the Directive, or follow through the reporting steps. Legal proceedings against defaulting Member States were started by the Commission in May 2009.

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<sup>3</sup> Germany and the Czech Republic stand out as Member States which fully embraced and moved forward on the Directive.

### 3. Status of Member State reporting under the Cogeneration Directive

Under the Cogeneration Directive the 27 Member States are asked to assess their national potential for cogeneration, review barriers to implementing this potential and then update the

<b>Reporting obligations of Cogeneration Directive 2004/08/EC (situation up to 05/10/2009)</b>				
MS	Progress Report	Analysis of National Potential	Barriers for CHP / administrative – procedural situation	Guarantees of Origin Scheme
	[Art 10(2)– Art 6(3)]	[Art 10(1) – Art 6(1)]	[Art 10(1) – Art 9(1&2)]	[Art 10(1)– Art 5(3)]
	due on 21/02/2007 and then each 4 years	due on 21/02/2006	due on 21/02/2006	due on 21/06/2007 (6 months after adoption of harmonized reference values – Commission Decision 2007/74/EC of 21/12/2006
BE	received	received	received	received
BG	received	received	received	received
CZ	received	not received	not received	not received
DK	received	received	received	received
DE	received	received	received	received
EE	received	received	received	received
IE	not received	received	received	not received
EL	received	received	received	not received
ES	received	received	received	not received
FR	received	not received	received	received
IT	waiting for translation	received	waiting for translation	received
CY	received	received	received	not received
LV	received	waiting for translation	waiting for translation	waiting for translation
LT	received	not received	waiting for translation	waiting for translation
LU	not received	waiting for translation	not received	not received
HU	not received	not received	not received	not received
MT	received	received	received	received
NL	received	received	received	received
AT	received	received	received	received
PL	received	received	received	received
PT	not received	not received	not received	not received
RO	received	received	received	received
SI	received	received	received	received
SK	received	received	received	received
FI	received	received	received	received
SE	waiting for translation	waiting for translation	waiting for translation	waiting for translation
UK	received	received	received	received

*Table 2 Status of reporting obligations of the EU Member States*

Commission on the progress towards achieving this potential. This is foreseen as a self motivated process of continuous improvement towards a higher level of cogeneration in the economy and an increased primary energy use efficiency and energy savings.

Reporting by Member States under the Directive has been slow<sup>4</sup> with 21 reports still to be submitted although the deadlines for submitting reports fell in 2006 and 2007 (Table 2).

All Member States should have delivered a report on the national potential for cogeneration to the European Commission by the 21<sup>st</sup> of February 2007. At the time of writing there are 23 National Potentials studies in the public domain, although one of these - from the Czech Republic - has not been officially received by the Commission. These reports cover over 80% of existing cogeneration capacity in Europe, and are the focus of this report. At December 2009 four Member States (France, Hungary, Portugal and Latvia) have made no submission at all on national cogeneration potentials. The missing potential studies of France, Hungary, Portugal and Latvia represent an additional potential to the numbers presented here.

### **3.1 National Potential studies on cogeneration**

Member States are asked to report on the national potential for cogeneration in 2010, 2015 and 2020. Starting from an assessment of heat demand over the period to 2020, Member States are asked to investigate different types of application and economic sectors where cogeneration is applicable and through this build a picture of the “technical potential” i.e. how much heat and electricity could be supplied through cogeneration in the absence of any other constraints. From this technical potential an economic potential is deduced using assumptions about the energy market, availability of support, required rate of return, etc. Member States have considerable freedom<sup>5</sup> in how they evaluate both the technical and the economic potentials although the Commission did issue guidelines which give a basic framework of points to consider (Annex 1)

### **3.2 Overview of Reporting of National Potentials for cogeneration**

In assessing the national potentials reports, the CODE project has looked for appropriate, thorough and transparent analysis which follows the guidelines laid out in the Directive.

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<sup>4</sup> The Commission started legal proceedings against Member States for non-compliance of the Cogeneration Directive in May 2009, and these Member States are now following the appropriate process to achieve compliance.

<sup>5</sup> The degree of freedom in the reporting has led to a large variety in reporting formats and approaches. The different choices of Member States in units of reporting and choice of base year have been overcome in the reporting by using reasonable assumptions consistently.

Member States have taken different approaches and used a differing degree of detail according to the information that is available. From the content of the reports it is clear that most Member States have gathered appropriate data, used reasonable modelling techniques and made clear their assumptions in their assessments. Good examples of reporting (but not an exhaustive list) are Slovakia, Germany and Spain.

However, some Member States have reported only general assumptions and quoted only the main results of work which is not publicly available. An assessment on quality and level of detail of the analysis is not possible. A few Member States have presented data, extrapolating from a few specific cases, but carried out only very limited analysis: this seems to fall short of the objective. Several member states report difficulties in assessing the following:

- micro CHP: poorly defined economic and technical capability as yet makes micro CHP difficult to include in analysis;
- cooling potential: data on cooling requirements is not available in many Member States and there is little available product on which to base an economic assessment;
- bio-energy and use of waste materials for energy production.

These are all areas where little prior work has been carried out and where little data currently exists. Several Member States have therefore stopped short of fully exploring this potential.

### **3.3 Analysing the reports for a European overview**

The absence of a standard reporting format for potential studies presents a number of challenges when analysing the reports. Specific difficulties lie in the lack of a consistent set of units, or sectoral analysis approach. As cogeneration potential is dependent on identifying heat demand which can host electricity generation, many but not all Member States chose to report potential in total heat energy delivered with additional information on electrical energy/installed generating capacity. Some Member States followed the sectors outlined in the Cogeneration Directive basing their analysis on the generating capacity of plants, while others chose to take an economic sector-based approach and looked at end use in industry, services or district heating. Several Member States based their reports around different reporting periods to those proposed by the Commission.

