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EVALUATION OF EC SCENARIOS FOR CO_2 EMISSION REDUCTION

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PREFACE

The study is carried out at the request of the Ministry of Economic Affairs, DG Energy (Project no. 7047) and has the objective to analyze and evaluate the different energy scenarios developed in 1991 by the CEC, DG XVII and DG XII.

Particularly the responsibilities of the Netherlands, during their Chairmanship of the Heads of States in the EC, for the negotiations on the CO_2 reductions per EC country provided the background for getting more insights in the present and future CO_2 emissions and reduction possibilities and costs of the EC countries.

The background papers and publications of these scenarios provided by DG XVII and DG XII were an excellent basis for the present evaluation. An earlier version of this report, ECN-C--92-009 in Dutch, was published in January this year.

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CONTENTS

1. INTRODUCTION

1.1. Objective

During the past few years the discussion on limiting the CO_2 emissions has been intensified with the view to curbing the greenhouse effect. Early 1992 the discussion within the European Commission resulted in a statement that total CO_2 emissions will be stabilized at the 1990 level in the year 2000 for the whole EC. Obviously this EC reduction objective necessitates further analysis of the reduction potential per country. This requires knowledge of the present CO_2 emissions and also insights in the CO_2 developments up to the year 2000 or 2010 in order to calculate reduction burden sharing necessary within the EC. The reduction options and their potential per country will be based on recently developed energy/CO_2 scenarios for the twelve EC countries by the Commission.

1.2. Method

The energy scenarios developed for the EC will be used for a comparison of the different CO_2 reduction options per EC country. More precisely it concerns the following EC scenarios:
1. The Energy 2010 scenarios (1990, [1]) developed by DG XVII (DG Energy).
2. CO_2 reduction scenarios developed by expert teams in the EC countries for DG XII (DG Research and Development) within the confines of the Cost-effectiveness Analysis of CO_2 Reduction Options (1991, [2]).

Based on a selection from the scenarios mentioned above, an explanation will be given concerning the differences between the countries with regard to CO_2 emissions and reduction options by means of a number of relevant scenario parameters. These data should help to provide a better insight into the CO_2 reduction options required per country for the achievement of the CO_2 emission objective in 2000.

A wide range of criteria is deemed relevant in order to properly judge the CO_2 emissions and the reduction options per country (see tables in appendix). Primarily it involves assumptions such as growth in population, GDP, energy prices etc. which largely determine the energy consumption and the fuel input and therefore also the CO_2 emissions for the EC as a whole and for a country in particular. In addition to an analysis of assumptions (projections which form the basis for the CO_2 emissions), the relevant results of the scenarios should also be analyzed. Note that first the scenarios are not completely targeted at our specific requirements for data and secondly DG XVII and DG XII do not always provide similar data formats. A summary of the relevant scenario data available can be found in the appendix. The next chapter gives a characterization of the DG XVII and DG XII scenarios. Chapter 3 provides information on the scenarios on EC level. Chapter 4 analyzes the scenarios per country and gives implications for CO_2 reduction targets per country, based on the use of several reduction criteria. Finally chapter 5 discusses the results and provides an account of conclusions and recommendations.

2. CHARACTERIZATION OF SCENARIO STUDIES

2.1. DG XVII scenarios

The four DG XVII scenarios (study Energy 2010, report Energy in Europe) were developed during the years 1988-1990. Subsequently insights which were valid for 1990 are not always applicable today 1991/92.

The construction of the scenarios was based on the "central" EC-wide economic projections which were thereafter split up for each country. Therefore the economic projections are more or less consistent between countries. These projections together with many assumptions concerning conservation in energy end-use, conversion efficiencies of energy etc. are the starting point for the MEDEE-model to calculate end-use and final consumption [4]. Subsequently, the primary energy consumption per EC country is derived with simple spreadsheets so that the resulting CO_2 emissions could then be calculated with the aid of CO_2 emission factors (Hector accounting framework). So the applied simulation methodology specifically involves calculations, based on different economic factors and many energy conversion assumptions, finally resulting in CO_2 emissions per sector and country. Costs considerations and/or comparisons do not play an explicit role, but wherever possible their impacts are included in the assumptions. See table 1 for a brief description of the DG XVII scenarios.

Scenario I, the so called "business as usual" scenario, portrays the possible developments in the EC without exceptional policy measures other than today's practices. It assumes (effects of) a further economic integration, moderate energy price developments and extreme amounts of energy savings. Therefore the authors call it the Conventional wisdom scenario, in which CO_2 emissions increase over the period of 1985-2010.

Scenario III, called Sustaining high economic growth, shows the effect of trying to combine a relatively high economic growth with care of the environment. An attempt is made to restrict the emissions by means of extra energy conservation measures, changes in behaviour and a substantial growth in the share of nuclear energy, all combined with an achievement of a slightly higher economic growth than in scenario I.

Finally, scenario IV, called High prices, outlines developments in energy supply and CO_2 emissions, if a moderate (scenario I) economic growth is combined with very strict environmental regulations, particularly with respect to CO_2 emissions. Emissions are not only restrained by means of reductions in energy consumption (scenario III) but also by a carbon tax on fossil fuels, a slight growth in nuclear capacity and more efficient production of energy.

Scenario II, Driving into tensions, is not taken into consideration in this evaluation because no CO_2 emission reduction is achieved with respect to 1990.

Table 1. Description of DG XVII scenarios

Scenario	I: Conventional wisdom	III: High growth	IV: High prices
Energy prices			
Oil	17.5 (1995) USD/bbl 20 (2000) USD/bbl 30 (2010) USD/bbl	20 (1995) USD/bbl 25 (2000) USD/bbl 20 (2010) USD/bbl	As in scenario I
Gas	Indexed to oil up to 2000, to coal thereafter	Decoupling with oil up to 2000, indexed to coal thereafter	
Coal	49 (1995) USD/tce 50 (2000) USD/tce 60 (2010) USD/tce	50 (1995) USD/tce 60 (2000) USD/tce 50 (2010) USD/tce	
GDP-growth	2.7% per year (1990-2000) 2.7% per year (2000-2010)	3.5% per year (1990-2000) 3.0% per year (2000-2010)	As in scenario I
Sectors			
Industry	Production growth; but stabilization of growth in energy-intensive branches	Substantial growth, but decreasing growth in energy-intensive branches	Restricted growth due to higher energy prices
Tertiary	Substantial growth of production	Substantial growth of production	Compensating additional growth up to 1995, then as scenario I
Households	Consumption growth 2.5% p.a.	Consumption growth 3.0% up to 2000, thereafter 2.5% p.a.	As in scenario I
Transport	Substantial growth	Real substantial growth, substitution by train after 2000	As in scenario I
Technology	New technology leads tot higher efficiency: 10% in industry and household space heating	Additional efficiency-improvements compared with scenario I	As in scenario III
Policy			
Energy	According to market mechanisms	Extra oil substitution by gas and after 2000 nuclear expanded	As in scenario III
Environment	EC legislation	Extra environmental standards influence fuel mix and energy efficiency	As in scenario III incl. carbon-tax on fossil fuels

Table 2. Description of DG XII scenarios

Scenario	Reference	Mure (savings)	X % CO_2 reduction
Energy prices			
Oil	17.5 (1995) USD/bbl 20 (2000) USD/bbl 30 (2010) USD/bbl	As in Reference scenario	As in Reference scenario
Gas	Indexed to oil up to 2000, then to coal		
Coal	49 (1995) USD/tce 50 (2000) USD/tce 60 (2010) USD/tce		
GDP-growth	2.7% per year (1990-2010)	As in Reference scenario	As in Reference scenario
Sectors			
Industry	Growth; stabilisation energy-intensive branches	As in Reference scenario	As in Reference scenario
Tertiary	Substantial growth	As in Reference scenario	As in Reference scenario
Households	Consumption growth 2.5% p.a.	Additional technological energy saving options	As in Mure scenario
Transport	Substantial growth	Additional technological and behavioral energy saving options	As in Mure scenario
Technology	New technology leads to higher efficiency	Additional energy saving options	As in Mure scenario
Policy			
Energy	According to market mechanisms	Government promotes additional technical/ macro-economic saving measures	As in Mure scenario
Environment	EC legislation	As in Reference scenario	As in Reference scenario
CO_2 target	No CO_2 target	As in Reference scenario	CO_2 emission targets at minimal national costs by fuel switch and application of new technologies: in 2000 stabilization of CO_2 emissions to 1988 level, in 2010 x% reduction with respect to 1988

2.2. DG XII scenarios

DG XII scenarios were drawn up in 1990 and implemented the economic and energy demand developments as exercised in scenario I of DG XVII. Therefore, the Conventional wisdom scenario was a key input for the energy demand projections used in the Reference scenario of the DG XII study (see table 2 on page 9).

Subsequently final energy consumption in the Reference scenario is more or less, depending on the country, equal to the final consumption in scenario I of DG XVII. Furthermore the Reference scenario includes the developments of the energy supply and emissions policy regulations implemented in 1990. Policies include capacity expansion plans for the public electricity companies and other public utilities in the EC countries.

Consequently the Reference scenario is an update of the DG XVII scenario I finished a year before, in particular with respect to the energy and emissions related regulations and policies. The Linear Programming model EFOM-ENV was used for development of the Reference, energy saving scenario (Mure), and subsequent CO_2 reduction scenarios. The model minimizes national costs for the energy system (supply and demand), given exogenous energy service demands, considering yearly constraints on capacities and CO_2 emissions [3].

Within the context of the Cost-Effectiveness Analysis of CO_2 Reduction Options study, the different CO_2 reduction scenarios are derived as follows. Subsequent to the Reference scenario, the so called Mure or Savings scenario is constructed by adding energy saving options to the model, for the household and transport sectors, which, if cost-effective (from a national standpoint), will contribute to meet energy demand. The contribution of the energy saving options is calculated without specific CO_2 emission reduction objectives.

The second DG XII scenario used for the present evaluation is defined by restricting the CO_2 emissions in 2000 and 2010 relative to the CO_2 emissions levels in 1988. According to the implementation of CO_2 targets for the year 2010, the third and fourth DG XII scenario were subjected to increasingly stricter CO_2 reductions, viz. 10 and 20% respectively. In both scenarios the CO_2 emission target in the year 2000 is equal to the emission level in 1988. Furthermore the CO_2 reduction percentage of 20% in 2010 was achieved by a limited number of EC countries. Some country scenario calculations could achieve CO_2 reductions further than 20%. These "extreme" reduction scenarios are presented in the CO_2 emission tables in the appendix.

The third DG XVII and fourth DG XII scenario have been constructed by different methods and assumptions, which has a heavy bearing on the scenarios of each country. The DG XVII scenarios portray different views of the future with respect to economy and energy technology and indicate the consequences for the environment (CO_2 emissions). The DG XII scenarios on the other hand originate from environmental objectives and calculate the most cost-effective measures which should be implemented in order to achieve the emission objectives. Methodological differences explain clearly the differences in the CO_2 emissions per scenario for the different studies, and are presented in the tables 2.4 to 2.8 in appendix.

2.3. Definitions

The studies were carried out under responsibility of two different EC directorates which resulted in substantial difference in definitions of key variables such as primary and final energy consumption. Both the DG XII and the DG XVII definition of a country's primary energy consumption exclude bunkers for international shipping (see figure 1, under the X-axis). In contrast to DG XII, the DG XVII scenarios do include bunkers for international flight traffic. This energy demand category is not differentiated and therefore is implicitly included in the domestic energy consumption. Both DG studies include feedstocks in the primary energy consumption.

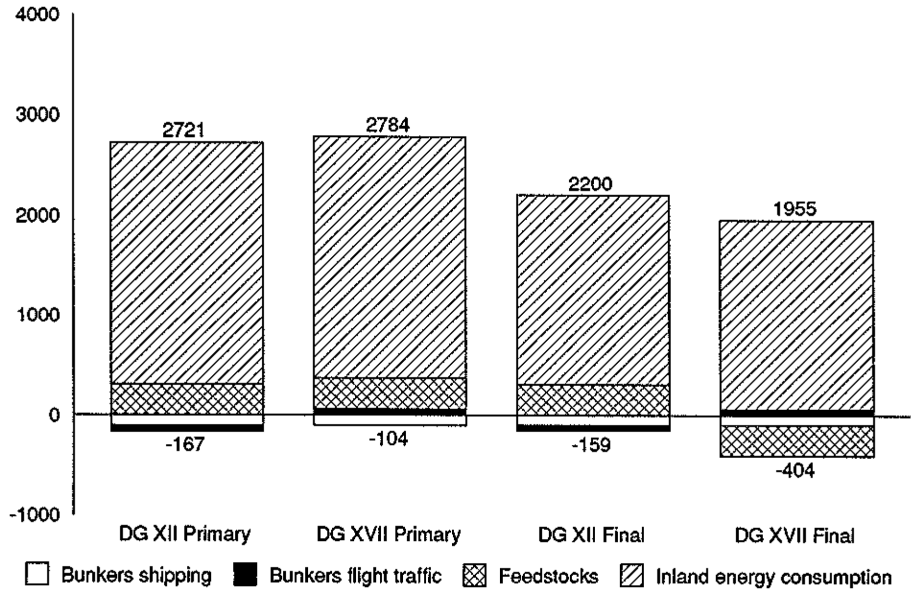

Figure 1. Definitions applied by DG XII and DG XVII for primary and final energy consumption illustrated with data for the Netherlands (1990), source Dutch Central Bureau of Statistics (CBS)

In the final consumption however, DG XII includes feedstocks whereas DG XVII does not. The situation concerning bunkers in the final energy consumption is the same as that for the primary consumption. Consequently, the definitions for the final consumption vary per sector and therefore are not directly comparable. Arising from these differences in definition, for DG XII it is expected that the figures for industry are higher (inclusion of feedstocks) and lower for transport (exclusion of international flight traffic) than those for DG XVII. In figure 1 data from the Dutch Central Bureau of Statistics (CBS) for 1990 in the Netherlands are used. In other EC countries the differences in definitions are smaller.

