The Second European Climate Change Programme

Working Group ECCP Review -Topic Group Energy Supply

Final Report

Introduction

The current report presents the most important messages coming from both meetings on energy supply. In order to enable a comparison with the results of ECCP I, the following key results of ECCP I, identifying the potential for emissions reductions of various measures (2010, EU15) are repeated.
The Working Group Energy Supply made an estimate of the emission reduction potential of a number of key measures.

Policies and measures 'Energy supply'	**Emission reduction potential (Mt CO_2eq)** By 2010 – EU15
1. EU ETS (incl. linking)	-
2. Directive RES-E	100-125
3. Directives on the promotion of transport bio-fuels (RES-T)	35-40
4. Directive on promotion of CHP	65
5. Further measures RES-H	36-48
6. Inventory public aid for energy – follow-up	N/k[1]
TOTAL	**236- 278**

The sectoral objectives study in ECCP I "Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change" (available on the following website http://europa.eu.int/comm/environment/enveco/climate_change/sectoral_objectives.htm) gave an estimate regarding the projected emissions in energy supply. Starting from 1990 with total emissions of 1285 Mt CO2eq., a baseline emissions figure (business as usual) in 2010 was calculated as 1267 Mt CO2eq. The projected reduction for the EU 15 under a scenario meeting the EU-15 Kyoto commitment was 180 Mt CO2eq. from 1990 and 162 Mt CO2eq. from the business as usual baseline of 2010.

[1] not known – no final conclusion on potential

A. Trends in energy supply

A.1 Trends 1990-2003[2]

EU-25, EU-15, EU-10

1. The greenhouse gas (GHG) emissions of the energy supply sector, totalling 1604 Mt CO2eq, represent 32,6% of the overall GHG emissions in 2003 for the EU 25. This is divided between public heat and electricity production (26,7 %), petroleum refining and manufacturing of solid fuels (4,2%), and fugitive emissions (1,7%).
   Compared to 1990, emissions of the energy supply sector decreased by 7,8% in the EU-25, but remained basically unchanged in the EU-15.
2. CO2 emissions from petroleum refining in the EU-15 increased by 12% in 1990-2003, reflecting to a certain extent increased demand for petroleum products for the transport sector and higher energy consumption to fulfil new European sulphur specifications in liquid fuels.
3. CO2 emissions from public electricity and heat production were reduced by 3,9% in 1990-2003 in the EU-25, but increased by 6,3% in the EU-15. The reductions with respect to an unchanged energy production park can mostly be attributed to fuel switching (2/3; gas replacing oil and coal) and improvements in efficiency (1/3). An increase in the share of renewables also contributed to emission reductions, but was less pronounced in 2002 and 2003 due to little hydropower generation as a result of low rainfall.
4. The steady increase in the final electricity consumption (approx. 1,9 % pa, almost equal to average GDP growth) has offset most the improvements in CO2 intensity due to fuel switch, efficiency improvements in thermal power generation and renewable energies. This highlights the overriding importance of energy demand management as a central element of a GHG abatement strategy, as the past period shows that significant improvements in CO2 intensity are countered by the overall increase in energy use.
5. The period 2000-2003 shows an increasing trend in CO2 emissions in the EU-25. Since 2000, improvements in CO2 intensity have been minor, as both fuel switch and efficiency improvements are happening at a much slower pace than in previous years.

Trends in Member States 1990-2003

6. Overall trends are a result of widely diverging trends in the Member States. The most important indicators for each Member State are given in Annex 1.
7. Electricity growth rates vary widely, with very high growth rates in Spain, Portugal, Ireland, Cyprus, Malta, Greece ranging from 4,2 % to 5,8%.
   Some Member States have a much lower economic intensity of final electricity consumption (final electricity consumption divided by GDP in 1995 market prices in GWh/Mio. EUR) in 2003 than others (Czech Republic, Greece and Slovakia between 1,067 and 1,215 whereas Denmark, Germany and Ireland between 0,201 and 0,244).