Assessing total economic potential at the European level is also difficult as Member States have not always made their basic scenario assumptions, their economic assumptions or their assessment methods explicit. As a result the CODE project has had to interpolate to a certain extent from the published data to give a first overall picture. However, where this has been

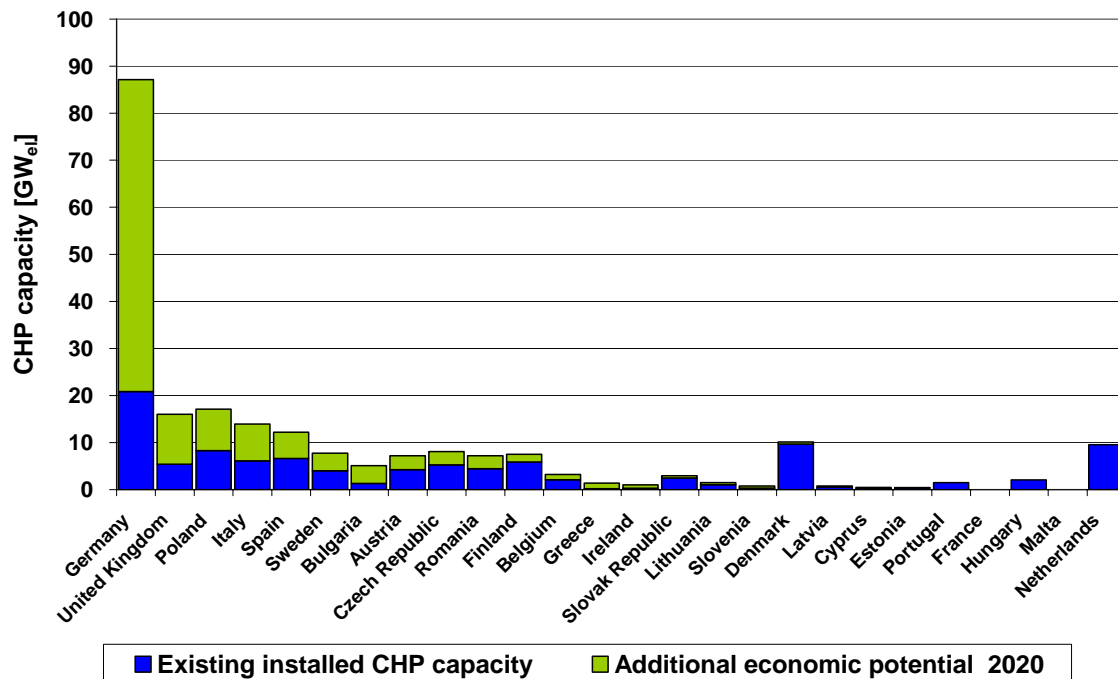
done we have chosen a conservative approach and used a single consistent conversion approach for the interpolation (see Annex 2).

### **3.4 European Cogeneration economic potential in 2020**

Estimates of economic potential are derived directly from an explicit technical potential or are simply declared as “the potential” without clarification of the technical potential. It was difficult to extract the information on potential from a number of Member States’ reports:

- Some results tended to be heavily qualified and not tabulated but included in text;
- Some Member States gave a wide range of potentials dependent on real or future variables rather than a single value, in this instance we chose the lower end of the range;
- Some Member States reported in terms of TWh of electrical output rather than capacity, in this instance we made an estimate of capacity from the output figure;
- The absence of full language translation of some Member States’ reports until late in the analysis period proved to be a challenge which leaves the risk that some nuances of the data have been missed.

Different approaches and assumptions have been used by Member States when it comes to the economic potential. Several factors of economic and the perceived market effectiveness of cogeneration plants have been used with a given internal rate of return on investment (IRR) level being a popular hurdle. Required operating hours and assumed levels of policy support are also used as screening methods, as are assumptions on implementation feasibility in Member States. In most cases the existing economic support mechanisms have been taken into account. Where both technical and economic potential are explicit, economic potential is significantly lower than the evaluated technical potential in the Member State. Some Member States have chosen not to give a single potential estimate but have rather modelled the potential under different scenarios, reflecting for example the effect of different carbon prices and support schemes.



**Figure 1: Existing installed cogeneration capacity and reported additional economic potential in the year 2020**

The reported European economic potential for cogeneration is shown in GWe installed capacity in figure 1 above. This capacity would provide by 2020 a total contribution to Europe’s energy flows of 455 TWh of electrical energy and at least 1,000 TWh of useful heat supply from an estimated 122 GWe of generating capacity. This represents a minimum<sup>6</sup> primary energy saving of 46 TWh and a value of CO2 avoided of \$0.8 billion Euros at a price of carbon of 39 Euros per ton (20.5 million tonnes of CO2).

The evaluation process for determining economic potential varies widely across reports, and the following observations apply:

- The judgement as to what is economic or not is heavily dependent on the Member State assumptions and on the assumed rate of return chosen by the Member State. For example the UK report identifies that an economic rate of return for a commercial enterprise is 15% while for a public sector investment 9% is acceptable. In making this decision all investments in district heating are judged uneconomic. Germany has based

<sup>6</sup> The lower energy saving is based on the minimum value of primary energy saving under the Cogeneration Directive of 10%. Modern cogeneration plant as reported by Denmark in their potentials report is saving 25% primary energy equating to a total of 115 TWh.

its report on a feasibility analysis using an annual interest rate of 8% in the commercial sector and 5% for the public sector;

- The economic effectiveness of the cogeneration potential for small scale (and micro) units in the services and household sectors is still below wider market application (in new EU Member States for example on average only 5% of evaluated technical potential is treated as economic potential in some Member States).