Combined Heat and Power generation (CHP), solar energy and biomass are not differentiated in the DG XVII study. However hydro-power, wind energy and geothermic energy are explicitly incorporated in the scenarios. So the DG XII study explicitly incorporates all the aforementioned forms of generation. The DG XII study however has not included any additional energy savings for the industry and the tertiary sector in the reduction scenarios compared with the Reference scenario.

In neither the DG XII study nor in the DG XVII study, the CO_2 emissions resulting from bunkers are incorporated in national emissions calculation. DG XVII accounts implicitly for international flight traffic in primary energy, thus CO_2 emissions from international flight traffic are included in their CO_2 emission calculations, which are not accounted for by DG XII. DG XVII CO_2 emissions do not contain emissions resulting from feedstocks. In contrast, DG XII CO_2 emissions contain emissions resulting from the processing of feedstocks although future emissions of the feedstocks themselves (containing "fixed" carbon) are not included.

3. SCENARIOS EC

3.1. General assumptions

The demographic developments are identical for all scenarios (table 1.1 appendix). The total EC population grows at a low rate. The number of families rises slightly and there is a projected decline in the average family size from 2.9 persons in 1980 to 2.4 persons per household in 2010.

Fuel prices, which influence energy consumption, are identical in DG XVII's scenarios I and IV and rise moderately from 1990 (tables 1.2-1.4). However, in scenario III there is an escalation of fuel prices up to the year 2000 and afterwards a curtailment. At that moment, the demand for fossil fuels declines primarily due to substantial energy savings and substitution to nuclear energy in scenario III.

Total GDP (Gross Domestic Product) for the EC rises annually in scenarios I and IV by 2.7%, resulting in a growth of 70% from 1990 to 2010 (table 1.5). A greater GDP growth of 92% is anticipated for scenario III during this period (annually 3.5% up to 2000, 3% after 2000).

The number of person-kilometres driven per private car (the total number of kilometres travelled by citizens) grows by 25% in scenario I and IV over the period 1990 to 2010, whereas a reduction of 2% is achieved in scenario III (table 1.7). The freight transport by road (in ton-kilometres) depicts a similar case (table 1.9). For goods and passenger transport by rail, a growth of approximately 27% is anticipated in scenario I and IV, whereas in scenario III, the passenger transport by rail grows by 250% and the goods transport by rail by 90% (tables 1.8 and 1.10). Scenario III depicts a shifting away from transport by road to rail transport. In addition, the demand for transport kilometres is restricted by behavioral regulations. Evidently the impositions in scenario IV do not have any influence on the modal-split or on the demand for transport kilometres.

From the value added table for industry (table 1.6), it is clear that the rate of economic growth in scenario III is lower in comparison with scenario I. The greater economic growth for this scenario is particularly achieved in the service sector. In scenario IV the rate of industrial growth is less. But the total growth is still equal to that of scenario I, thus the service sector has a greater growth of the value added than in scenario I, but not as much as is obtained in scenario III (table 1.11).

3.2. Fuel supply

According to the DG XVII projections, the oil share in the primary energy consumption (according to Eurostat definitions) shall decrease in favour of nuclear energy and gas (table 2.2). In scenario I, oil consumption decreases from 45% in 1990 to 36% in 2010 in favour of nuclear, coal and gas (in order of sequence). Renewable energy sources ("others") increase by less than one percent to 2010. In the DG XVII study, a differentiation is made only between geothermic energy, wind energy and hydro-power. In scenario III, as a result of environmental restrictions, the oil share in 2010 is even lower (circa 30%) and similarly the share of coal is reduced, viz. from 20.5% in 1990 to 18.7% in 2010. This provides a transition in favour of gas (from 18.5% in 1990 to 25.8% in 2010) and nuclear energy (from 14% in 1990 to 22.7% in 2010). In comparison with scenario III, the nuclear energy share in scenario IV in 2010 is 3% smaller, in favour of coal and renewable energy sources.

The Reference scenario of DG XII does not present exactly the same fuel shares for 1990 or for 2000 and 2010 as the Conventional wisdom scenario of DG XVII (table 2.3). This can be explained by the fact that this scenario is developed in 1990 and thus includes recent policy changes by governments and utilities. By comparison to the Conventional wisdom scenario, the

Reference scenario foresees a larger gas share at the expense of the nuclear and coal shares in 2010. In addition, the share of renewable energy sources grows substantially in this scenario as a result of incorporation of these options, from 2.7% in 1990 to 5.4% in 2010. The supposition can be made that because the DG XII Reference scenario was more recently developed, it has been influenced more by the present interest for a sustainable energy supply.

The differences in the fuel shares obtained in the DG XII scenarios have a totally different background as regards method, than the differences in the DG XVII study. Changes in DG XII fuel shares occur simply because of a lower CO_2 emission constraint applied in the model. The model selects the most cost-effective option. The Reference scenario is not the cheapest scenario. A number of energy saving options were added to the model after running the Reference scenario (the Mure-case). The changes in fuel shares depend on the options available in the model. Experts determine these mostly on technological and economical grounds. Therefore, the results of the DG XII scenarios can deviate from those of the DG XVII scenarios. In the 20% reduction scenario, the gas share for 2010 has grown enormously (to 34%), almost completely at the expense of coal. Renewable energy sources increase in 2010 to 7.6%. Because it is expected that most EC countries will impose a nuclear moratorium nuclear energy rises hardly.

3.3. CO_2 emissions

Coincidently the Conventional wisdom scenario and the Reference scenario provide an identical picture concerning CO_2 emissions relative to energy, despite the use of different methods, CO_2 emission factors, fuel input etc. The primary energy categories, corrected for feedstocks and bunkers, were the starting point for DG XVII calculations of CO_2 emissions. DG XII calculates the actual emission resulting from fuel and technology mix by the use of the EFOM-ENV model, also excluding emissions from bunkers and feedstocks.

In the Conventional wisdom scenario, CO_2 emissions rise by 9% in the year 2000 (from 1990) and by 14% in 2010 (tables 2.4 and 2.5). In the more recently finished Reference scenario, the emissions grow less rapidly, i.e. 7% in 2000 and 10% in 2010. This is predominantly caused by a slightly higher average technology-efficiency resulting in a lower primary energy consumption. As was already made apparent, the DG XII scenario has also a slightly different fuel input. It appears that instead of nuclear energy and coal, a higher share for natural gas and renewable energy sources share result in practically equal CO_2 emissions.

In DG XVII scenario III, the CO_2 emissions will be reduced in 2010 by 12% with respect to 1990, but there is still an estimation of a 13% growth in 2000 (greater than in the Conventional wisdom scenario). This results from the greater economic growth in scenario III, whereas the CO_2 emissions will be addressed after the year 2000 only by means of greater efficiency and input of nuclear energy and gas.

Scenario IV, however, envisages a stabilization of the CO_2 emissions in 2000 to the 1990 level, resulting from the conjectured moderate economic growth (as in scenario I) in combination with the efficiency improvements of scenario III. The changes in behaviour as a result of fuel taxes are also conjectured. Resulting from this, and with a moderate increase of nuclear energy, a 24% reduction of CO_2 emissions will be achieved for 2010 with respect to 1990 emissions.

All the DG XII reduction scenarios achieve a 5% reduction in 2000 with respect to the 1990 CO_2 emission level. This is not surprising because, for the year 2000, the models for the countries have been imposed with a higher CO_2 constraint which is equal to the 1988 emission level. A continuing CO_2 reduction is evident from the Constant scenario to the Maximum reduction scenario for 2010. The Constant scenario shows EC CO_2 emissions lower than the 1988 level because some countries already reduce part of their CO_2 emissions by additional cost-effective energy saving options in the Reference scenario, the so called Mure scenario. On the other hand, the 20% reduction scenario for the EC as a whole does not achieve a 20% reduction owing to the fact that most countries in the DG XII study do not attain this percentage.

It is striking that the Maximum reduction scenario has calculated a CO_2 emission decline more or less equal to the "environment scenario" IV of DG XVII, despite the differences in assumptions. The CO_2 reduction potential assigned to the studies is in the same range; However, the method of achieving the CO_2 reduction is different. In the Maximum reduction scenario, the amount of primary energy required in 2010 is greater than in scenario IV. The contribution of energy savings is smaller here. It should be noted that the DG XII study did not assume any energy saving measure for the industry and the tertiary sector. Nevertheless, the DG XII study achieves a similar CO_2 reduction in 2010 by another fuel input. Contrary to scenario IV of DG XVII, in the DG XII Maximum reduction scenario the nuclear energy share is much smaller, and the coal share is substantially reduced in favour of gas and to a lesser extent renewable energy sources.

For all scenarios, the CO_2 emissions per ECU-GDP are declining (table 2.6). Note that only scenario III has a higher GDP than the other scenarios.

Because population grows hardly in the EC and is similar for all scenarios the CO_2 emissions per capita portray a similar development in time as the CO_2 emissions as such.

CO_2 emission per TJ primary energy can be considered to be an average CO_2 emission factor for the national energy supply. Effects of energy savings on the CO_2 emissions are not showing in this indicator. For 1990 the DG XVII CO_2 emission per TJ primary energy is 4 ton/TJ lower than in the DG XII scenario (table 2.8). CO_2 emissions are almost the same in 1990 but the primary energy input for DG XVII is higher. For illustration the present value (1990) of the CO_2 emissions per TJ primary energy lies slightly above the CO_2 emission factor of gas. For nearly all scenarios in 2000, the average CO_2 emission per TJ primary energy is similar to the CO_2 emission factor for natural gas.

4. ANALYSIS PER COUNTRY

4.1. General assumptions

For the time span given in the Energy in Europe report, the population of each country is described as being "relatively stable". However very small yearly growth percentage differences over a period of 25 years lead to large differences between the countries in population level. The population of Germany, Belgium and Denmark decreases 6% in 2010 by comparison to 1990, whereas Portugal, the Netherlands, Greece and Ireland rise 9% (tables 3.1 and 3.2). However in the year 2000, the differences between the countries in population growth are within a margin of 7%. Although the population growth is often seen as indisputable for these type of studies, results over a long period are extremely sensitive for this factor. Differences in energy consumption and CO_2 reduction possibilities per country in 2010 are to a large extent related to the differences in population growth.

In scenario I and IV, GDP for Portugal and Spain have the highest growth with 132 and 88 index points respectively in 2010 with respect to 1990 (tables 3.6 and 3.7). France, Italy, the Netherlands and United Kingdom have the lowest increase (less than 70 index points in 2010). In the other EC countries GDP projections are estimated between 70 and 80 index points. For the year 2000, the differences are once again small (within a margin of 10%) with the exception of Portugal having an extreme GDP rise (20%). Note that the distribution of growth over the sectors in scenario I and IV is different. Approximately there are three groups differentiated in scenario III: "the extreme growers" such as Portugal and Spain (in 2010 approximately 170% increase by comparison to 1990), the "substantial growers" Greece and Ireland with 120% and the rest with an 80% growth in 2010 with respect to 1990. The same group division applies for the year 2000 but the difference between Greece and Ireland and the rest is negligible.

Clearly it is not possible to place a direct relationship between growth of the GDP and the growth of CO_2 emissions. Nevertheless, in comparing CO_2 emissions between countries it is important that the differences in economic growth between the EC countries in scenario I and IV are relatively small (certainly in 2000) so that their effects on CO_2 emission ratios of the countries are also relatively small. The fact that differences in GDP growth per country also lead to differences in CO_2 emission growth per country should be considered in scenario III.

Obviously GDP per capita is an important indicator of the affluence of a country (tables 3.8 and 3.9). This factor plays a part in the comparison in paragraph 4.4. Remarkably, the Netherlands has the lowest increase in GDP per capita of the EC countries in all scenarios for 2000 and 2010. It is also striking that despite a substantial GDP growth for Portugal and Greece, GDP per capita of these countries remains substantially behind the rest of the EC, also in 2010.

4.2. Final energy consumption

The final energy consumption for industry appears to be greater for DG XII than for DG XVII scenarios because of the inclusion of feedstocks (tables 4.1 and 4.2). In the DG XII scenarios, there is a lack of data concerning industrial energy consumption for a number of countries. Therefore, a DG XVII estimate corrected for feedstocks is used in order to derive other reference figures.

Important energy saving effects in industry are projected in the DG XVII scenarios II and IV, which of course result in CO_2 reductions. In comparison to scenario I, scenario IV of DG XVII assumes an approximate 30% decrease of final energy consumption for industry in 2010. This is not caused by an increase in electrification. Unfortunately DG XII has not investigated the scope of additional (to the Reference scenario) energy saving options in industry. Furthermore for the United Kingdom it is not clear why the 10% and 20% reduction scenarios give a higher final consumption than in the Reference scenario. Switching from electricity to combined heat and power generation can only partly explain this phenomena.

Tables 4.3 and 4.4 show the energy consumption for transport. The 1990 final consumption for transport is different for DG XII and DG XVII for France, the Netherlands, Portugal and United Kingdom. These differences cannot be completely explained by the inclusion of international flight traffic by DG XVII. The effects of energy saving options in transport in the DG XVII scenarios (45% reduction with respect to 1990) appear to be greater than for the DG XII scenarios (3% with respect to 1990). This extreme difference can only be explained by a drastic change in transport behaviour, of which a restricted number of measures are also included in the DG XII scenarios.

For a number of countries, the final consumption of the tertiary and domestic sectors is different for DG XVII and DG XII (tables 4.5 and 4.6). The consumption of Denmark, Portugal, Spain and the Netherlands is higher in the DG XVII study while the consumption for France and Greece is lower than in the DG XII study. But it is unclear why. Note that additional reduction options in the tertiary sector are not included in the DG XII scenarios. This explains why the consumption in the DG XII reduction scenarios remains slightly higher than in the DG XVII scenarios.

4.3. CO_2 emissions

As already mentioned, both studies have used different methods to calculate CO_2 emission. CO_2 emission factors in ton CO_2 per Terajoule fuel can be calculated exactly from the fuels carbon content and heating value. However there exist two definitions for the heating value. According to the European convention, the lower heating value is used, according the American convention the higher heating value is applied. See table 8.1 for an impression of the CO_2 emission factors used in the studies. The difference in factors between ECN and ETSU can be explained by the use of the different conventions.