[2] If no other source is mentioned all the figures come from the European Environment Agency

In the EU 25 the economic intensity of final electricity consumption has been decreasing in average from 1990 until 2000 (-0,3%) but increasing in average from 2000 until 2003 (+0,2%).

8. Efficiency improvements in conventional electricity generation are below the EU 25 average in Austria, Denmark, Italy, and Germany. Efficiency improvements are even negative in France, the Netherlands, Finland, Sweden, Slovakia, Latvia, Czech Republic and Lithuania.
9. The use of CHP in electricity production varies widely across Member States. Many countries (such as Greece, Ireland, France, UK, Slovenia, Sweden, Italy, Belgium, Spain and Luxemburg) have a share of CHP electricity below 10%, while the best performing countries (the Netherlands, Latvia, Finland, Denmark) have a level of electricity from CHP reaching 30% or more.
10. The only countries that have made important progress towards their renewable electricity targets are Denmark, Germany, and Spain (until 2003), but progress is taking place in an increasing number of countries since then.

Investment and technological trends

11. Gas turbine combined cycle (CCGT) remains the dominant technology of choice for current investments throughout the EU (23800 MW on line in 2004-2005, and approximately 31000 MW under construction until 2010), due to its relatively low capital costs, high flexibility, high efficiency and low CO2 intensity. This is followed by renewable electricity, in particular wind, spurred by RES-E regulatory frameworks in an increasing number of countries.
12. Investments in new nuclear plants are and will likely remain low in the coming years due to high capital costs and because the new generation of nuclear technology has not yet proven that it can be implemented on a large scale. Investments in new coal fired plants are becoming more attractive if current price differentials between (high) gas and coal prices are expected to continue over longer time frames.
13. The EU emissions trading scheme has until now had little influence on investment patterns, as it has become operational one year ago, as it is early to assess its longer term impact, and as it confirms the current preference for CCGT. However, depending on constraints in future National Allocation Plans, it will dampen a move towards coal based generation that could be the result of continued large gas-coal price differentials.
14. The CO2 emissions of a state of the art coal fired plant are approximately 35% less than those of the typical coal plant in the EU. Increased use of co-firing and new power plant technologies can further decrease CO2 emissions. In the future, carbon capture and geological storage gives fossil fuel based generation a potential medium to long term prospect of near zero emission technology.
15. Nearly 60% of current coal fired plants are over 25 years old. In total 650-900 GW of new installed capacity (2/3 for replacement and 1/3 to meet new demand) is expected to be needed in the next 30 years, depending on the actual plant retirement age, if no demand measures are taken. The new capacity is comparable to the current installed capacity. The technology choice for this investment, alongside with the extent of demand side measures, will to a very large extent determine the CO2 emissions from the electricity sector.

The unavoidable renewal of the power generation fleet presents therefore a major opportunity to move towards a low carbon electricity sector.

16. The total end use of net heat and electricity (27,5 EJ) represents 38 % of the primary energy input (72,7 EJ) with losses in the energy transformation sector of 30% (21,5 EJ) for EU 25 in 2003[3]. These data show the importance of an increase in efficiency for primary energy conversion.

A.2 Projections until 2010, until 2030

17. The new Primes baseline presents an outlook for the development of the electricity sector supply until 2030, based on a set of assumptions (such as GDP growth, prices of various primary energy sources, currently existing climate change polices -e.g. CO2 allowance price and current incentives for renewables in the Member States-, state of play related to nuclear in the various countries).
18. The new Primes baseline projects 3% higher CO2 emissions than the previous baseline in the energy sector in 2010, largely due to higher oil and gas prices which lead to more coal based generation (on the basis of a fixed CO2 allowance price).
19. This new projection shows an increased divergence from aggregated Member States projections, as submitted under the greenhouse gas monitoring system. The aggregate of Member States projections with measures projections and without Kyoto mechanisms is resulting in – 1,6% CO2eq. emissions for the period 1990-2010 for all the sectors.
20. The CO2 abatement of existing policies in the Members States in the period 2005-2010 is estimated by PRIMES at 1,6% for renewable electricity (64,9 Mt CO2eq), 0,4% for CHP (16 Mt CO2eq) and 0,6% (24,2 Mt CO2eq.) for biofuels. These figures are lower than those anticipated in ECCP I.
21. On the other hand, emissions are considerably lower than in the previous baseline in the period 2020-2030, due to lower assumed GDP growth and most importantly due to higher oil and gas prices, leading to more use of renewable energy and co-generation in the longer term. However, in this scenario (implying current policies) emissions in the electricity sector remain 4-5% above 1990 in the period 2020-2030, with a sustaining observed past trend that improvements in CO2 intensity are being cancelled out by electricity consumption growth. Also in the longer term the baseline, which includes current measures, is not in line with long term climate change objectives. Additional measures are required.