#### Regional observations:

- There is significant unexploited industrial heat potential for cogeneration in Europe. In the larger economies this makes up around 50% of the potential;<sup>7</sup>
- In southern parts of Europe, the industrial potential and tertiary sector heat potential have been stressed over the district heating potential. The cooling potential is also stressed;
- Significant potential exists in new Member States particularly for refurbishment of district heating schemes and their upgrade to include modern cogeneration (where currently only heat is distributed). This is universally the case where a large district heating infrastructure already exists;
- In many new Member States the highest share of economic potential in the evaluated technical potential is linked to the modernisation and upgrade of cogeneration units in district heating systems, with the replacement of existing steam turbines by combined cycle units running on natural gas;
- There is a definite trend to extrapolate the future opportunity from known past successes. Hence in countries which have a strong history of district heating and a lesser experience in industry, the potential is seen very much in expanding district heating, with less opportunity in moving more cogeneration into industry to be based on industrial heat. In countries such as the United Kingdom where there is a history of industrial cogeneration and virtually no district heating, the additional potential is all seen as being in industry and small commercial developments. In Germany which has a strong tradition in both segments, both segments are seen as potential for expansion;
- Germany reports a very large economic potential. Two factors in the view of the CODE project team have created this result:
  1. A long term energy strategy based on renewables and energy efficiency, linked to a strong commitment to meeting Kyoto goals. This produces a high motivation to find energy efficient solutions for the supply of both heat and electricity; and

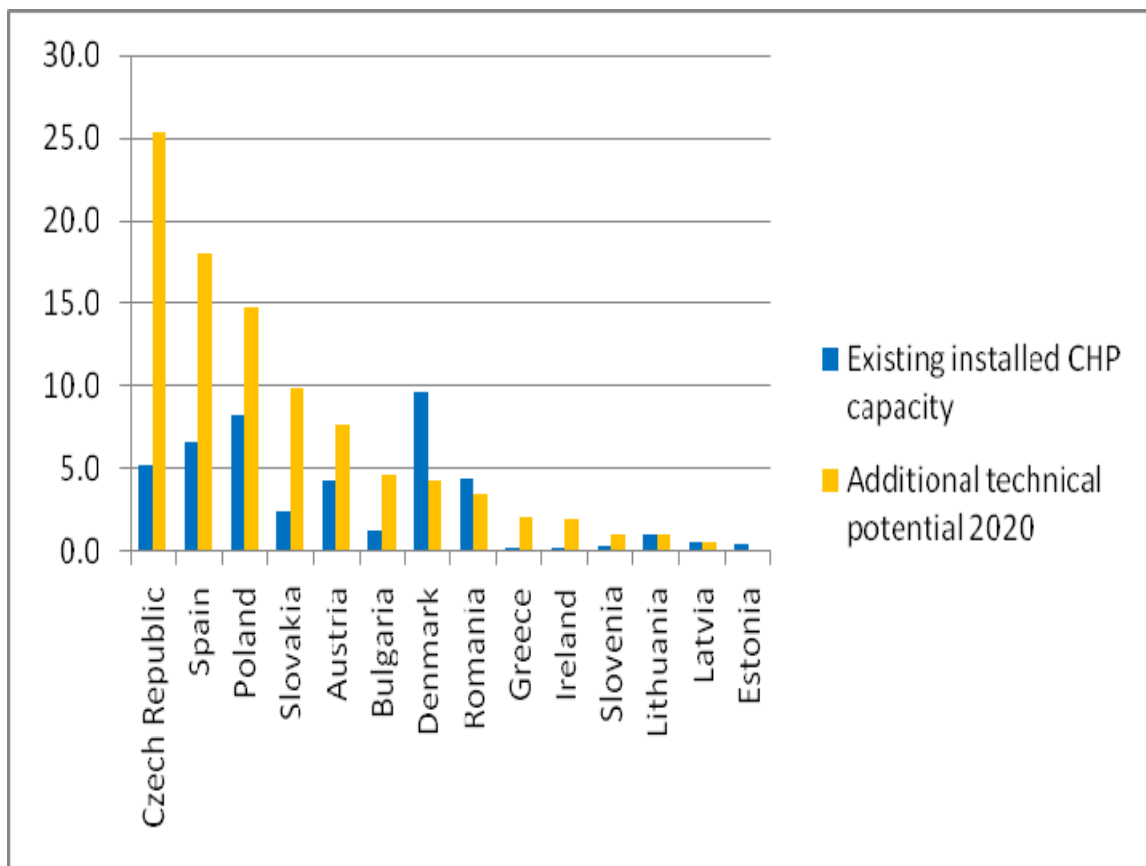
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<sup>7</sup> D-ploy study on industrial CHP in 4 major industry sectors – [www.d-ploy.eu](http://www.d-ploy.eu)

2. A tradition of both industrial process and district heating schemes using cogeneration. This produces a strong technical, social and economic understanding of the potential of cogeneration to improve energy efficiency and allows a robust and self confident analysis of the potential.