There has been intensive consultation between the experts from the different EC countries concerning the use of emission factors in the DG XII study. It was finally decided that there are grounds for variation between countries in the CO_2 emission factor of a fuel. Therefore, countries have sometimes used slightly different emission factors. But also the separate execution of the scenario calculations is a source of "unexplained" differences in CO_2 emission factors (see the Greek emission factors for steam coal and lignite) per country. DG XVII used equal CO_2 emission factors for all countries. This is in essence a less reliable method.

The differences in emission factors partially explain why the calculated CO_2 emissions for 1990 in the DG XVII and DG XII study, which are in fact projections, differ in comparison to the 1985 data. But if the overall CO_2 emissions per study and per country (therefore per set of CO_2 factors) are interpreted relative to 1990, the effect of the use of different CO_2 emission factors is negligible. This is important because different emission factors for fuels lead to different CO_2 reduction potentials. But in general differences in technological, economical or political assumptions used for the scenarios are the overriding factors in estimating the CO_2 emissions and their reduction potential.

Next, the twelve EC countries will be dealt with individually to obtain an impression of the CO_2 emission development and CO_2 reduction options per country, which is important to discuss and assess the reduction targets among EC countries. National CO_2 emissions in 1990, 2000, and 2010 of both studies (chapter 7 appendix) are compared with one another and particular attention is payed to the differences between countries. For the years 2000 and 2010, the different CO_2 reduction scenarios per study are examined and compared with one another and tested for consistency.

As already explained earlier the Reference scenario of the DG XII study is almost similar with respect to the energy end use as the "business as usual" scenario of DG XVII. The first reduction

(Constant) scenario contains all, including the additional saving options. Almost all these options are also incorporated, because they are cost-effective from a national cost minimization standpoint. As a result the primary energy consumption is substantially lower than in the Reference scenario. Remember that the results of the reduction scenarios for the DG XII study for the year 2000 were achieved using a similar CO_2 ceiling, viz. the 1988 emission level, for all reduction scenarios. Therefore, the Maximum reduction scenario does not obtain the maximum reduction potential for the year 2000. Once more, the DG XII scenarios are aimed at CO_2 emission reduction whereas the DG XVII scenarios provide data on the CO_2 implications for different energy and environmental policies. Note that in the next paragraphs all references to rise of emission reduction are made with reference to 1990 values.

Belgium (B)

The DG XVII and DG XII studies have the same view concerning the 1990 CO_2 emission of Belgium. Scenario I and the Reference scenario are also similar with a rise of the emissions in 2000 and 2010 of approximately 11% and 5% respectively. The relative decline in 2010 is primarily caused by a decline in the number of inhabitants and an increase of the gas and nuclear energy share in the energy supply. According to the extreme scenarios in both studies, a restricted CO_2 reduction (5%) is already possible in 2000. DG XVII attains this due to a combination of energy savings and an increase of the gas input. DG XII attains this reduction by means of a moderate penetration of energy saving options and an increase in both the gas share and the nuclear share. According to the DG XII study, the maximum CO_2 reduction in 2010 is approximately 18% and according to DG XVII (scenario IV) 27%. This difference is explained by a substantial amount of energy saving projected in the industry (lacking in the DG XII study) and in transport. But the reductions in the transport sector included in the DG XII study are estimated lower than by DG XVII, especially with respect to the measures concerning limiting the transport kilometres. But these small differences are slightly obscured by more substantial impacts from substitution of gas and nuclear energy for coal in the DG XII study.

Denmark (DK)

The DG XVII emissions of 1990 are slightly higher than the DG XII emissions. Probably this is explained by the substantial amount of combined heat and power generation in Denmark, which is not explicitly modelled in the DG XVII study. In the DG XII study, however, using EFOM-ENV so that in particular in the tertiary and domestic sectors, the energy production is substantially more efficient. On the other hand, the fuel mix in the DG XII study contains more coal, but the final energy consumption is lower. "Business as usual" scenario I foresees an even more substantial rise (20%) up to 2010, whereas in the Reference scenario CO_2 emissions both in 2000 and 2010 are nearly stabilized. Less intensive increase of energy consumption as compared with DG XVII together with slight substitution of coal by gas and renewable energy sources are the main reason. Scenario IV projects CO_2 stabilization for 2000, whereas the reduction scenario of DG XII attains 10% reduction, again due to lower energy end-use. In the extreme reduction scenarios for 2010, a reduction of 30% has been calculated by DG XII which is also 10% more than the DG XVII figure, but attained in a similar manner, viz. with substitution of coal by gas and renewable energy.

France (F)

The calculated CO_2 emissions of both studies for 1990 for France are reasonably similar. The same holds for the Reference scenario and DG XVII scenario I, even if the first gives slightly higher emissions in 2010, although less fossil fuels are used. Emissions have risen by 5% in 2000, by 8% in the Reference scenario in 2010 and by 5% in scenario I in 2010, while the population has also increased by 5% in 2010. In the DG XVII scenario it is attained with increased application of nuclear energy (47% in 2010), and in the DG XII scenario with a combination of renewable energy sources (principally biomass) of 8% of the primary energy in 2010, gas and nuclear energy. It is certainly possible to reduce CO_2 emissions in 2000 with respect to 1990. Both studies achieve this through energy savings and nuclear energy, DG XVII slightly more than DG XII. In the reduction scenarios, the "maximum" reduction calculated by DG XII of more than 20% is equal to that of scenario III for 2010. This is attained for DG XVII by energy savings and nuclear energy. In the DG XII study this is combined once more with biomass. Scenario IV (DG XVII) attains an extra 16% CO_2 reduction by means of additional energy savings through changes in behaviour. Of course for a relatively low CO_2 level country, substitution provides a reduction percentage if the coal share (although small) is decreased. In contrast, clearly extreme reductions are attained by means of savings. Probably these savings are not cost-effective with respect to CO_2 reduction, since CO_2 emissions per TJ primary energy are relatively low.

Germany (D)

In the Conventional wisdom scenario, (former West) Germany can stabilize emissions for 2000 and 2010. But 5% CO_2 is already reduced in the Reference scenario in 2010 (due to assumed more efficient conversion). A 6% decline in population, together with a slight increased use of gas and nuclear energy, number among the causes. By comparison to scenario I, there is a remarkable increase in emissions in scenario III for 2000, because coal is utilized for additional electricity production. The reasons for this are unclear. However in scenario IV a 10% reduction is achieved for 2000 by means of energy savings and a moderate fuel switch. Reduction scenarios of DG XII appear to confirm this. A 6% reduction is already achieved without substitution of fuels, without imposing a CO_2 ceiling in 2000. For the year 2010, the Maximum reduction scenario of the DG XII study gives the highest CO_2 reduction in the study, namely more than 30%. Thus it is possible to attain large reductions in Germany by means of fuel substitution. The DG XII Maximum reduction scenario uses more gas, renewable energy sources and nuclear energy (substituted for coal and oil) than scenario IV, while slightly less energy is saved.

Greece (GR)

The CO_2 emissions of the Reference scenario are not similar to those of scenario I (DG XVII). The reason is that the CO_2 emission factors of lignite and coal such as used in the DG XII study (see table 8.1 in appendix) are too high (123, 110 ton/TJ respectively). These fuels are partially substituted in the scenarios thereby giving unreliable results which are not easy to correct afterwards. Subsequently, the present evaluation concentrates on the DG XVII figures. CO_2 emissions rise severely in scenario I, with 33% in 2000 and 72% in 2010. Of course the most important reason for this is the substantial economic growth (120% in 2010), but also the population grows by 6%. Reduction of CO_2 is not attainable within the short term (year 2000) in scenario IV (18% rise). Stabilization can be attained in scenario IV in the year 2010 by means of huge energy savings, through the introduction of West European efficient technologies. Greece does not intend to use nuclear energy in any of the scenarios.

Ireland (IRL)

The DG XII study on Ireland was not yet available, which means that here the DG XVII study will be dealt with. CO_2 emissions for Ireland grow substantially in scenario I, a rise of 19% in 2000 and 43% in 2010, which is partly due to a population increase of 6% up to 2010 and a reasonable GDP rise of 75% in 2010. This increase is mainly occurring in industrial energy consumption. Together with the Netherlands, Portugal, United Kingdom and Spain, Ireland is not capable of stabilizing the industrial CO_2 emissions in scenario I in 2010. Generally the coal share in primary energy for Ireland increases from 37% in 1990 to 45% in 2010. In the reduction scenarios, moderate substitution (oil, gas and a small quantity of renewable energy sources for coal) and energy savings in the tertiary and domestic sectors in particular cannot stabilize the emissions in 2000 to the 1990 level. Although in 2010 by comparison to scenario I, considerable reductions are possible in scenario IV: CO_2 emission level of +43% to -22% compared to the 1990 CO_2 emissions. The most extreme reduction is attained in scenario IV, through enormous energy savings in all sectors. Furthermore the coal share is stabilized on the 1990 level.

Italy (IT)

CO_2 emissions for 1990 differ in both studies, namely 389 and 420 Mton CO_2 in DG XVII and DG XII scenarios respectively. The DG XII study gives a CO_2 emission whereby all primary energy is converted to CO_2. The figures in the DG XVII study are lower because a correction is made for feedstocks, which therefore seems more exact. The emissions rise in both scenario I and the Reference scenario, by approximately 15% in 2000 and 25% in 2010. The coal share doubles from approximately 10% in 1990 to 20% in 2010. The gas share grows by a few percentage points. There is a slight growth in population. According to the alternative scenarios, Italy can already stabilize its emissions in 2000, even if that is the maximum level attainable according to the DG XVII scenario IV. Emissions in the DG XII study stabilize at 1988 level (and can decrease perhaps even more). This is reached by considerable fuel switch and more energy saving. The reductions for both studies are equal for 2010, approximately 15%. DG XVII achieves this principally through energy savings whereas in the DG XII scenario the gas share raises until hardly using any more coal. Nuclear energy is not incorporated in both studies, but a significant amount (9%) of renewable energy sources is projected.

Luxembourg (LUX)

Only in the DG XVII study material is available for Luxembourg. In scenario I, Luxembourg can already stabilize its emissions for 2000 and 2010. The population size also remains stable during this period. It is remarkable that although the increase in energy consumption is partially supplied for by additional gas input, while the input of other fuels remains the same, the emissions even decrease slightly. In scenario III and IV, the CO_2 reduction of 28% is attained by means of energy savings, significantly in the electricity sector, while the fuel mix remains the same (see table 5.4).

The Netherlands (NL)

For the Netherlands, the 1990 CO_2 emissions of both studies are not completely similar. This is particularly a result of differences in energy consumption in the tertiary, domestic, and transport sectors. The DG XVII final energy consumption and primary energy consumption seem to be on the high side. It is remarkable that in 2000, the Netherlands has the greatest population rise of the EC (5%). From 1990 to 2010, the population increases by 8%. For the year 2000, the emissions in the Reference scenario increase by 6%, while scenario I shows an increase of 15%. In the DG XVII scenario I, mainly coal is substituted for gas. The DG XII Reference scenario does the opposite. Both scenarios for 2010 show an emission rise of approximately 15%. Nevertheless the primary energy consumption for DG XVII is at least 350 PJ greater than in the DG XII study. This difference cannot be explained completely by the fact that DG XVII incorporates international flight traffic in the primary energy. Nuclear energy is used for a substantial part of the 350 PJ whereas this is not used in the DG XII study. Furthermore the amount of coal and oil incorporated by DG XVII is considerably greater. The alternative reduction scenarios of both studies show that it is relatively difficult for the Netherlands to reduce CO_2 emissions. The DG XII study is more optimistic for the year 2000, with a stabilization of the emissions. Scenario IV in DG XVII shows a 5% rise. Once again, this is a result of a lower gas input and a higher energy consumption. But for 2010, both extreme reduction scenarios give a similar emission reduction of 10%. However, there are still substantial differences in fuel input. Due to considerable energy savings in the DG XVII scenarios, the primary energy consumption is comparable with that of DG XII.

Portugal (P)

The CO_2 emissions for 1990 for Portugal amount to 34 Mton in both studies. The rise of emissions is greater both in scenario I and the Reference scenario than in the other EC countries, namely 80% in 2010. Substantial economic growth and, to a lesser extent, population growth are the main causes of the rise. The coal share rises to approximately 25%. Reduction is possible by end-use savings. Due to high emission increases both in the Reference scenario and scenario I, stabilization is not attained in the DG XII scenarios (remember energy saving potential is not complete), but is achieved in the DG XVII scenario IV.

Spain (ES)

Spanish 1990 CO_2 emissions are very different for both studies. In particular CO_2 emissions from industry are higher in the DG XII study. Furthermore the DG XII study shows a 400 PJ lower nuclear energy input. The emissions in the base-cases of both studies rise by approximately 20% in 2000 and 30% in 2010, but the emissions of the DG XII study remain structurally higher owing to a much lower nuclear energy input. In scenario IV, Spain can substantially reduce CO_2 (35% with respect to 1990) in 2010, certainly given the substantial growth in energy demand in scenario I. This can be achieved through considerable energy savings (approximately 45% of final energy consumption) which restricts the oil and coal inputs. The DG XII Maximum reduction scenario restricts the emissions by 18% in 2010, because the energy consumption is not reduced sufficiently and the nuclear energy share is lower than in the DG XVII study is assumed. According to the DG XVII scenarios, these reduction options cannot be utilized for the year 2000 (9% rise of CO_2). In contrast, according to DG XII, 9% CO_2 reduction is attainable, namely by means of greater energy savings, a lower coal share and a higher gas share. The emissions from the electricity sector in the DG XII study are questionably low.