B. Policies and measures in Member States

22. The Member States' reported policies and measures (UNFCCC communications and GHG monitoring mechanism) and quantified emission reductions concerning energy supply and other sectors were brought together

[3] Data from the ecoheatcool project (www.ecoheatcool.org)

in a database and assessed in a specific study executed by Öko Institut and funded by the Commission.

23. Quantified emission reductions are sometimes missing and no quantified data were available for Belgium, Cyprus, Czech Republic, Malta, Poland, Hungary and Luxemburg. In so far as quantified emissions reductions are reported, it remains in many cases unclear what the basis is for the quantification (what is the reference case and what are its assumptions, basic methodology for calculation, starting year and status of measures often not indicated). Also double counting of effects of certain measures can occur.
24. The total sum of reported and quantified emissions reductions in energy supply amounts to 255Mt CO2eq. for 2010. Some larger quantified emission reductions may largely represent business as usual developments in the sector (e.g. measures reported as 'fuel switch', 'energy efficiency improvements in the power sector', 'higher imports'), rather than a result from actual national policies and measures, and their quantification as emission reductions might give a biased view on projections, in particular if 'negative' developments are not considered.
25. For renewables, Member States (EU 15) report a total reduction of 102 Mt CO2eq (105 Mt EU-25), which is lower than the ECCP I estimate of 136-173 Mt CO2eq. (RES-E and RES-H).
26. For the policies and measures related to CHP, 11 Member States reported (under the EC monitoring mechanism and UNFCCC) a quantified potential reduction of 58[4] Mt CO2eq by 2010 (mostly in Germany and Italy), which is corresponding well to the projected emission reduction estimate in ECCP I of 65 Mio. t CO2eq due to the implementation of the CHP directive.
27. The difficulty of comparing the reported figures underlines the overall need for better and consistent quantification of projections: business as usual and especially with current and additional measures. Especially no ex-post evaluation of policies and measures has been conducted by the Member States.

C. EU-wide policies and measures and implementation in the MS

C.1 Directive on electricity from renewable energy sources

28. Targets for 2010 were agreed for renewable electricity for each of the Member States in the EU-25, totalling 21% of the electricity production for EU 15. At the end of 2004, the Commission estimated that on the basis of current Member States' policies and measures, the share of renewable electricity would reach 18-19% in 2010. The major issue remains the effective implementation of these policies and measures at the national level.
29. The Commission has adopted a new communication on the support of electricity from renewable energy sources (COM (2005) 627). In this document the different support schemes implemented in the Member States were evaluated, indicating wide differences in the effectiveness of support schemes

[4] Of which 26,4 Mt are CCGT where it is not clear if the heat produced is used as such.

across Member States. The Communication recommended 4 key issues in relation to the implementation of the RES-E Directive by Member States :

a. an optimisation of support schemes
b. better implementation of provisions related to the removal of administrative barriers
c. better implementation of provisions related to ensuring fair grid access.
d. stable frameworks

30. The experience of Spain shows that a coherent and sustained policy can deliver a considerable increase in renewable energy in a cost-effective way. According to the costs and benefits estimations from the PRIMES model the costs for supporting policies for renewables and CHP for electricity are lower than the average costs of reduction of CO2 emissions in the same sector in 2010 (22 EUR/t CO2 of support costs for renewables compared to 49 EUR/t abatement costs).
31. The improved management and further development of the grid is considered an important element for a larger scale expansion of wind and other renewables in the medium term. Truly independent TSO and DSOs are an important enabling factor for renewable energy and other new entrants in liberalised electricity markets. Appropriate prediction, forecasting and regulation of balancing costs, contribute to a better integration of RES in the internal market.