### 3.5 European Cogeneration technical potential in 2020

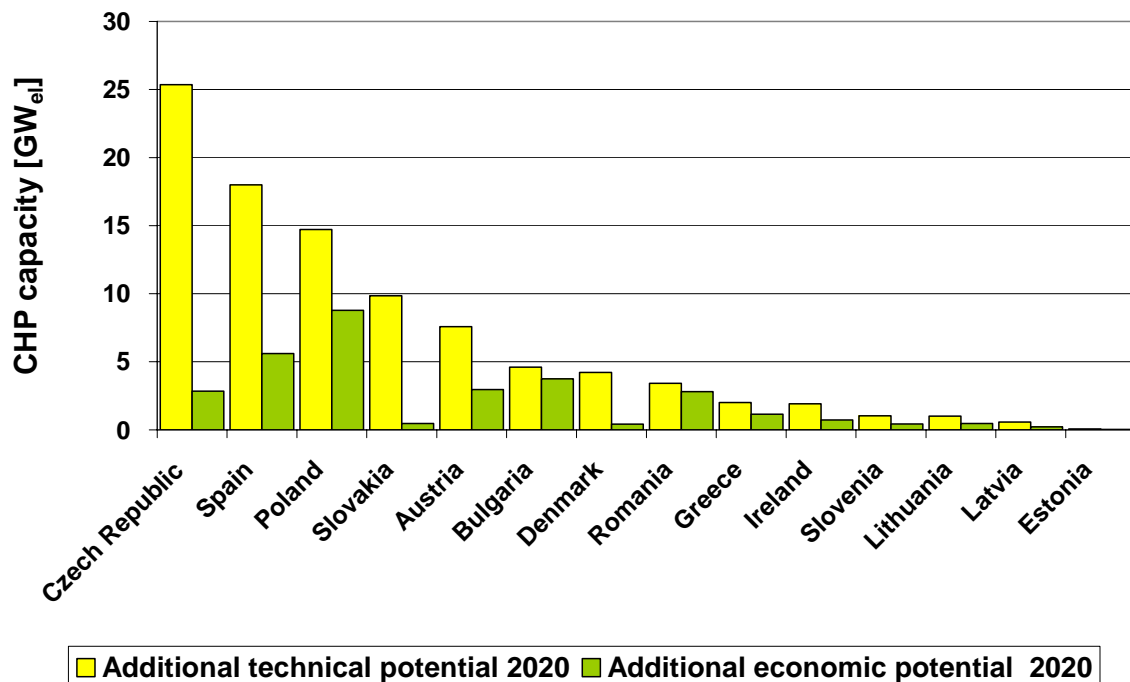
Only 14 Member States have reported a technical potential although every Member State must have made this assessment as a first step to assessing economic potential. The reported figures, compared to current installed capacity are shown in figure 2 below.



**Figure 2 Comparison of the Member State identified technical potential (additional) compared with the existing installed capacity.**

There is no simple or direct relationship between the identified technical potential and the existing installed capacity. Eight of the 14 Member States have identified the technical capacity as twice as large or more than the installed capacity.

The Member States' technical potentials are based on the analysis of current cogeneration status with projections of future heat and electricity demand. The level of detail and approaches in considering sectors and sizes/technologies/energy sources of cogeneration units varies but the majority of analyses are based on a segmentation approach, i.e. bottom up. When the Member States evaluated technical potential against their economic criteria, the economic potential emerged as in figure 3 below.



**Figure 3 Reported additional technical and economical potential of cogeneration electrical capacity by 14 Member States in the year 2020**

Again there is no simple or direct relationship between the identified technical potential and the economic potential. The technical potential has not always been clearly stated in each Member State report and there is a low level of reporting of technical potential in general.

Where a Member State has clearly and unambiguously identified a technical potential:

- There is a lack of background in relation to methodologies to determine the above and often the Member State has used existing potential studies as the basis of the compliance documentation for articles 6 and 11 and not undertaken bespoke research to fulfil these requirements of these articles;
- Those Member States that have commissioned bespoke research for the purposes of identifying national potentials for cogeneration have mainly used a top down approach;
- Where technical potential has been identified separately, a wide range of sectors have been highlighted;

- Potential is seen across the full capacity size ranges of cogeneration installations from micro to very large scale;
- In general very little focus has been put on the potential associated with micro CHP, cooling or bio-energy, and these remain a potential upside to the published figures.

## **4. Member States progress in identifying barriers to the greater promotion of cogeneration in the EU**

Three Member States have not reported on barriers to the promotion of cogeneration in their territory (Luxembourg, Hungary and Portugal). The following summary is for those Member States who have reported. Across the full 24 Member States who have reported on barriers, several significant barriers are identified. The common themes are addressed below while the detail can be found in the four CODE Regional Reports (See Annexes 4.1, 4.2, 4.3 and 4.4).

As might be expected the Member States with a high penetration of cogeneration (Finland, Denmark) report in their heat and electricity sectors proportionally less barriers to do with administration or grid connection. Finland asserts “minor barriers” for expanding cogeneration overall, while in Denmark’s report, regulatory and administrative barriers are not cited and barriers in general are few in number. There are a large number of different barriers quoted by the Member States. Often these are not prioritised and the list always reflects key characteristics of the local energy market and the countries energy history. There are however certain common themes which emerge as the major barriers which Member States believe they face currently. For more information on specific countries or on the extent of the barriers quoted consult the regional reports (See Annexes 4.1, 4.2, 4.3 and 4.4).