United Kingdom (UK)

The CO_2 emission for 1990 for the United Kingdom given in the DG XII study is lower than the emission given in the DG XVII study, primarily owing to a 1000 PJ lower primary energy consumption. DG XVII incorporates 470 PJ more nuclear energy, which does not fully explain the difference. The same holds for 2000 and 2010. Furthermore, gas is substituted for coal in the Reference scenario. The input of nuclear and renewable energy sources in the DG XII study is exactly the opposite to DG XVII. Therefore in 2010, DG XII emissions (stabilized to DG XII 1990 value) are 100 Mton lower than DG XVII emissions. In the DG XII reduction scenario, 33% CO_2 can be reduced in 2010, 23% in scenario IV. DG XVII reduces more, but DG XII restricts the coal share to 13% by incorporating more gas and renewable energy sources. According to the DG XVII scenarios, CO_2 emissions could hardly be stabilized for the year 2000, because the fuel input is not changed. According to DG XII, CO_2 emissions can be reduced by a higher gas input and input of renewable energy sources with respect to 1990.

4.4. CO_2 reduction criteria

If the Community is intending to agree upon specific CO_2 reduction targets per country, a wide range of criteria can be used to draw up and to support this CO_2 emission reduction policy objective. Presently a number of criteria can be selected which facilitates comparison of the different EC countries with respect to the implementation of these policies. These criteria link CO_2 emissions to a specific factor, such as GDP or population size, which influences the emission and the scope for reduction. Furthermore these criteria can be used as a basis for negotiations between countries concerning agreements on CO_2 emission reductions in the EC.

CO_2 emission per GDP

The CO_2 emission per ECU GDP is a measure of the CO_2 intensity of the national economy. The figures in tables 7.9-7.12 show large differences between the countries. Having a heavy industry which is energy intensive and a less developed service sector, a large coal share in primary energy consumption, or an inefficient energy system all play an important role, particularly for countries in the south, such as Greece and Portugal which expect high GDP growth rates in the future. In general for all EC countries in the Conventional wisdom scenario the economy becomes less CO_2 intensive to 2010. The emission per GDP indexed to the EC average shows that the relationship between the countries changes in time. In the DG XVII table, Italy and the Netherlands increase their CO_2 emission per GDP because they already use a relatively low carbon fuel mix in 1990. Economic growth for the United Kingdom is low and therefore the United Kingdom maintains a relatively high CO_2 emission per GDP. For Portugal and Spain the emissions decrease correspondingly due to a high economic growth. In contrast, Greece has a reasonably high economical growth but reduces relatively less CO_2. France, Germany and Belgium reduce substantially. However, the reduction for Denmark is small in contrast with the economic growth. The DG XII table presents a different picture because the GDP is the same for the scenarios and consequently the emission per GDP can only be lowered by means of CO_2 reduction. As a result of this, the relationship between the countries in the maximum reduction scenarios remain almost the same as that for 1990. Only Portugal, Italy and the Netherlands appear to have a relatively small reduction potential (compared to economic growth) at their disposal (N.B. the data for Greece are not correct), whereas the opposite holds for Spain and Germany.

CO_2 emission per capita

The CO_2 emission per capita differs greatly among the countries (tables 7.13 and 7.14). Luxembourg has a CO_2 emission per capita which is 10 times greater than Portugal due to difference in affluence and CO_2 intensity. All the countries are capable of reducing the CO_2 emission per capita, except in scenario I. In countries which have a substantial population growth (such as the Netherlands) the emissions per capita appear to decrease considerably.

CO_2 reduction costs

In the DG XII study, the CO_2 reduction costs are estimated for each country. Since it was derived with a Linear Programming model, the model calculated the least-cost-mix of the options to realize a particular CO_2 objective. In table 7.17, the Mure-case, the Reference scenario augmented by additional saving options in the household and transport sectors, presents lower costs than the Reference scenario. From a national standpoint, a large part of the energy saving measures is cost-effective. On the other hand, it is still not determined if it is worthwhile for the consumer to install, for example, a high efficiency boiler. If this is the case, then it is not yet certain that the consumer will actually make these investments. Costs of stimulating policy and/or measures are not included in the costs under analysis here. CO_2 reductions due to savings are quite different per country, whereas the averted costs rank closely to each other. It does not make much sense because roughly speaking a small country introduces less energy savings and therefore averts less costs.

The extra costs over the period of 1985-2010 with respect to the Mure scenario of the Constant scenario (stabilization CO_2 emissions to 1990 level) differ considerably per country. The Netherlands, Greece, Italy, Spain and Belgium must invest in reduction, while the other countries can simply stabilize emissions (stabilization is not possible for Portugal). This is somewhat more difficult for 10% reduction. The costs per ton of avoided CO_2 for the Netherlands and Spain in this scenario are by far the highest. The costs per ton of avoided CO_2 for Denmark and United Kingdom do not even amount to a tenth of this. Therefore from the EC point of view, an equal emission objective for all EC countries is not a cost-effective method of reducing CO_2 emissions.

Table 7.18 shows the amount of avoided CO_2 expressed in 1990 CO_2 emission percentages since emission negotiations often utilize these terms. To be able to compare the costs per country over the period 1985 to 2010, they are expressed as a percentage of the 1990 GDP of the country. This does not present a picture of the cost-effectiveness of emission reduction but rather gives an impression of the effort made by a country to attain a comparable emission reduction percentage. It appears that by comparison the Netherlands once more must pay the greatest GDP-percentage for a two percent emission reduction (figures for Greece are not reliable). In the 10% reduction scenario, there are even greater differences in effort per country. By comparison to the other countries, Spain, the Netherlands and Italy consign a significant part of the GDP.

Criteria concept

The equation below provides an impression of CO_2 emission developments based on 4 standard indicators which play a role in CO_2 emission (reduction). The CO_2 emission per TJ Primary Energy Requirement is a standard for the average CO_2 emission from the fuels consumed. The amount of primary energy used is also dependent on the economy. The quotient TJ TPER per GDP demonstrates the extent of the performance of a country with regard to energy efficiency or wastefulness. The GDP per capita is a measurement of the affluence of the population. These factors are multiplied by the number of inhabitants to calculate the total emission for the country.

$$CO_2 \text{ emission} = CO_2 / \text{TJ TPER} \times \text{TJ TPER} / \text{GDP} \times \text{GDP} / \text{capita} \times \text{capita}$$

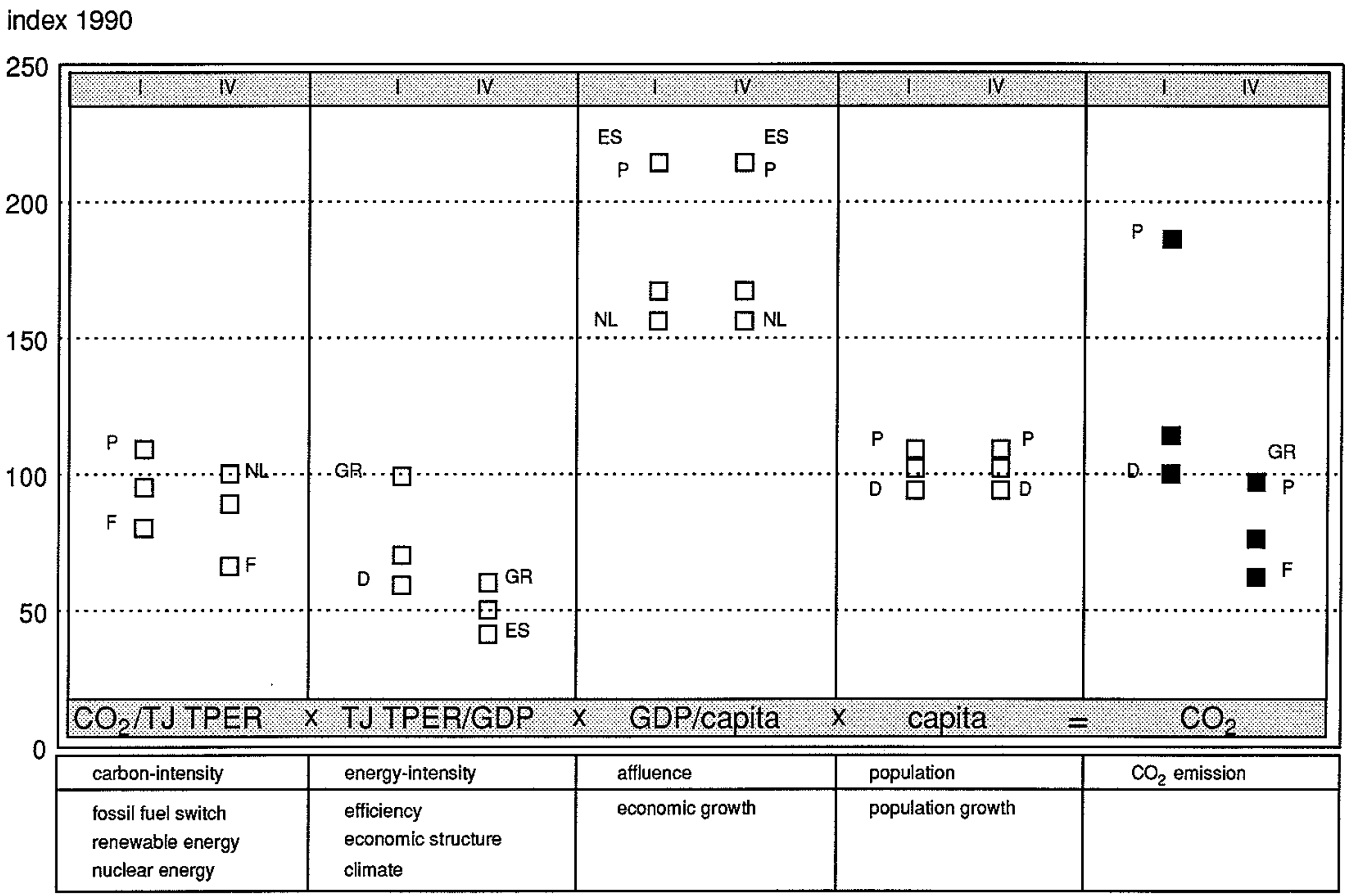

Figure 2. Changes of upper, lower, and EC average of CO_2/TJ TPER, TJ TPER/GDP, GDP/capita, capita and CO_2 emissions, in 2010 by country for DG XVII scenario I and IV. Values are indexed on 1990 country values (index change=0).

The fuel mix of the different countries for 1990 in tables 7.14 and 7.15 is very important because with the exception of energy savings, the reduction potential depends on this factor. If this factor is already low (the Netherlands and France) then substantial CO_2 reduction should not be expected from substitution. Noticeably for the EC as a whole, only 11% cleaner fuels are incorporated in the most vigorous reduction scenario IV of DG XVII. The greatest part of the 24% emission reduction occurs therefore at the expense of efficiency and energy demand reduction measures. In the DG XII study, the change of the fuel input actually amounts to 19% in the 20% reduction scenario (compared with 1988).

Tables 6.5 and 6.6 provide an indication of the energy efficiency/intensity of the EC countries. There are large differences for every country for 1990, for instance due to differences in structure (heavy industry or services) or conversion efficiency. This indicator decreases with time for all EC countries. An important difference between the extreme CO_2 reduction scenarios in the DG XVII and DG XII studies results from larger restriction of the primary energy consumption in the DG XVII study.

The affluence indicator GDP/capita is given in table 3.8. There are again large differences between the countries. The indexed table shows that the growth of the income per capita for the Netherlands is the lowest. The countries in the south are at the top with respect to the growth in personal incomes, unexpectedly Ireland too.

The development of the population is already dealt with in paragraph 4.1.

The comparison made above must be handled with the necessary caution. In particular, the GDP does not have a steady link with CO_2 emissions. GDP per capita is more an indicator for financial and economical possibilities for attaining CO_2 reduction options. On inserting results from the various scenarios into the equation, even a slightly negative development concerning one of the factors (for example the growth in population or efficiency) can have considerable impact on the achievement of the CO_2 reduction objectives. Take the following for example: The introduction of the energy saving measures is not as successful as expected and a slightly higher economic growth is realized (both scenario III) whereas substitution does not surpass the level in the Conventional wisdom. Then CO_2 emissions will just about be stabilized in 2010. A slightly greater growth in population can even be more radical for the attainment of the reduction objectives.

4.5. Implications for CO_2 reduction targets

In figure 2 the relative importance of factors related to CO_2 emissions are indicated. Clearly, besides population growth, the development of CO_2 emissions is determined by a large increase in GDP/capita on one hand, and by a decrease in carbon- and energy-intensity on the other hand. In other words, if economic growth must be realized without emission growth, measures must be taken in order to stabilize emissions. This can be attained by different policies such as changing the fuel mix, decreasing energy-intensity etc.

Since economic and population growth in scenario I and IV are equal, scenario differences in CO_2 emissions are caused by differences in carbon- and energy-intensity. CO_2 emissions in 2010 are much lower in scenario IV than in scenario I, partly due to changes in fuel mix, but largely due to a diminishing energy-intensity. Both factors overrule the impacts of economic growth and population growth completely which results in almost 40% lower CO_2 emissions in the EC. If GDP/capita in 2010 is equal to the 1990 value, CO_2 emissions would be 60% lower than in the business as usual scenario.

Concluding one can say that in scenario IV emissions are primarily abated by improving conversion efficiency, decreasing useful energy demand, and changing the economic structure. Next fossil fuel switch, renewable energy, and nuclear energy are important reduction factors in scenario IV.