C.2 Biofuels Directive and Biomass Action Plan (note: not the agricultural side)

32. The well-to-wheels GHG emission reductions of different biofuels pathways are well understood. In particular, the JRC/EUCAR/CONCAWE well-to-wheels study provides a comprehensive reference document. Today's biofuels typically produce 40-80% as much GHG emission as conventional fuels, depending on the fuel and how it is produced.
33. The percentage of energy demand that can be substituted by biomass derived fuels is limited, so it is important to use available resources in the most effective way. JRC is leading discussion to gain concensus on the amount of biomass that can practically be made available in Europe.
34. The biofuels directive was transposed in the national legislation at the end of 2004. It establishes reference values for the market share of biofuels in 2005 (2%) and in 2010 (5,75%). The share of biofuels in 2003 in the EU 25 was 0,6% which shows that significant efforts were needed to reach the 2005 target.
35. In 2006 a review of the biofuels directive will be conducted. It will mainly be focused on the economical and environmental performances of biofuels. This reviewing exercise may lead to a proposal to amend the Directive.
36. Wood gasification or direct use of biomass for heat and power offers greater GHG savings at lower costs than conventional road biofuels. Biofuels for road vehicles remain an important option to reduce GHG emissions because it is an easy way of reducing directly fossil fuel use for vehicles by using the existing infrastructure. To this end, presently attention is also given to a second generation of biofuels. Liquid biofuels also reduces the dependency of Europe on imported oil. However, it should be recognised that biofuels are limited both in terms of European production and the amount that can be incorporated into

fuels, and in addition they have their own supply risks linked to harvest fluctuations. In this respect increasing the energy efficiency of transport modes using fossil fuels and developing CO2 free transport modes are crucial issues.

37. The share of biomass used to produce electricity and heat varies strongly across Europe. In Germany in 2004 more than half of the total final energy provision from renewable energy sources came from bioenergy (45,6 % from biogenic heat; 7,2 % from electricity from biomass and 8,5 % from biofuels). The so-called "Nawaro bonus", i.e. an increased fee payment for electricity from biomass exclusively produced from regenerative raw materials from agriculture and forestry triggered a momentum for the use of biogenic energy forms.
38. To increase the use of biomass in electricity production and larger scale heat, the development of a well functioning supply chain is of primary importance.

C.3 Directive on Combined Heat and Power

39. The new directive will set up harmonised definitions, reference values for separate production and a calculation methodology for primary energy savings by high efficient CHP. Each Member State will have to evaluate its CHP potential.
40. Today the share of CHP in electricity production varies very strongly in the MS. In Denmark and the Netherlands it represents 30% or more and in UK and France less than 10%. An informal indicative target of 18% has been defined in 1997 for the EU15.
41. The economics of investing in CHP currently cannot be clearly assessed. The major factors influencing this are the uncertainties about long term gas and power prices. The heat demand plays a relatively smaller role.
42. Many MS already have support schemes in place for CHP based on national initiatives from before the adoption of the CHP Directive. A few Member States have substantially increased CHP capacities whereas others have not and some stagnated.
43. The trends for CHP on the market show an evolution toward larger scale, lower heat to power ratio and greater flexibility. It seems that the market trend is more oriented toward electricity production than supply of heat.
44. The market does not invest from itself in CHP so some supporting policies are needed.
45. Developing active policies on district heating and cooling is to be considered as an important element for a larger scale expansion of CHP and the success of the CHP Directive.
46. District heating and cooling grids make it possible to optimally use and combine surplus heat from electricity production based on conventional or renewable fuels, from waste incineration and/or from industrial processes.
47. Intelligent energy solutions are demand-driven and therefore require a comprehensive approach taking into account the whole chain from primary energy conversion to final consumption. Policies addressing the heating and cooling markets should prioritise solutions based on renewable energies as well as surplus heat from energy conversion and industrial processes.