### **4.1 Barriers to growth of cogeneration: financial barriers to cogeneration development**

A key element of profitability of a cogeneration plant is the run time of the plant which is dependent on the heat demand of the industrial process, commercial entity or space heating demand the cogeneration plant is supplying. The longer the operating hours in any one year, the more rapidly the profit accumulates from a new plant and the faster is the pay back on investment. The ideal situation is a high number of heat demand hours. Hence industrial applications with long operating hours or district heating in a region of long winters are attractive options for cogeneration. The second most significant impact on the cost effectiveness of cogeneration is what is called the “spark spread”: the difference between the price of electricity and the price of the basic fuel on which the cogeneration depends. The larger the price/cost difference, the more profitable the sale of the electricity from cogeneration will be, hence the shorter the payback time and the lower the risk of any investment.

All Member States cite some form of financial barrier for cogeneration. Leading among these are:

- The relatively low price of electricity, especially for households and the relatively high price of gas. This is frequently coupled with concerns regarding secure availability of supply and the risks associated with single suppliers (Czech republic, Slovenia, Latvia, Lithuania and Spain)

Gas is a low carbon fuel and hence good for reducing climate change. However, cogeneration plants on gas have a high marginal cost of fuel compared to either mature base load coal plants or nuclear base load. The result is that while cogenerators can compete in peak periods, they cannot compete in off-peak. Nor are cogenerators free to operate to optimise the value of their electricity sales on the market as their primary customers (the heat customers) must be also be served.

- Uncertainty in the forward price of fuel and electricity as a whole making investment in cogeneration a relatively high risk by comparison with other discretionary investments (Germany and Spain).
- Negative Impact of ETS on cost of cogenerated heat and electricity further erodes profitability

The negative impact is a particular concern in the new Member States and was specifically mentioned by Poland where there is a considerable amount of coal in the primary fuel mix. For all Member States the additional cost of carbon driven by ETS and which cannot be passed on in the electricity pricing when generating off peak will impact the overall profitability of cogeneration. Additionally the ETS cost of carbon in heat from district heating where district heating is in competition with heat sources outside ETS will also have a negative impact on profitability.

- Impact of market liberalisation (Belgium and the Netherlands)

Market liberalisation has tended to suppressed the price of electricity

New Member States:

The new Member States tended to highlight additional economic barriers as the most significant barriers to the further development of cogeneration:

- Significant capital investment is required to upgrade cogeneration schemes in all sectors. In housing and district heating schemes significant capital investment is required to repair, modernise, insulate and install cogeneration in existing networks. At the same time the access to capital is particularly poor due to low credit rating of local companies and in the district heating sector due to the poor commercial models which have operated historically (see below);

- Several Member States highlighted the poor commercial model currently operating in some district heating companies as a barrier. Regulation of the sector including control of the price of heat, operating hours and social obligations made the sector unattractive commercially, while many carry significant debt due to customer payment defaults.

The sensitivity of particularly small scale cogeneration and district heating to the economics of the energy sector is highlighted in the following comments from the Member State reports:

- Denmark reports: In the next few years the price of electricity will not be high enough to allow for investment in new cogeneration capacity. This is attributed to the fact that the electricity price is below the long-term marginal costs for a new plant. It goes on to note that as older plants are taken out of service, capacity will gradually fall and the price of electricity will rise to a level at which investments may be profitable.
- Finland reports: “Modern CHP is competitive on the market in relation to the separate production of heat and power. This is mainly due to the structure of our industry and the climatic conditions”. “CHP production is not particularly supported in Finland, with the exception of small-scale CHP production based on renewable energy sources, since small scale separate production is still relatively more competitive than CHP production”.
- Belgium reports: At a federal level the report points to market uncertainty due to liberalisation and fuel price volatility. This is exacerbated by the required capital outlay of cogeneration projects
- Poland reports: The fundamental barrier to the development of cogeneration is economic. The price of power and heat on the national competitive markets, in consideration of the balancing market, does not point towards investment in combined sources.

#### **4.2 Barriers to growth of cogeneration: administrative and procedural barriers to cogeneration development**

Many Member States (Romania, Greece, Cyprus, Germany, Spain and Estonia) have highlighted administrative and procedural barriers to the further development of cogeneration. These relate to the difficulties of developing commissioning and running cogeneration plants. A sample of the types of problems still being faced is given below:

- Authorisation procedures are bureaucratic and difficult to work with;
- There is an undue cost of information associated with the proposal and early development of a project;
- Procedures for connection to electrical grids are not standardised or codified;
- Placing of cogeneration electricity on the local energy market does not allow for the characteristics of operating cogeneration;

- Initial costs of connecting to the grid and thereafter operating the plant unduly burden the cogeneration plant;
- Unfavourable provisions concerning back-up electricity supplies decrease the credit items of cogeneration producers from the avoided network charges,

#### **4.3 Barriers to growth of cogeneration: general**

There are very few Member States comments on technical barriers to the promotion of cogeneration. This is understandable as high efficiency cogeneration technology for the production of heat and electricity is a mature technology which is well understood and generally available. One Member State, i.e. Poland, chose to emphasise this point and stated “At the present level of power technology development technical barriers are of virtually no importance.”

Germany, which has clearly a strong technical base in cogeneration, chose to comment on the ongoing need to develop cogeneration technology highlighting that a technical barrier existed in the case of gas turbine combined heat and power technology and counter pressure machines, where there is a fixed ratio of electricity to useful heat production. This lack of flexibility makes it difficult for this type of plant to respond to changes in demand for electricity and hence in the electricity price. This threatens the potential to operate profitably in a modern fully liberalised electricity market.

Malta and Spain both cite the limited availability of a natural gas supply as a technical barrier. Several Member States mention the early development stages of both cooling technology (Spain and Greece) and micro CHP (United Kingdom, Denmark and Greece) as preventing their comments on these technologies.