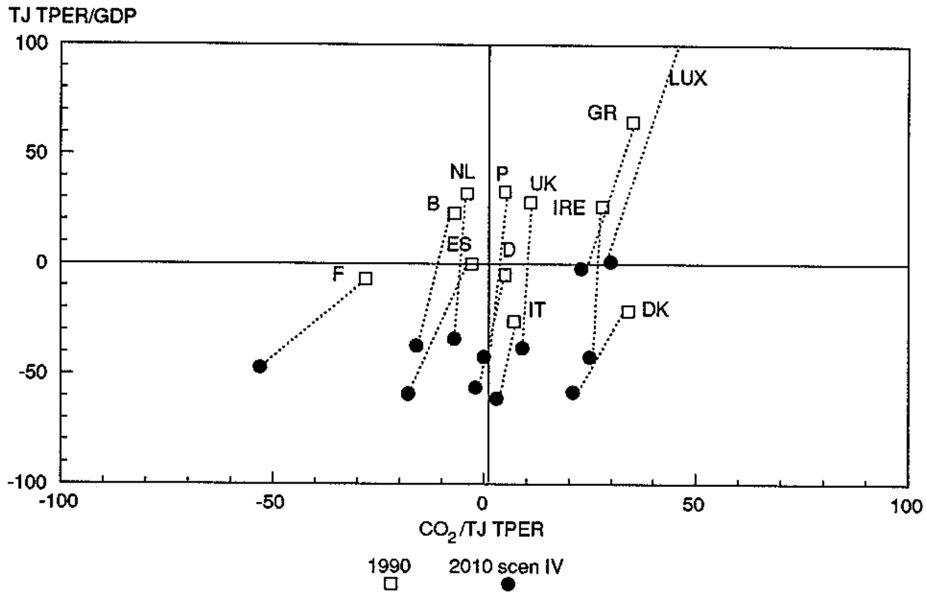

Figure 3a. TJ TPER/GDP related to CO_2/TJ TPER, indexed to 1990 EC-12 average (index change=0), in DG XVII scenario IV from 1990 to 2010

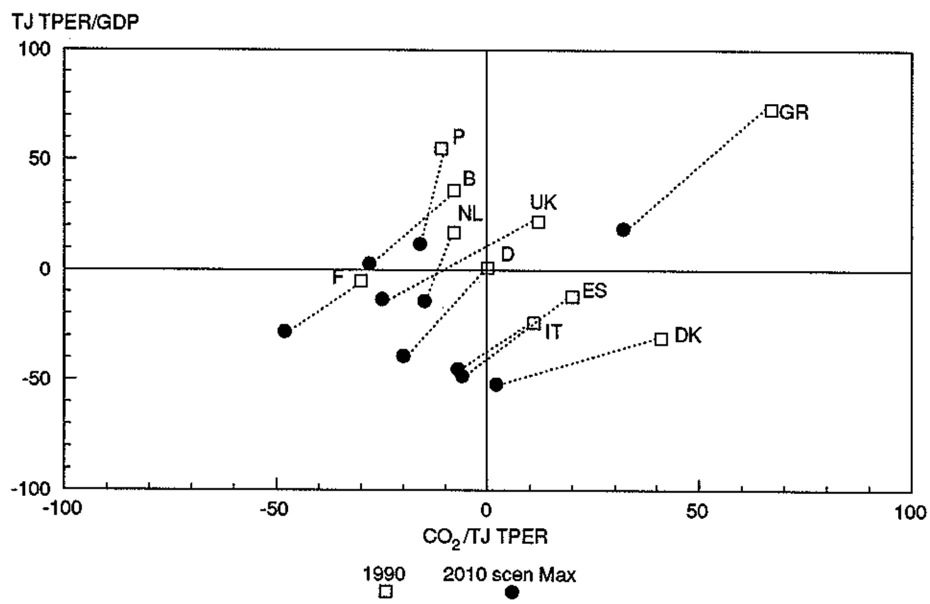

Figure 3b. TJ TPER/GDP related to CO_2/TJ TPER, indexed to 1990 EC-10 average (index change=0), in DG XII scenario Maximum CO_2 reduction from 1990 to 2010

The development in time of the two "reducing factors" carbon- and energy-intensity are explained in more detail below. For sharing the burden of CO_2 reductions among countries it is necessary to compare country specific implications of emission targets in more detail. Figure 3a shows the developments of carbon- and energy-intensity per country, which are indexed to the EC 1990 averages since emission target negotiations refer to the EC 1990 emissions. In the right part of the figure carbon-intensive, relative to the 1990 EC average, countries are located, the upper part of the figure contains the energy-intensive relative to 1990 EC average countries. This way four compartments with their property are created.

In 1990 Portugal, United Kingdom, Ireland, Greece, and Luxembourg are energy- and carbon-intensive countries. Only France is energy- and carbon-extensive. The Netherlands and Belgium are energy-intensive but also relatively carbon-extensive. Italy and Denmark are carbon-intensive but not energy-intensive countries. Spain and Germany have more or less similar to the EC average carbon- and energy-intensity levels. In the "environment scenario" IV for the year 2010 all countries become energy-extensive countries with respect to 1990 EC average level. But the carbon-intensive and carbon-extensive groups of the 1990 groups still exists in 2010. Generally the carbon-intensity in most countries decreases somewhat. Also country differences in carbon-intensity do not decline. Despite that France has already a low average fuel CO_2 emission factor, it lowers its carbon-intensity more than any country by increasing the nuclear electricity production, which option is not considered in most other countries.

In figure 3b, 1990 and 2010 data from the DG XII Maximum reduction scenario are presented. Maximum reduction scenario energy-intensity improved less than in scenario IV, which can be explained by the fact that structural changes are not easy to translate in reduction options for a LP-optimization model. Therefore structural changes are more or less neglected in the model and thus the scenario. Furthermore, extra energy saving options in industry other than already perceived in the Reference scenarios were not considered in the DG XII study. However changing the carbon-intensity is treated extensively in this type of models. All countries changed their fuel mix to less carbon containing fuels. So almost all countries become more carbon- and energy-extensive, compared to EC 1990 average. Portugal and the Netherlands do not seem to be able to change their fuel mix in that direction. Unlike Belgium these countries did or could not use relatively more fuels with a lower carbon content (i.e. uranium) in the next twenty years. The potentials for renewables have been considered relatively small in these small, densely populated countries.

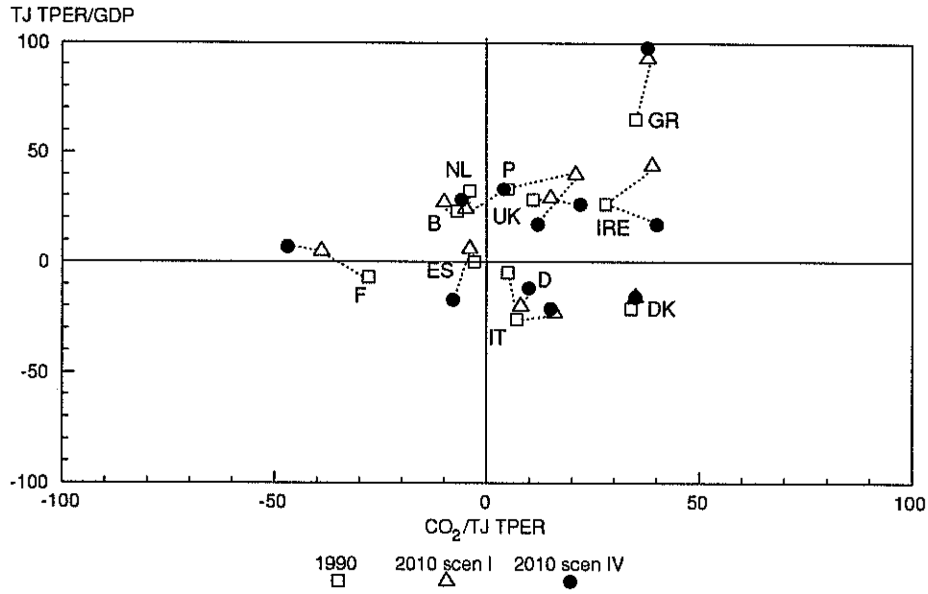

Figure 4a. TJ TPER/GDP as a function of CO_2/TJ TPER, indexed to EC-12 averages of year and scenario (index change=0), in DG XVII scenario I and IV from 1990 to 2010

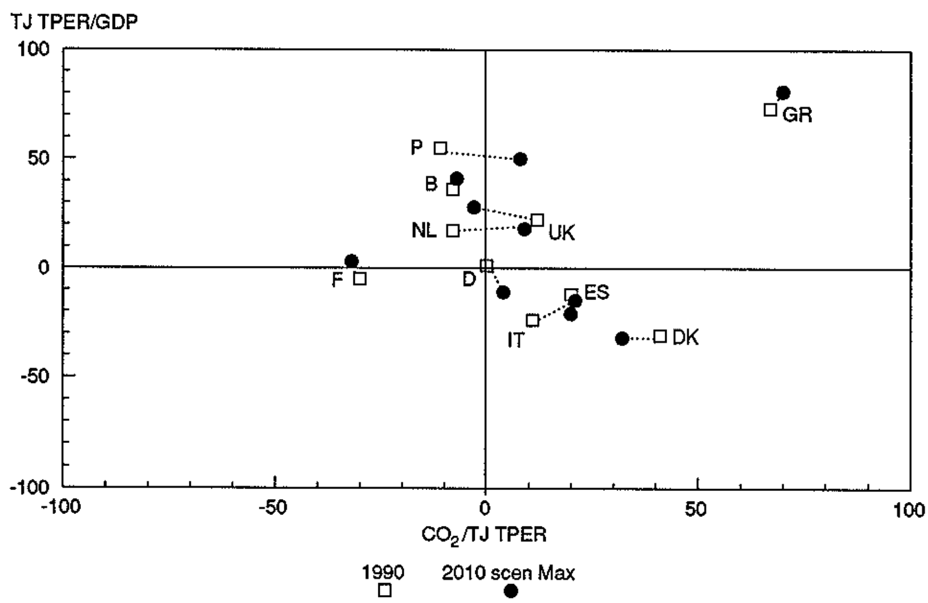

Figure 4b. TJ TPER/GDP as a function of CO_2/TJ TPER, indexed to EC-10 year averages (index change=0), in DG XII scenario Maximum CO_2 reduction from 1990 to 2010

For reaching a common opinion among countries it is essential to show that emission reduction targets are set in such a way that each country feels to be treated "fairly". Therefore, criteria have to be compared per country relative to each other over a period of time. So implicitly a set of CO_2 emission targets must guarantee equal opportunities for improving economic standards of living in each country compared to the current situation. In the next figures energy- and carbon-intensity for each country are indexed to the EC average of the same year and scenario. Subsequently the figures portray the development of the criteria proportions between countries.

In figure 4a data of 1990 and 2010 for scenario I and IV show that the ranges of the criteria between countries do not alter over time nor per scenario. It seems that the differences are not completely fixed over time, but a carbon-intensive country such as Ireland becomes more intensive instead of less intensive. In the "environment scenario" IV one expects that country differences will become smaller, amazingly the opposite is occurring.

Carbon- and energy-intensity proportions between countries in the Maximum reduction scenario of DG XII (figure 4b) do vary. But the country carbon-intensities do not approach EC average and neither do the country energy-intensities. In general it can be concluded that country differences with respect to energy- and carbon-intensity are preserved in all scenarios.

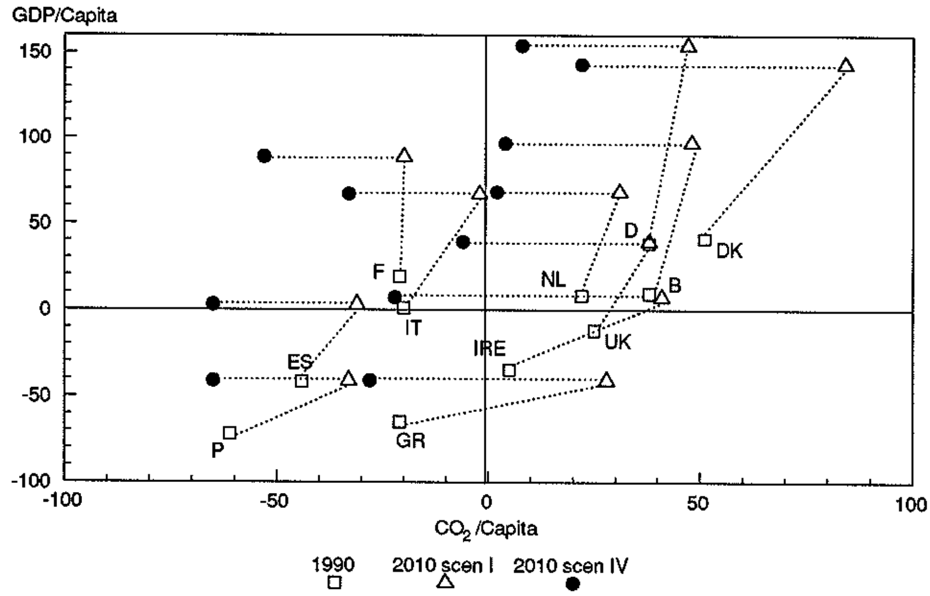

Figure 5a. TJ GDP/capita as a function of CO_2/capita, indexed to 1990 EC-12 average (index change=0), in DG XVII scenario I and IV from 1990 to 2010

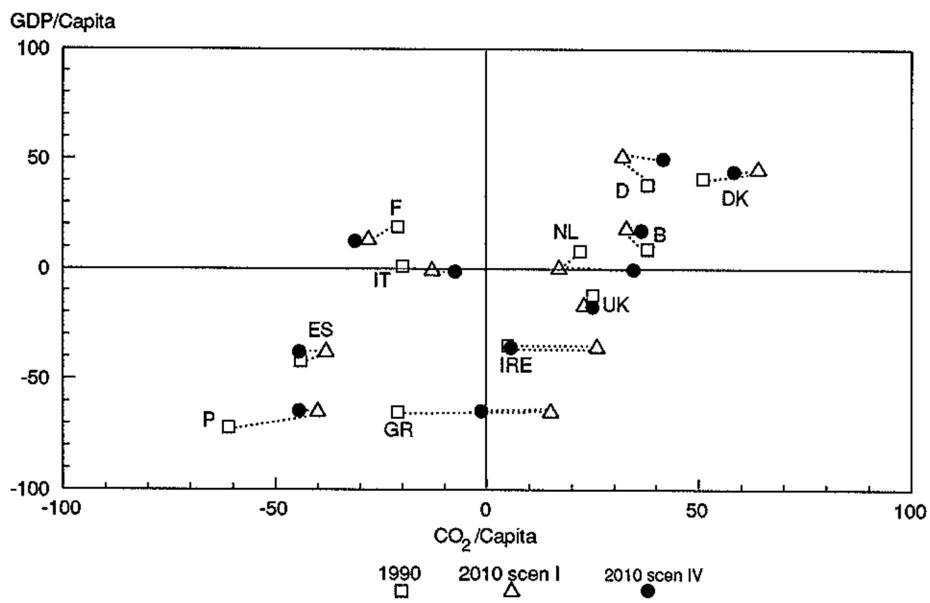

Figure 5b. TJ GDP/capita as a function of CO_2/capita, indexed to EC-12 averages of year and scenario (index change=0), in DG XVII scenario I and IV from 1990 to 2010

The figures 5a and 5b present an overview of the major background factor at which CO_2 reduction takes place, viz. GDP/capita, in relation to the CO_2 reduction expressed in CO_2/capita. Both indicators represent the two main policy goals of society in scenario IV, which has been developed to answer the question whether it is possible to combine economic growth with sufficient protection of the environment in terms of CO_2/capita. Only the DG XVII study will be analyzed since it concerned economic projections, in contrast with the DG XII study which did not use alternative GDP-projections for deriving energy demand forecasts.