C.4 Further measures RES-H and use of waste heat

48. No specific directive about renewable energy sources for heating & cooling production has been adopted yet. Such a directive was mentioned in the Green Paper on energy which was published on 8. March 2006. An assessment will be carried to assess whether and how a directive on cooling and heating can bring a significant additional potential for renewable energy sources in Europe. Also a lot of heat in the EU is released into the environment because it is considered waste heat at the site of production, though this waste heat could at least partly be used to cover a genuine demand for heating and cooling nearby.

D. The Broader regulatory Framework

D.1 Impact of conventional energy policy on greenhouse gases emissions

49. Despite concerns about the emissions of CO2 and residual air pollutants emanating from the burning of fossil fuels, the amount of fossil fuel subsidies remains high. The lack of consistent subsidy data does not allow any analysis about the appropriateness of the amounts and structures of these subsidies.
50. Ensuring a fair market access for independent power suppliers will improve the investment climate for CHP and renewables. It is important that national energy regulators prevent anti-competitive behaviour of dominant companies and increase transparency in the markets, including transparency on price-setting mechanisms.

D.2 Interactions between EU ETS and renewable and energy efficiency policies

51. Both major goals of the study conducted by NERA for the European Commission on interactions between EU ETS and renewable and energy efficiency policies are: 1) to identify and describe the interactions between the EU ETS and green and white certificate schemes; 2) to assess the implication of these interactions for policy goals and design.
52. Certificate schemes typically do not lower total CO2 emissions from power generation in the presence of EU ETS, unless the determination of the cap within the EU ETS takes into account ex ante expected reductions from this policy. Emissions trading means that emissions reductions due to certificate schemes are offset by emissions increases by other participants of the trading scheme.
53. Certificates schemes do not necessarily incentivise the most cost-effective CO2 abatement options. This comparison does not take into account any non-CO2 benefits, nor that current allocation rules do not fully price in the value of CO2 allowances in future investment decisions, or any "technology-learning" benefits of the certificate schemes.
54. Certificate schemes lower the price of CO2 allowances but the total costs of achieving the cap are higher in the short term.

D.3 Long term energy scenarios for the EU

55. A full policy option case has been modelled in PRIMES. The policy package in this case combines:
    - an extensive support for acceleration of renewables (additional policies from existing ones)
    - new standards and measures for high energy efficiency
    - accepted advanced nuclear technology
    - new standards and fuels for transports

    This scenario predicts emissions that in 2030 are 25% lower than in1990.

E. Conclusions and recommendations

56. The work achieved under the working group Energy Supply showed the difficulty of assessing the impact of the policies and measures on GHG emissions at EU and MS level. In this regard a better modelling and reporting from Member States is needed. Especially an ex-post evaluation of policies and measures is necessary.
57. The current policies and measures did not deliver the full reduction potential projected in ECCP I because of lacking of active and effective implementation by all the MS.
58. Measures for sectors outside the scope of the EU ETS are critical in terms of determining the reductions needed within the EU ETS system in the second NAP. Member States should carefully check the expected emissions reductions from those measures.
    Measures affecting sectors within the scope of the EU ETS system (e.g. renewables, CHP, energy efficiency of electricity supply and use) cannot be expected to deliver emission reductions if their expected effects are not taken into account in the National Allocation Plan. In this case the operators will replace "cheap" measures (under the allowance price) by "subsidised" measures and no additional benefit of the discussed policies and measures (renewables, CHP …) will be achieved in the short and medium term.
59. The increase of the share of renewable energy sources can make a major contribution to the EU energy challenges of climate change and security of energy supply. It needs to be considered how a more effective, cost effective and coherent renewable energy policy framework (targets, support schemes) across the EU and across the various applications can be developed for the medium to long term.
60. In general the industry is ready to develop new clean technologies but a long term regulatory framework is important to reduce the risks of investing in such technologies.
61. The continuous increase in electricity consumption remains a major issue (see WG Energy Demand) because the supply has to meet the demand. All the efforts to increase the share of clean electricity production are diluted by the continuous increase of the electricity consumption. Decoupling of economic growth and electricity consumption remains a major challenge for future climate change policies.