#### **4.4 CODE project team and regional meeting comments**

The Regional Workshops of the CODE project, supplemented by one-on-one discussions with Member State stakeholders, were held in Milan (May 2009), London, Warsaw (September 2009) and Athens (October 2009). These meetings gave an opportunity for the cogeneration stakeholders in the region to discuss the success of the implementation of the Cogeneration Directive and to highlight their areas of concern.

There was a certain amount of satisfaction in some Member States over their implementation of the Directive and its successes so far, notably Belgium, Spain and Germany. Each of these

Member States has been diligent in implementing the Directive and has followed through with support mechanisms to promote cogeneration and to further develop the potential identified.

There are refreshing developments in Denmark and the Netherlands where district heating and small cogeneration in agriculture are both finding new business opportunities through selling balancing services to the grid and through using heat storage to optimise their time on the market. In Germany, where micro CHP is also most widely used, announcements in summer of 2009 of the intention of Lichtblick to create a virtual power station of micro CHP units in order to balance the increasing volume of wind on the grid, show that new technology is stimulating new ways of working with cogeneration.

The major themes which emerged from these four Regional Workshops are:

*1. Impact of the right to dispatch or not on the overall economics of cogeneration significantly effects the commercial operation of cogeneration plant.*

This is a theme which appeared only in the Estonian report, however, it is an important discussion point for policy around cogeneration. It was also raised in all except the Warsaw regional meeting and is considered by stakeholders to be a significant barrier to the promotion of cogeneration. The Cogeneration Directive has provisions for Member States to give the right of priority dispatch to cogeneration plants. Priority of dispatch is already granted to renewable energy. Given the low carbon nature of cogeneration among fossil fuel sources and its ability to supply electricity when the heat demand is also present, giving priority of despatch to cogeneration makes good energy efficiency and CO<sub>2</sub> reduction sense. Attractively for the TSO or DSO the availability of the cogeneration electricity is predictable and dependable and increasingly flexibility is being introduced. However, achieving recognition of the operating characteristics of cogeneration in order to maximise its energy efficiency and CO<sub>2</sub> reduction potential is hard.

*2. Project inception, development and commission issues around grid connection both technical and financial*

Particularly with small installations where connection is a significant part of the total project cost and the connection is at DSO level, there are multiple problems originating in the ongoing poor adaption of the transmission and distribution networks to the emerging demand for distributed generation. The stakeholders at regional level supported in detail the issues raised by Member States under administrative and procedural issues.

In Spain for example there is an obligation on the grid owner to give a cogeneration plant an interconnection depending on the capacity of the grid. A feasibility study must be carried out

and before it can be started the grid owner requires that a bank guarantee for a sum equivalent to the value of the proposed project is taken out by the project owner.

In the UK there are 12 DSO's covering the country. All have separate information systems, contracts and structures for distributed generation connection and none are set up to engage with distributed generators on a regular basis.

### *3. Capital issues, and business model issues, particularly in district heating refurbishment in new Member States*

Considerable concern was voiced both the new Member States seeking to promote cogeneration through the refurbishment of district heating. Moreover, a deterioration in the economic model for district heating is widely anticipated with the advent of ETS phase III. These concerns can be summed up as the certainty of increased cost through ETS without the certainty of any direct upside through more profitable sales of electricity or heat. Whether these fears prove correct or not the immediate impact on the market is real. Faced with the uncertainty of the post 2013 situation and the possibility of eroded margins investors will be cautious.

#### Economic competitiveness of district heating systems:

- High cost of refurbishment and construction of district heating network systems in comparison of low costs of individual heat supply systems (boilers, etc, especially attractive for investors of new buildings (Poland, Hungary, Czech Republic, Slovenia, Slovakia, Lithuania, Latvia and Spain);
- Regulation on of setting end use heat price, which not always reflects all cost of heat supply, especially in case of price regulation for customers protection (Poland and Slovenia);
- High costs of CO<sub>2</sub> emission allowances (ETS) which could significantly increase final heat prices and cause disconnection of consumers – carbon leakage to the non ETS sector (Poland);
- Poor public attitude/acceptance of district heat supply (mainly caused from the past bad experiences) (Bulgaria, Poland, Hungary, Slovenia).

#### Economic competitiveness of Industrial CHP

- industrial cogeneration has to contend with particular obstacles: a lack of interest and a lack of in-house know-how;

- high transaction costs for information;
- unstable market conditions as a result of uncertain industrial activity and energy prices;
- lack of priority access to the grid;
- in the industrial sector in the low-temperature heating area, inadequate obligation to accept and pay for electricity from cogeneration

#### Small and medium scale cogeneration

- High cost of information transactions around projects;
- Non-standardised connection procedures and documentation for connection of new plants;
- Onerous costs imposed by DSO to connection to and use of grid.

## **5. Member States progress in reviewing support mechanisms for the promotion of cogeneration**

The Cogeneration Directive requires Member States to review their progress against the objectives of the Directive, initially in 2007 and thereafter every four years "evaluating progress towards increasing the share of high efficiency cogeneration". Member states tended not to give very full accounts of support mechanisms but rather to include comments on the schemes during either their assessment of economic potential or during the first progress report.