In figure 5a the developments of CO_2/capita and GDP/capita per country from 1990 to 2010 for scenario I and IV are indexed to 1990 EC averages. Clearly both in scenario I and IV GDP/capita increases are large for the relative rich countries and small for the relative poor countries (explained by the fact that a low growth percentage of a large amount is more than a high growth percentage of a small amount). Furthermore in the business as usual scenario I from 1990 to 2010 all countries increase their CO_2/capita. Of course in scenario IV all countries decrease the CO_2/capita, but the Netherlands, Belgium, Germany, and Denmark maintain still higher CO_2/capita values than the EC 1990 average. Apparently their measures for lowering the energy- and carbon-intensity do not compensate for their economic growth. But Portugal, Spain, and Greece can lower their CO_2/capita although it is already under 1990 EC average. Notably, CO_2/capita is relatively low due to their lower GDP/capita, and it can be further lowered in the next decades due to their presently high energy- and carbon-intensity. However, an exception is Spain, which has already a relatively low carbon-intensity in scenario I.

Indexing on EC average values for every year and scenario results in figure 5b, shows the differences of the criteria between countries. Again it can be seen that proportions do not really change. Relatively rich countries can become relatively richer and some high CO_2 emitting countries become relatively higher emitters.

Conclusions and discussion

It can be concluded that in 2010 substantial (circa 20%) EC CO_2 emission reductions with respect to 1990 are possible, if projected moderate economic growth is combined with measures to reduce the carbon- and energy-intensity of EC economies. All countries can contribute to these CO_2 emission reduction and in all countries the energy-intensity can be lower than the 1990 EC average energy-intensity (DG XVII). Also the carbon-intensity can decrease below the 1990 EC average carbon-intensity in almost all countries (DG XII), which generally provides a cost-effective way of reducing CO_2 emissions.

However, relative differences in carbon-, energy-intensity, and economic living standard between countries will be preserved or grow larger over time in both the "environment scenario" IV (DG XVII) and Maximum reduction scenario (DG XII) compared with 1990 or business as usual scenario. A reason for persistence of the relative differences between countries is the relatively short scenario horizon. According to the DG XVII study a period of 20 years is too limited for substantial structural economic changes that have impact on CO_2 emissions. It is obvious that longer term CO_2 emission targets, based on decreasing differences between countries, can provide more easily a common economic interest for all countries involved in the negotiations.

Given the limited flexibility for changes of the energy system, short term cost-effective CO_2 reduction (DG XII) results in different reduction possibilities for different energy systems in different countries, herewith preserving relative differences. However, CO_2 emission reduction measures involving changes in the fuel mix are not entirely caused by structural changes of the energy economy. These measures will decrease the carbon-intensity differences between countries.

The results of the studies clearly show that relative differences between countries in carbon-, energy-intensity and economic living standard are preserved or even enlarged. Therefore the results confirm the current difficulties of deriving a common European-wide opinion on reduction targets on the basis of short term scenario research.

5. CONCLUSIONS AND RECOMMENDATIONS

For the year 2010, according to both the DG XVII and the DG XII studies, it is possible to stabilize or even reduce the CO_2 emissions in the EC with respect to the 1990 CO_2 emission level. This already occurs in the Conventional wisdom scenario for countries such as Germany and Luxembourg. Furthermore this also holds for the United Kingdom in the Reference scenario and approximately for Denmark and Belgium. In 2010, all countries can reduce their CO_2 emissions to below the 1990 level in the CO_2 reduction scenarios. However, the extent and the effort involved differs considerably per country. These differences are largely determined by differences in population growth, economic growth, fuel input and energy saving potential. It is necessary for efficient and effective CO_2 reduction policies that all countries contribute equally or have an equal burden sharing. The DG XII study shows that many CO_2 reduction options (in particular energy savings) are cost-effective. Furthermore, with an almost equal effort with respect to costs, each country can realize a considerable, but different, CO_2 reduction potential.

The CO_2 reduction potential of the EC countries for 2010 is quite similar for both studies. However the DG XVII study puts strong emphasis on energy saving (in conversion and final consumption) but little on fuel input changes. Great uncertainty exists as to how these substantial energy savings can be realized. DG XII has not incorporated savings in all sectors. Therefore smaller percentages are used than in the DG XVII study (mostly technological measures). On the other hand, in the DG XII study, substitution by low-carbon fuels are carried out to the extreme in some cases, so that the coal consumption in the EC for example, is halved in 2010. Furthermore effects of the radical changes in the fuel consumption on the fuel prices are not included.

Nevertheless it can be concluded that, with respect to 1990, a CO_2 reduction for the EC in 2010 of approximately 20% seems to be possible with measures, in the form of a realistic combination of DG XVII and DG XII reduction options from various scenarios.

For the year 2000, in both studies, the CO_2 emissions per country are relatively more different. Only the extreme scenario IV of the DG XVII scenarios attains stabilization of EC CO_2 emissions in 2000. Of the EC countries, only Belgium, Denmark, France, Germany and Luxembourg achieve a CO_2 reduction with respect to 1990 in 2000. In the DG XII study all countries except Portugal achieve in 2000 a CO_2 reduction with respect to 1990. Understandable since the DG XII study is more oriented towards technological measures, so that it can respond more flexibly towards the emission objectives, without behavioral and other delays. One could argue that technological measures are needed to attain moderate CO_2 emission objectives in the short term and that long run structural changes such as demand reductions are necessary and attainable for the realisation of long term emission reduction objectives. On the other hand the methodology used by DG XII is limited with respect to observation and implementation of structural changes. These were analyzed more deeply in the DG XVII study.

According to the scenarios, CO_2 stabilization at 1990 level is possible in the year 2000 by the EC as a whole and by nearly all countries individually. Nevertheless, it should be taken into account that the efforts required per country for this type of objective differ considerably. Moreover, burden sharing on equal CO_2 emission targets for all EC countries is certainly not a cost-effective way of reducing EC CO_2 emissions from a EC point of view.

Furthermore this study clearly shows that in both DG XII and DG XVII studies relative differences between countries in carbon-, energy-intensity and economic living standard are preserved or even enlarged. This confirms the current difficulties of deriving a common European-wide opinion on reduction targets on the basis of short term scenario research. It is obvious that longer term CO_2 emission targets, based on converging criteria differences between countries, can provide more easily a common economic interest for all countries involved in the negotiations.

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APPENDIX

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1. GENERAL EC-12 DATA OF DG XVII SCENARIOS I,III AND IV

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1. GENERAL EC-12 DATA OF DG XVII SCENARIOS I,III and IV

Table 1.1 Demographic developments EC-12 for all scenarios

Year	1980	1985	1990	1995	2000	2010
			[million]			
population	317.9	321.8	325.8	328.7	330.8	331.3
households	110.4	117.1	122.9	127.8	132.1	136.8
av.hsh.size	2.9	2.7	2.7	2.6	2.5	2.4

Table 1.2 Oil price for DG XVII scenarios I,III and IV

Year Scenario	1985	1990	1995	2000	2010
		[USD-87/bbl]			
scdg17 I	29.2	15.5	17.5	20.0	30.0
scdg17 III	29.2	15.5	20.0	25.0	20.0
scdg17 IV	29.2	15.5	17.5	20.0	30.0

Table 1.3 Coal price for DG XVII scenarios I,III and IV

Year Scenario	1985	1990	1995	2000	2010
		[USD-87/tce]			
scdg17 I	48.8	44.6	49.0	50.0	60.0
scdg17 III	48.8	44.6	50.0	60.0	50.0
scdg17 IV	48.8	44.6	49.0	50.0	60.0

Table 1.4 Gas price for DG XVII scenarios I,III and IV

Year Scenario	1985	1990	1995	2000	2010
		[USD-87/MBtu]			
scdg17 I	4.1	2.0	2.5	2.7	3.5
scdg17 III	4.1	2.0	2.6	3.2	2.7
scdg17 IV	4.1	2.0	2.5	2.7	3.5

Table 1.5 Total GDP EC-12 for DG XVII scenarios I,III and IV

Year Scenario	1985	1990	1995 [billion ECU-87]	2000	2010
sc I and IV	3470	4107	4701	5367	6997
sc III	3470	4107	4904	5868	7869

Table 1.6 Value added industrial sector EC-12 for DG XVII scenarios I,III and IV

Year Scenario	1985	1990	1995 [billion ECU-87]	2000	2010
scdg17 I	790	934	1067	1219	1591
scdg17 III	790	934	1093	1213	1493
scdg17 IV	790	934	996	1089	1302

Table 1.7 Number of passenger-km associated with private cars EC-12 for DG XVII scenarios I,III and IV

Year Scenario	1985	1990 [billion p-km]	1995	2000	2010
scdg17 I	2304	3022	3381	3598	3766
scdg17 III	2304	3022	3424	3698	2969
scdg17 IV	2304	3022	3381	3598	3766

Table 1.8 Number of passenger-km railway EC-12 for DG XVII scenarios I,III and IV

Year Scenario	1985	1990 [billion p-km]	1995	2000	2010
scdg17 I	232	248	266	283	315
scdg17 III	232	248	252	299	859
scdg17 IV	232	248	266	283	315

Table 1.9 Number of ton-km by road EC-12
for DG XVII scenarios I,III and IV

Year Scenario	1985	1990 [billion t-km]	1995	2000	2010
scdg17 I	643	805	895	975	1139
scdg17 III	643	805	993	1048	879
scdg17 IV	643	805	895	975	1139

Table 1.10 Number of ton-km railway EC-12
for DG XVII scenarios I,III and IV

Year Scenario	1985	1990 [billion t-km]	1995	2000	2010
scdg17 I	183	198	211	224	254
scdg17 III	183	198	210	232	380
scdg17 IV	183	198	211	224	254

Table 1.11 Value added service sector EC-12
for DG XVII scenarios I,III and IV

Year Scenario	1985	1990 [billion ECU-87]	1995	2000	2010
scdg17 I	1940	2270	2657	3095	4159
scdg17 III	1940	2270	2762	3312	4763
scdg17 IV	1940	2270	2788	3248	4408

2. EC ENERGY CONSUMPTION AND CO_2 EMISSIONS PER SCENARIO

Table 2.1 Share by fuel final energy consumption EC-12 for DG XVII scenarios I,III and IV

Year	1990	2000			2010		
Scenario		I	III	IV	I	III	IV
Fuel			[%]				
Coal	7.1	6.0	5.3	4.9	5.7	4.2	3.9
Oil	50.4	47.4	47.7	46.6	44.3	37.3	34.8
Nat. Gas	24.1	25.0	25.7	25.9	25.8	31.4	32.4
Electrici	17.4	20.2	19.8	21.0	22.6	24.7	26.0
Heat	0.9	1.3	1.3	1.4	1.4	1.5	1.9
Renewable	0.0	0.2	0.2	0.2	0.3	0.8	0.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2.2 Share by fuel primary energy consumption EC-12 for DG XVII scenarios I,III and IV

Year	1990	2000			2010		
Scenario		I	III	IV	I	III	IV
Fuel			[%]				
Solids	20.5	21.5	20.5	20.1	23.4	18.7	21.3
Oil	45.0	41.5	41.3	41.0	35.9	30.1	30.1
Nat. Gas	18.5	19.5	21.1	20.1	20.1	25.8	25.4
Nuclear	14.0	15.3	15.0	16.4	18.3	22.7	19.7
Others	2.0	2.1	2.1	2.4	2.3	2.7	3.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2.3 Share by fuel primary energy consumption EC-10 for DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scen.	all	REF	CON	10%	20%	REF	CON	10%	20%
Fuel					[%]				
coal	23.0	21.3	19.3	19.0	18.8	20.3	16.1	13.9	9.6
oil	42.6	39.3	39.3	38.9	39.0	36.6	37.3	34.7	34.2
gas	19.6	21.9	22.8	23.6	23.8	25.4	28.0	31.3	34.1
nuclear	12.2	12.7	13.7	13.4	13.4	12.3	12.6	13.6	14.4
renew	2.7	4.6	4.9	5.0	5.0	5.4	5.9	6.5	7.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2.4 CO_2 emissions EC-12 for DG XVII and EC-10 for DG XII scenarios

Year Scenario	1990	1995 [Mton]	2000	2010
scdg17 I	2765	2930	3026	3143
scdg17 III	2765	3136	3121	2426
scdg17 IV	2765	2813	2702	2098
scdg12 REF	2781	2956	2963	3064
scdg12 CON	2773	2819	2644	2581
scdg12 10%	2775	2823	2634	2418
scdg12 20%	2775	2823	2627	2244
scdg12 MAX	2775	2823	2630	2111

Table 2.5 CO_2 emissions index EC-12 for DG XVII and EC-10 for DG XII scenarios

Year Scenario	1990	1995 [1990=100]	2000	2010
scdg17 I	100	106	109	114
scdg17 III	100	113	113	88
scdg17 IV	100	102	98	76
scdg12 REF	100	106	107	110
scdg12 CON	100	102	95	93
scdg12 10%	100	102	95	87
scdg12 20%	100	102	95	81
scdg12 MAX	100	102	95	76