Annex 1: assessment of energy supply indicators per Member State *(Data from EEA)*

	Kyoto target	Total Energy consumption 1990-2003	Electricity demand growth 1990-2003	CO2 energy intensity (energy related CO2 emissions/total energy consumption) 1990-2003	Efficiency of electricity production from conventional thermal power stations (electricity output/total input) 1990-2003	Share of CHP electricity in total electricity generation in 2002	Share of renewable energy sources in total energy consumption in 2003	Share of renewable energy sources in total electricity consumption in 2003
Austria	- 13%	2,1 %	2,7 %	- 0,3%	0,4%	13,6%	20,3%	55,9%
Belgium	- 7,5%	1,3%	2,5 %	- 0,9%	1,1%	7,5%	1,9%	1,8%
Cyprus	None	2,6%	5,8 %	+ 0,8%	2,0%	0,0%	1,5%	0,0%
Czech Republic	- 8%	- 0,6%	0,6 %	- 1,8%	-1,6%	17,1%	2,8%	2,8%
Denmark	- 21%	1,1%	0,8 %	- 0,2%	0,4%	49,1%	13,3%	23,2%
Estonia	- 8%	- 4,5%	-1,5 %	- 0,7%	1,8%	11,0%	9,5%	0,5%
Finland	0%	2,0%	2,5 %	+ 0,1%	-0,4%	38,0%	21,2%	21,8%
France	0%	1,4%	2,4 %	- 1,0%	-0,1%	4,0%	6,4%	13,0%
Germany	- 21%	-0,3%	1,0 %	- 1,0%	0,3%	9,8%	3,4%	7,9%
Greece	+ 25%	2,4%	4,2 %	- 0,2%	1,1%	1,9%	5,1%	9,6%
Hungary	- 6%	-0,4%	0,0 %	- 0,8%	1,6%	21,5%	3,4%	0,9%
Ireland	+ 13%	3,0%	5,2 %	- 0,3%	0,7%	2,5%	1,7%	4,3%
Italy	- 6,5%	1,3%	2,4 %	- 0,3%	0,2%	7,4%	5,9%	12,8%
Latvia	- 8%	-0,7%	-3,9 %	- 6,4%	-2,0%	37,5%	33,4%	35,4%
Lithuania	- 8%	-4,3%	-3,9 %	- 4,6%	-2,8%	9,7%	7,8%	2,8%
Luxembourg	- 28%	1,3%	2,9 %	- 1,7%	5,3%	7,9%	1,4%	2,3%
Malta	None	3,2%	5,5 %	- 1,1%	1,0%	0,0%	0,0%	0,0%
Netherlands	- 6%	1,4%	2,4 %	- 0,4%	-0,2%	29,9%	2,5%	4,7%
Poland	- 6%	-0,5%	0,2 %	- 0,9%	1,9%	16,0%	5,4%	1,6%
Portugal	+ 27 %	3,2%	4,8 %	- 0,2%	0,6%	10,0%	17,0%	36,4%
Slovakia	- 8%	-0,8%	-0,2 %	- 1,8%	-1,6%	17,5%	3,3%	12,0%
Slovenia	- 8%	1,8%	2,0 %	- 0,9%	1,4%	5,9%	10,5%	23,1%
Spain	+ 15%	3,2%	4,4 %	- 0,1%	1,2%	7,8%	7,0%	22,3%
Sweden	+ 4%	0,6%	0,6 %	- 0,7%	-0,8%	6,8%	26,3%	40,0%
United Kingdom	- 12,5%	0,7%	1,6 %	- 1,0%	1,1%	5,4%	1,4%	2,8%