Several Member States have modified their support schemes during implementation of the Directive. Notably Germany, Belgium, Spain, Greece, Slovenia and Luxembourg have consciously chosen to enhance support for cogeneration. At the same time other Member States, notably the Netherlands, France and Hungary, have cut back on support for cogeneration. These different changes in support mechanism highlight that there is nothing within the Cogeneration Directive which will guarantee the support and promotion of cogeneration per se. Rather, where there is a broader effective strategy to increase energy efficiency or a similar pro-cogeneration driver then the Directive allows special support to be put in place. Hence the Cogeneration Directive has not put in place a driver for the development of cogeneration in EU Member States, rather it is has created encouragement for the already willing.

### **CODE project team and Regional meeting comments**

An overview of the wide range of support mechanism in place across Europe is given below. The reality that the cogeneration market is basically flat, and consists heavily of replacement, shows that the policies in place are ineffective in growing the market. The Regional Workshops heard some criticism of support mechanisms in different Member States and discussion emphasised the need to consider not just the individual support mechanisms but their interaction with Member State taxes, procedures at TSOs and DSOs and wider energy policy goals. In the South Western Region, Italy has a certification in place that is weak, poorly structured and insufficient to promote cogeneration. In France the purchase obligation which supported cogeneration in the 1990s has been steadily diminished. In the Netherlands the favourable schemes of the past have all but disappeared.

Member States in reporting their systems have tended to adopt schemes that existed for other purposes (such as renewables). It is not clear how much use has been made of the schemes thus far in Northern, South Eastern and South Western Regions. However almost all Member States in the Eastern region have a fully functioning system and have based their support schemes on GoO certifications.

## **6. Member States progress in establishing a system of guarantees of origin for electricity from high efficiency cogeneration**

Spain, Greece, Ireland, Cyprus, Luxembourg, Hungary and Portugal have not reported on their scheme for Guarantees of Origin (GoO). The creation of the GoO structure is an action under the Directive, which requires structuring, effort and investment of resource. Performance has been particularly poor in this area against the due date of June 2007. This lack of completion of actions on GoO may reflect a lack of experience with this type of certification, this is certainly the case for Greece and Cyprus.

A table showing the status of implementation of GoO schemes is included in Annex 3.

## 7. Conclusions and recommendations

The Member State implementation of the Cogeneration Directive into law and the completion of reporting requirements have been slow. Given that so many elements of the final national implementation and the reporting are currently absent, the overall performance has to be considered poor. The potential study reporting has however identified an additional 122 MWe capacity potential for cogeneration in Europe mainly in Member States whose existing penetration of cogeneration is under 20%. The Directive has also stimulated activity to improve the policy structure around cogeneration in several Member States.

The CODE project makes the following recommendations and observations:

### 7.1 Recommendations

As reporting on progress is an ongoing activity under the Directive, the CODE project recommends:

- Provide Member States with a clear structure for future reporting:
  - Clear specification of energy units to energy be used;
  - Require reporting of both heat and electricity;
  - Define market segmentation for reporting including the granularity of: 1) industry sectors; and 2) thermal/electrical capacity of installations;
  - Clear measures covering the status of implementation. For example regarding GoO the measure should certainly address volume of GoO issued in last year, and possibly traded volume.
- Further reporting requests to Member States should emphasise the need to look at the cooling, waste heat, micro and bioenergy potential for cogeneration;
- Member States should clarify explicitly what assumptions are being used, and what scenario is in being assumed, to determine what is "economic" potential and what is "technical" potential;
- The European Commission should from now on be firm on Member States and firmly impose reporting deadlines. The continual process of assessment, learning and reporting under the Directive is the only potential "bite" which the Directive contains and so must be enforced.

## 7.2 Observations

- The Directive has been successful in creating a regulatory framework for the promotion of cogeneration as seen by the consistency which is now emerging in the Member States legislation on cogeneration;
- Where Member States have chosen to make cogeneration part of a structured energy efficiency strategy, they have also put actions in place to start to remove barriers and to improve support for cogeneration to overcome market shortfalls;
- Enhanced use of cogeneration generally across the Member States has not yet emerged as a visible market reaction to implementation of the Directive. The exceptions to this statement are Germany, Spain, Belgium and Slovenia. Although the Member States have highlighted considerable additional potential for cogeneration in Europe, they have also highlighted some very weighty barriers to achieving this potential. Special efforts in the areas of grid connection, regulation and administration, and financing need to be addressed;
- The majority of Member States appear to have produced a defensible national potentials report based to a reasonable extent on a bottom up approach. The reports are generally conservative technically and vary considerably in the economic assessment approach. Member States find opportunities in either industrial cogeneration or district heating according to their history. Cooling, micro CHP and bio-energy opportunities are in many cases unexplored, at this point due to lack of reliable technical and market information. This tendency not to look for wider and new applications and the current shortage of good information in the newest applications, suggests that opportunities were not enthusiastically sought rather history was developed;
- The cogeneration potentials study is one of the few occasions on which Member States were asked to consider the energy requirements of heat with electricity demand as a by-product. The result has been generally positive uncovering a potential to double European CHP. More focus on heat in energy planning will assist the future reporting.