Table 2.6 CO_2 emissions per GDP EC-12 for DG XVII and EC-10 for DG XII scenarios

Year Scenario	1990	1995 [kg/ECU-87]	2000	2010
scdg17 I	0.673	0.623	0.564	0.449
scdg17 III	0.673	0.639	0.532	0.308
scdg17 IV	0.673	0.598	0.503	0.300
scdg12 REF	0.683	0.634	0.557	0.442
scdg12 CON	0.681	0.605	0.497	0.372
scdg12 10%	0.681	0.606	0.495	0.349
scdg12 20%	0.681	0.606	0.494	0.324

Table 2.7 CO_2 emissions per capita EC-12 for DG XVII and EC-10 for DG XII scenarios

Year Scenario	1990	1995	2000	2010
		[ton/capita]		
scdg17 I	8.49	8.92	9.15	9.49
scdg17 III	8.49	9.54	9.44	7.32
scdg17 IV	8.49	8.56	8.17	6.33
scdg12 REF	8.64	9.10	9.07	9.36
scdg12 CON	8.62	8.68	8.09	7.89
scdg12 10%	8.62	8.69	8.06	7.39
scdg12 20%	8.62	8.69	8.04	6.86

Table 2.8 CO_2 emissions per TJ primary energy consumption EC-12 for DG XVII and EC-10 for DG XII scenarios

Year Scenario	1990	1995	2000	2010
		[ton/TJ TPER]		
scdg17 I	57.51	57.07	56.53	54.53
scdg17 III	57.51	57.24	56.53	49.15
scdg17 IV	57.51	56.46	55.19	51.34
scdg12 REF	61.48	61.15	59.44	59.19
scdg12 CON	61.53	60.94	56.62	54.97
scdg12 10%	61.53	61.06	56.75	53.20
scdg12 20%	61.53	60.95	56.70	50.01

3. GENERAL DATA PER COUNTRY DG XVII SCENARIOS

Table 3.1 Population per country for all scenarios

Year Country	1980	1985	1990	1995 [million]	2000	2010
B	9.85	9.86	9.73	9.78	9.62	9.37
DK	5.12	5.11	5.14	5.16	5.16	5.06
F	53.88	55.17	56.10	57.10	57.90	58.80
D	61.57	61.02	62.00	61.55	61.05	58.30
GR	9.64	9.93	10.08	10.11	10.35	10.65
IRE	3.40	3.58	3.54	3.60	3.67	3.75
IT	56.43	57.14	57.33	57.76	57.96	58.30
LUX	0.36	0.37	0.37	0.37	0.37	0.37
NL	14.15	14.49	14.93	15.28	15.70	16.10
P	9.77	10.16	10.34	10.45	10.57	11.22
ES	37.39	38.60	39.30	40.10	40.50	41.20
UK	56.31	56.35	56.90	57.40	57.90	58.20
EC-12	317.9	321.8	325.8	328.7	330.8	331.3

Table 3.2 Population index per country for all scenarios

Year Country	1980	1985	1990	1995 [1990=100]	2000	2010
B	101	101	100	101	99	96
DK	100	99	100	100	100	98
F	96	98	100	102	103	105
D	99	98	100	99	98	94
GR	96	99	100	100	103	106
IRE	96	101	100	102	104	106
IT	98	100	100	101	101	102
LUX	97	100	100	100	100	100
NL	95	97	100	102	105	108
P	94	98	100	101	102	109
ES	95	98	100	102	103	105
UK	99	99	100	101	102	102
EC-12	98	99	100	101	102	102

Table 3.3 Number of households per country for all scenarios

Year Country	1980	1985	1990 [million]	1995	2000	2010
B	3.4	3.6	3.6	3.7	3.8	3.9
DK	2.1	2.2	2.3	2.3	2.3	2.3
F	19.1	20.4	21.6	22.7	23.6	24.8
D	25.1	26.5	27.6	27.6	27.5	26.6
GR	2.9	3.1	3.3	3.5	3.8	3.9
IRE	0.9	0.9	1.0	1.0	1.1	1.2
IT	18.2	19.1	20.8	22.2	23.2	23.8
LUX	.12	.13	.14	.14	.15	.15
NL	5.2	5.5	5.7	6.1	6.4	6.7
P	3.0	3.1	3.3	3.5	3.6	4.1
ES	10.1	11.4	11.7	12.2	13.1	14.7
UK	20.3	21.3	21.9	22.9	23.6	24.6
EC-12	110.4	117.2	122.9	127.8	132.2	136.8

Table 3.4 Number of households index per country for all scenarios

Year Country	1980	1985	1990 [1990=100]	1995	2000	2010
B	94	100	100	103	106	108
DK	91	96	100	100	100	100
F	88	94	100	105	109	115
D	91	96	100	100	100	96
GR	88	94	100	106	115	118
IRE	90	90	100	100	110	120
IT	88	92	100	107	112	114
LUX	86	93	100	100	107	107
NL	91	96	100	107	112	118
P	91	94	100	106	109	124
ES	86	97	100	104	112	126
UK	93	97	100	105	108	112
EC-12	90	95	100	104	108	111

Table 3.5 Average household size per country for all scenarios

Year Country	1980	1985	1990	1995	2000	2010
			[capita/household]			
B	2.9	2.7	2.7	2.6	2.5	2.4
DK	2.4	2.3	2.2	2.2	2.2	2.2
F	2.8	2.7	2.6	2.5	2.5	2.4
D	2.5	2.3	2.2	2.2	2.2	2.2
GR	3.3	3.2	3.1	2.9	2.7	2.7
IRE	3.8	4.0	3.5	3.6	3.3	3.1
IT	3.1	3.0	2.8	2.6	2.5	2.4
LUX	3.0	2.8	2.6	2.6	2.5	2.5
NL	2.7	2.6	2.6	2.5	2.5	2.4
P	3.3	3.3	3.1	3.0	2.9	2.7
ES	3.7	3.4	3.4	3.3	3.1	'2.8
UK	2.8	2.6	2.6	2.5	2.5	2.4
EC-12	2.9	2.7	2.6	2.6	2.5	2.4

Table 3.6 GDP per country for DG XVII scenarios I, III and IV

Year Scenario Country	1990 all	2000 I&IV	 III	2010 I&IV	 III
		[billion ECU-87]			
B	134	176	185	233	247
DK	92	118	124	155	162
F	840	1081	1163	1397	1548
D	1078	1414	1514	1864	1995
GR	45	59	70	79	99
IRE	29	39	49	51	65
IT	729	956	1028	1224	1369
LUX	6	8	8	10	11
NL	203	258	274	341	365
P	36	56	66	84	98
ES	286	396	513	538	759
UK	629	805	875	1021	1153
EC-12	4107	5367	5868	6997	7869

Table 3.7 GDP index per country for DG XVII scenarios I, III and IV

Year	1990	2000		2010	
Scenario	all	I&IV	III	I&IV	III
Country	[1990=100]				
B	100	132	138	174	184
DK	100	129	136	170	177
F	100	129	138	166	184
D	100	131	140	173	185
GR	100	131	156	176	220
IRE	100	134	168	175	224
IT	100	131	141	168	188
LUX	100	133	138	175	184
NL	100	127	135	168	180
P	100	154	182	232	271
ES	100	138	179	188	265
UK	100	128	139	162	183
EC-12	100	131	143	170	192

Table 3.8 GDP per capita per country for DG XVII scenarios I, III and IV

Year	1990	2000		2010	
Scenario	all	I&IV	III	I&IV	III
Country	[thousand ECU-87/capita]				
B	13.76	18.35	19.26	24.83	26.31
DK	17.82	22.84	24.09	30.69	32.07
F	14.98	18.67	20.08	23.77	26.32
D	17.39	23.16	24.79	31.97	34.22
GR	4.45	5.68	6.76	7.42	9.26
IRE	8.19	10.56	13.30	13.49	17.32
IT	12.72	16.50	17.74	21.00	23.48
LUX	15.89	21.14	21.98	27.87	29.25
NL	13.58	16.45	17.44	21.15	22.64
P	3.50	5.26	6.21	7.48	8.75
ES	7.29	9.78	12.66	13.05	18.42
UK	11.06	13.91	15.11	17.54	19.81
EC-12	12.61	16.23	17.74	21.12	23.75

Table 3.9 GDP per capita index per country for DG XVII scenarios I, III and IV

Year	1990	2000		2010	
Scenario	all	I&IV	III	I&IV	III
Country	[1990=100]				
B	100	133	140	180	191
DK	100	128	135	172	180
F	100	125	134	159	176
D	100	133	143	184	197
GR	100	128	152	167	208
IRE	100	129	162	165	212
IT	100	130	140	165	185
LUX	100	133	138	175	184
NL	100	121	128	156	167
P	100	150	178	214	250
ES	100	134	174	179	253
UK	100	126	137	159	179
EC-12	100	129	141	167	188

Table 3.10 Crude steel production for DG XVII scenarios I,III and IV

Year	1990	1995			2010		
Scenario	all	I	III	IV	I	III	IV
Country	[million ton]						
B	11.8	12.2	12.2	11.0	12.2	10.9	10.9
DK	0.6	0.6	0.6	0.5	0.6	0.5	0.5
F	18.9	19.1	19.5	18.0	19.7	17.1	17.1
D	39.9	40.2	41.5	37.9	40.8	35.1	35.1
GR	1.0	1.1	1.1	1.1	1.3	1.2	1.2
IRE	0.3	0.3	0.3	0.3	0.3	0.3	0.3
IT	24.8	24.2	25.0	22.8	23.1	21.2	21.2
LUX	3.7	3.8	3.9	3.7	3.8	3.8	3.8
NL	5.7	5.9	5.9	5.5	6.1	5.4	5.4
P	0.8	0.9	0.9	0.9	0.9	0.9	0.9
ES	15.4	15.7	16.2	15.0	17.9	17.4	17.4
UK	16.6	17.0	17.4	16.1	17.4	15.6	15.6
EC-12	139.5	141.0	144.5	132.8	144.1	129.4	129.5

Table 3.11 Energy consumption for crude steel production for DG XVII scenarios I,III and IV

Year	1990	2000			2010		
Scenario	all	I	III	V	I	III	IV
Country				[toe/ton]			
B	0.39	0.37	0.36	0.37	0.36	0.30	0.36
DK	0.24	0.23	0.23	0.23	0.22	0.21	0.22
F	0.42	0.38	0.36	0.38	0.35	0.29	0.35
D	0.40	0.37	0.36	0.37	0.34	0.29	0.34
GR	0.29	0.28	0.28	0.28	0.27	0.26	0.27
IRE	0.19	0.18	0.18	0.18	0.17	0.17	0.17
IT	0.31	0.29	0.26	0.29	0.27	0.24	0.27
LUX	0.36	0.35	0.34	0.35	0.33	0.32	0.33
NL	0.39	0.37	0.36	0.37	0.37	0.30	0.37
P	0.37	0.32	0.31	0.32	0.30	0.27	0.30
ES	0.30	0.26	0.25	0.26	0.24	0.20	0.24
UK	0.41	0.39	0.37	0.39	0.36	0.31	0.36
EC-12	0.37	0.34	0.33	0.34	0.31	0.28	0.31

Table 3.12 Energy consumption index for crude steel production for DG XVII scenarios I,III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country				[1990=100]			
B	100	95	92	95	92	77	92
DK	100	96	96	96	92	88	92
F	100	90	86	90	83	69	83
D	100	93	90	93	85	73	85
GR	100	97	97	97	93	90	93
IRE	100	95	95	95	89	89	89
IT	100	94	84	94	87	77	87
LUX	100	97	94	97	92	89	92
NL	100	95	92	95	95	77	95
P	100	86	84	86	81	73	81
ES	100	87	83	87	80	67	80
UK	100	95	90	95	88	76	88
EC-12	100	92	89	92	84	76	84

4. FINAL ENERGY CONSUMPTION PER COUNTRY

Table 4.1 Final energy consumption industry per country
DG XVII scenarios I,III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country				[PJ]			
B	494.5	527.6	530.5	480.7	573.6	475.2	412.4
DK	122.7	138.2	139.4	123.5	170.0	133.6	118.5
F	1551.3	1654.3	1593.6	1479.7	1791.2	1435.7	1314.7
D	2516.8	2507.6	2611.9	2263.1	2538.6	2351.8	2050.0
GR	173.3	236.6	263.8	208.5	288.1	272.6	173.3
IRE	93.8	120.2	142.4	108.9	136.5	126.9	79.6
IT	1416.0	1494.3	1537.9	1354.5	1616.6	1408.9	1239.8
LUX	73.3	77.9	79.6	68.7	81.6	72.9	63.3
NL	617.6	692.1	685.8	635.2	784.2	653.2	611.7
P	137.8	194.7	213.1	173.3	253.3	209.8	149.1
ES	769.2	860.4	945.0	769.6	942.9	918.6	527.1
UK	1504.0	1644.2	1659.3	1492.7	1787.0	1529.9	1258.6
EC-12	9470.2	10148.0	10402.2	9158.2	10963.7	9589.1	7998.1

Table 4.2 Final energy consumption industry per country
DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scen.	all	REF	CON	10%	20%	REF	CON	10%	20%
Country					[PJ]				
B	626	668	669	667	667	728	729	738	731
DK	118	130	130	130	130	154	153	153	153
F	2068	2268	2261	2259	2264	2440	2440	2436	2432
D *	3313	3289	3289	3289	3289	3316	3316	3316	3316
GR	181	242	242	242	242	296	292	292	292
IRE	n.a.								
IT *	1791	1906	1906	1906	1906	2057	2057	2057	2057
LUX	n.a.								
NL	962	1013	1012	1014	1014	1106	1102	1101	1101
P *	201	266	266	266	266	329	329	329	329
ES *	1002	1114	1114	1114	1114	1233	1233	1233	1233
UK	2048	2176	2172	2352	2352	2341	2336	2530	2528
EC-10	12310	13072	13061	13239	13244	14000	13987	14185	14172