# Annex 1: European Commission guidelines on national cogeneration potentials estimation and reporting

## ANNEX IV

### Criteria for analysis of national potentials for high-efficiency cogeneration

- (a) The analysis of national potentials referred to in Article 6 shall consider:
- the type of fuels that are likely to be used to realise the cogeneration potentials, including specific considerations on the potential for increasing the use of renewable energy sources in the national heat markets via cogeneration,
  - the type of cogeneration technologies as listed in Annex I that are likely to be used to realise the national potential,
  - the type of separate production of heat and electricity or, where feasible, mechanical energy that high-efficiency cogeneration is likely to substitute,
  - a division of the potential into modernisation of existing capacity and construction of new capacity.
- (b) The analysis shall include appropriate mechanisms to assess the cost effectiveness — in terms of primary energy savings — of increasing the share of high-efficiency cogeneration in the national energy mix. The analysis of cost effectiveness shall also take into account national commitments accepted in the context of the climate change commitments accepted by the Community pursuant to the Kyoto Protocol to the United Nations Framework Convention on Climate Change.
- (c) The analysis of the national cogeneration potential shall specify the potentials in relation to the timeframes 2010, 2015 and 2020 and include, where feasible, appropriate cost estimates for each of the timeframes.
-

## **Annex 2: Calculation methodologies for CODE project (conversions and interpolations)**

### **Introduction**

The published Member States reports were interrogated and where it was available the following information was collected:

- Existing cogeneration capacity (in terms of electrical capacity) GWe
- Technical cogeneration capacity (in terms of electrical capacity) GWe
- Economic cogeneration capacity (in terms of electrical capacity) GWe

Some Member States did not provide all data under all of these three sections and where this is missing estimates have been made in accordance with the procedure noted below.

We have compared the existing capacity with the Economic Capacity to derive an estimate of the Additional Economic Capacity to be exploited throughout Europe.

We have estimated the Primary Energy Savings (PES) and corresponding CO<sub>2</sub> emissions reduction that are available if this additional economic cogeneration capacity were to be implemented. The methodology for estimating the Energy Savings and CO<sub>2</sub> emission reduction is noted below.

### **Methodology to estimate Economic Capacity where data is not reported**

Most Member States reported their existing cogeneration capacity but where this is missing the latest Eurostat data has been used.

Some Member States have reported both Existing Capacity and Economic Capacity, these data have been summed and the ratio of Existing to Economic for reporting countries in Europe has been noted.

Where a Member State has not reported Economic Capacity, it has been estimated by applying the European ratio to its Existing Capacity

### **Methodology to estimate Energy Savings from the Additional Economic Capacity**

Member States are required to complete reports on the basis of compliant cogeneration, this implies that cogeneration included must have achieved PES of at least 10%. However, Member States have not reported on the actual Energy Savings Achieved. In order to estimate the Energy Savings, three assumptions must be made:

- Ratio of Capacity to Output.
- Energy Savings attributable to adoption of cogeneration
- Energy Savings can be assumed as electricity

The ratio of Capacity to Output was derived from the latest Eurostat data (2007) for cogeneration employed in Europe by dividing the installed capacity by the total electrical generation.

The achievable energy saving was deemed to be 10% as this is the minimum required by the Directive.

The total additional Economic Capacity was found by subtracting the Existing Capacity from the Economic Capacity as derived above.

The Energy Saving was then found by multiplying the Additional Economic Capacity by the ratio of Capacity to Output and multiplying this result by 10%.

### **Methodology to estimate Carbon Dioxide emission reductions attributable to the Energy Saving**

The Energy Saving derived above is in the form of electricity. The average CO<sub>2</sub> concentration of electricity generated in Europe is quoted as 0.45 kg/kWh. To estimate the CO<sub>2</sub> emission reductions available the total annual Energy saving was multiplied by 0.45kg/kWh. The value of this potential CO<sub>2</sub> reduction was found by multiplying by the price of €39 / ton of CO<sub>2</sub> as quoted in the Commission impact assessment.

### Annex 3: Status of implementation of Guarantee of Origins schemes in the EU (December 2009)

Reporting obligations of Cogeneration Directive 2004/08/EC (situation up to 05/10/2009)				
MS	Progress Report	Analysis of National Potential	Barriers for CHP / administrative – procedural situation	Guarantees of Origin Scheme
	[Art 10(2)– Art 6(3)]	[Art 10(1) – Art 6(1)]	[Art 10(1) – Art 9(1&2)]	[Art 10(1)– Art 5(3)]
	due on 21/02/2007 and then each 4 years	due on 21/02/2006	due on 21/02/2006	due on 21/06/2007 (6 months after adoption of harmonized reference values – Commission Decision 2007/74/EC of 21/12/2006
BE	received	received	received	received
BG	received	received	received	received
CZ	received	not received	not received	not received
DK	received	received	received	received
DE	received	received	received	received
EE	received	received	received	received
IE	not received	received	received	not received
EL	received	received	received	not received
ES	received	received	received	not received
FR	received	not received	received	received
IT	waiting for translation	received	waiting for translation	received
CY	received	received	received	not received
LV	received	waiting for translation	waiting for translation	waiting for translation
LT	received	not received	waiting for translation	waiting for translation
LU	not received	waiting for translation	not received	not received

<b>HU</b>	<b>not received</b>	<b>not received</b>	<b>not received</b>	<b>not received</b>
<b>MT</b>	received	received	received	received
<b>NL</b>	received	received	received	received
<b>AT</b>	received	received	received	received
<b>PL</b>	received	received	received	received
<b>PT</b>	<b>not received</b>	<b>not received</b>	<b>not received</b>	<b>not received</b>
<b>RO</b>	received	received	received	received
<b>SI</b>	received	received	received	received
<b>SK</b>	received	received	received	received
<b>FI</b>	received	received	received	received
<b>SE</b>	<b>waiting for translation</b>	<b>waiting for translation</b>	<b>waiting for translation</b>	<b>waiting for translation</b>
<b>UK</b>	received	received	received	received

## **Annex 4: Regional reports on Member State reporting under the Cogeneration Directive**

Annex 4.1: Northern Europe Region

Annex 4.2: Eastern Europe

Annex 4.3: South Western Europe

Annex 4.4: South Eastern Europe