* = DG XVII figures

Table 4.3 Final energy consumption transport per country
DG XVII scenarios I,III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country				[PJ]			
B	309.0	337.5	338.7	292.7	323.2	216.9	178.8
DK	184.6	202.2	200.1	183.0	230.3	127.7	112.6
F	1671.5	1828.9	1933.6	1563.0	1881.6	1213.8	900.2
D	2058.7	2037.8	2030.7	1841.0	1926.0	1246.9	1060.6
GR	229.0	335.8	360.5	294.8	375.2	324.1	213.1
IRE	79.6	92.1	100.9	83.3	108.0	80.0	46.9
IT	1417.3	1559.7	1609.5	1387.2	1614.9	978.5	758.7
LUX	32.7	35.2	33.5	30.1	34.3	23.0	19.3
NL	451.4	482.8	490.3	437.5	468.1	302.3	254.6
P	155.3	190.5	213.1	169.2	211.0	162.0	109.7
ES	801.0	1019.5	1171.9	908.6	1157.7	899.8	499.1
UK	1922.7	2166.4	2200.3	1942.3	2294.9	1328.5	1040.9
EC-12	9312.7	10288.3	10683.1	9132.7	10625.3	6903.5	5194.4

Table 4.4 Final energy consumption transport per country
DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scenario	all	REF	CON	10%	20%	REF	CON	10%	20%
Country					[PJ]				
B	311	353	289	289	289	345	277	277	271
DK	152	178	160	160	160	211	191	191	191
F	1523	1676	1401	1401	1401	1721	1416	1416	1416
D	2043	2019	1823	1823	1823	1909	1717	1717	1677
GR	231	338	298	297	297	379	323	317	317
IRE	n.a.								
IT	1421	1569	1497	1496	1489	1575	1380	1204	1195
LUX	n.a.								
NL	361	417	349	349	349	493	395	367	367
P	134	171	161	161	161	200	172	172	172
ES	811	1157	1147	1144	1144	1424	1271	1168	1168
UK	1718	1982	1627	1627	1627	2138	1705	1705	1705
EC-10	8705	9860	8752	8747	8740	10395	8847	8534	8479

Table 4.5 Final energy consumption tertiary-domestic per country DG XVII scenarios I,III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country				[PJ]			
B	569.4	611.7	630.6	520.9	599.2	561.5	459.3
DK	331.2	346.7	358.4	322.8	356.7	318.6	293.9
F	2368.6	2554.5	2625.2	2322.5	2632.8	2420.1	2024.0
D	3375.6	3413.7	3623.4	3009.6	3330.3	3238.6	2677.6
GR	146.1	193.0	224.8	178.4	248.3	244.1	157.0
IRE	126.9	138.6	147.8	87.9	148.2	135.2	79.6
IT	1594.8	1783.7	1843.5	1671.9	1878.3	1741.8	1591.5
LUX	26.8	30.1	34.3	25.1	31.4	37.3	20.9
NL	923.7	982.3	1038.4	916.5	1014.9	974.3	847.4
P	85.0	116.8	136.5	109.7	159.9	169.6	117.7
ES	535.5	647.7	745.3	599.2	737.7	803.5	469.8
UK	2652.0	2807.0	2947.6	2487.5	2855.1	2694.8	2128.3
EC-12	12735.6	13625.8	14356.0	12252.0	13993.0	13339.4	10866.9

Table 4.6 Final energy consumption tertiary-domestic sector per country DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scenario	all	REF	CON	10%	20%	REF	CON	10%	20%
Country					[PJ]				
B	583	621	565	565	565	601	546	560	557
DK	267	281	276	275	275	297	290	278	278
F	2692	2945	2728	2728	2651	3048	2640	2505	2437
D	3323	3515	3475	3475	3475	3577	3469	3469	3471
GR	165	209	169	169	169	255	202	200	200
IRE	n.a.								
IT	1572	1790	1640	1640	1640	1925	1758	1755	1753
LUX	n.a.								
NL	807	834	786	784	784	833	693	658	658
P	64	92	77	77	77	128	108	108	108
ES	325	402	353	353	353	439	384	364	364
UK	2627	2793	2413	2413	2413	2835	2458	2411	2353
EC-10	12425	13482	12482	12479	12402	13938	12548	12308	12179

Table 4.7 Total final energy consumption per country
DG XVII scenarios I,III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country				[PJ]			
B	1373	1477	1500	1294	1496	1254	1051
DK	639	687	698	629	757	580	525
F	5591	6038	6152	5365	6306	5070	4239
D	7951	7959	8266	7114	7795	6837	5788
GR	548	765	849	682	912	841	543
IRE	300	351	391	280	393	342	206
IT	4428	4838	4991	4414	5110	4129	3590
LUX	133	143	147	124	147	133	104
NL	1993	2157	2215	1989	2267	1930	1714
P	378	502	563	452	624	541	376
ES	2106	2528	2862	2277	2838	2622	1496
UK	6079	6618	6807	5923	6937	5553	4428
EC-12	31518	34062	35441	30543	35582	29832	24059

Table 4.8 Total final energy consumption per country
DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scenario	all	REF	CON	10%	20%	REF	CON	10%	20%
Country					[PJ]				
B	1520	1642	1523	1521	1521	1674	1552	1575	1559
DK	537	589	566	565	565	662	634	622	622
F	6283	6889	6390	6388	6316	7209	6496	6357	6285
D*	8679	8823	8587	8587	8587	8802	8502	8502	8464
GR	577	789	709	708	708	930	817	809	809
IRE	n.a.								
IT*	4784	5265	5043	5042	5035	5557	5195	5016	5005
LUX	n.a.								
NL	2130	2264	2147	2147	2147	2432	2190	2126	2126
P*	399	529	504	504	504	657	609	609	609
ES*	2138	2673	2614	2611	2611	3096	2888	2765	2765
UK	6393	6951	6212	6392	6392	7314	6499	6646	6586
EC-10	33440	36414	34295	34465	34386	38333	35382	35027	34830

* = figures for industrial sector are from DG XVII

Table 4.9 Final energy consumption industry per value added per country DG XVII scenarios I,III and IV

Year	1990		2000			2010	
Scenario	all	I	III	IV	I	III	IV
Country			[Mtoe/billion ECU-87]				
B	0.50	0.43	0.42	0.41	0.38	0.31	0.30
DK	0.21	0.18	0.19	0.18	0.16	0.15	0.14
F	0.23	0.20	0.19	0.19	0.18	0.14	0.14
D	0.22	0.18	0.18	0.18	0.15	0.14	0.13
GR	0.52	0.54	0.52	0.49	0.48	0.37	0.30
IRE	0.27	0.24	0.25	0.25	0.21	0.15	0.14
IT	0.22	0.19	0.19	0.18	0.17	0.14	0.14
LUX	1.03	0.83	0.87	0.82	0.73	0.66	0.63
NL	0.48	0.42	0.42	0.43	0.35	0.33	0.34
P	0.34	0.33	0.33	0.31	0.32	0.23	0.20
ES	0.29	0.24	0.21	0.23	0.21	0.14	0.12
UK	0.24	0.21	0.20	0.20	0.20	0.15	0.15
EC-12	0.25	0.22	0.21	0.21	0.19	0.16	0.15

Table 4.10 Final energy demand passenger transportation per p-km per country DG XVII scenario I

Year	1990	2000	2010
Country	[toe/million p-km]		
B	42.20	40.50	38.70
DK	45.50	42.40	39.80
F	35.00	31.70	30.60
D	47.80	44.20	41.00
GR	51.80	44.00	40.20
IRE	46.30	45.40	41.50
IT	36.30	33.60	30.80
LUX	n.a.		
NL	38.30	37.60	36.20
P	41.70	38.20	36.20
ES	43.40	39.60	36.30
UK	50.30	47.80	46.80

Table 4.11 Final energy demand freight transportation per t-km per country DG XVII scenario I

Year Country	1990	2000	2010
	[toe/million t-km]		
B	53.00	50.30	47.70
DK	84.20	72.00	65.00
F	67.20	67.30	64.40
D	36.30	37.40	34.60
GR	138.90	144.00	131.60
IRE	48.70	45.60	42.40
IT	46.30	41.90	43.10
LUX	n.a.		
NL	85.20	74.80	66.70
P	82.90	69.20	63.40
ES	74.00	37.00	36.30
UK	60.00	59.40	60.30

5. ELECTRICITY PER COUNTRY

Table 5.1 Electricity demand (incl. transportation losses and own use) DG XVII scenarios I,III and IV

Year	1990		2000			2010	
Scenario	all	I	III	IV	I	III	IV
Country			[TWh]				
B	61.8	81.4	79.2	77.0	98.9	84.0	70.1
DK	30.9	38.1	37.9	35.1	45.1	37.0	34.2
F	358.5	472.5	457.7	445.3	574.2	493.0	451.6
D	427.6	480.5	504.8	448.5	517.6	489.0	430.5
GR	32.7	48.1	51.0	44.0	69.6	61.0	42.4
IRE	13.1	17.7	20.6	16.8	23.0	23.4	16.6
IT	236.7	309.0	304.8	285.6	367.7	325.9	304.5
LUX	4.8	5.9	6.0	5.4	6.9	6.0	5.2
NL	75.6	91.0	93.3	84.4	110.6	97.1	86.7
P	26.7	38.0	42.7	35.4	52.2	50.3	36.6
ES	134.3	175.2	210.3	162.5	216.3	242.1	135.3
UK	317.3	382.0	376.0	358.0	425.3	387.7	338.9
EC-12	1720.0	2139.4	2184.3	1998.0	2507.4	2296.5	1952.6

Table 5.2 Electricity demand per GDP DG XVII scenarios I,III and IV

Year	1990		2000			2010	
Scenario	all	I	III	IV	I	III	IV
Country			[MWh/ECU-87]				
B	0.46	0.46	0.43	0.44	0.43	0.34	0.30
DK	0.34	0.32	0.30	0.30	0.29	0.23	0.22
F	0.43	0.44	0.39	0.41	0.41	0.32	0.32
D	0.40	0.34	0.33	0.32	0.28	0.25	0.23
GR	0.73	0.82	0.73	0.75	0.88	0.62	0.54
IRE	0.45	0.46	0.42	0.43	0.45	0.36	0.33
IT	0.32	0.32	0.30	0.30	0.30	0.24	0.25
LUX	0.82	0.75	0.74	0.69	0.67	0.55	0.50
NL	0.37	0.35	0.34	0.33	0.32	0.27	0.25
P	0.74	0.68	0.65	0.64	0.62	0.51	0.44
ES	0.47	0.44	0.41	0.41	0.40	0.32	0.25
UK	0.50	0.47	0.43	0.44	0.42	0.34	0.33
EC-12	0.42	0.40	0.37	0.37	0.34	0.29	0.28

Table 5.3 Electricity demand per capita DG XVII scenarios I,III and IV

Year	1990		2000			2010	
Scenario	all	I	III	IV	I	III	IV
Country			[MWh/capita]				
B	6.35	8.46	8.23	8.00	10.55	8.96	7.48
DK	6.01	7.38	7.34	6.80	8.91	7.31	6.76
F	6.39	8.16	7.91	7.69	9.77	8.38	7.68
D	6.90	7.87	8.27	7.35	8.88	8.39	7.38
GR	3.24	4.65	4.93	4.25	6.54	5.73	3.98
IRE	3.70	4.82	5.61	4.58	6.13	6.24	4.43
IT	4.13	5.33	5.26	4.93	6.31	5.59	5.22
LUX	12.97	15.95	16.22	14.59	18.65	16.22	14.05
NL	5.06	5.80	5.94	5.38	6.87	6.03	5.39
P	2.58	3.60	4.04	3.35	4.65	4.48	3.26
ES	3.42	4.33	5.19	4.01	5.25	5.88	3.28
UK	5.58	6.60	6.49	6.18	7.31	6.66	5.82
EC-12	5.28	6.47	6.60	6.04	7.57	6.93	5.89

Table 5.4a Electricity production by fuel DG XVII scenarios I, III, IV

Year		1990		2000			2010	
Scenario		all	I	III	IV	I	III	IV
Country/fuel				[TWh]				
B	nuclear	37.5	37.5	37.5	37.5	52.7	52.7	35.0
	solids	16.2	25.5	21.0	20.8	30.0	12.7	15.0
	oil	5.5	6.7	6.7	5.1	3.1	2.5	2.4
	gas	3.4	8.3	11.2	10.1	9.0	13.7	13.4
	renew.	1.6	2.2	2.2	2.4	2.9	2.9	3.1
	Total	64.2	80.2	78.6	75.9	97.7	84.5	68.9
DK	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	solids	28.0	31.9	31.4	28.8	35.5	25.3	23.3
	oil	1.3	1.2	1.2	1.2	1.4	1.0	1.1
	gas	0.5	2.9	3.2	3.1	6.4	7.3	6.4
	renew.	0.5	1.6	1.6	1.6	1.3	2.9	2.9
	Total	30.3	37.6	37.4	34.7	44.6	36.5	33.7
F	nuclear	293.7	413.1	419.6	403.6	503.6	483.8	425.4
	solids	27.1	32.7	26.6	22.4	65.1	19.9	21.4
	oil	1.5	13.2	6.7	5.9	0.7	0.7	0.7
	gas	3.1	7.3	10.3	7.3	13.3	14.6	12.6
	renew.	69.7	70.8	70.8	70.8	71.2	71.2	71.2
	Total	395.1	537.1	534.0	510.0	653.9	590.2	531.3
D	nuclear	159.4	157.4	157.4	157.4	183.5	198.2	144.1
	solids	198.6	235.0	252.7	202.3	258.7	203.4	199.7
	oil	22.4	11.9	12.9	11.9	4.9	3.5	4.9
	gas	22.7	45.6	50.1	45.6	36.0	51.6	46.1
	renew.	21.4	23.4	23.4	24.1	27.5	27.5	28.7
	Total	424.5	473.3	496.5	441.3	510.6	484.2	423.5
GR	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	solids	22.3	34.3	33.4	28.9	54.7	37.7	24.9
	oil	6.8	3.4	3.6	3.4	2.5	2.8	2.5
	gas	0.0	1.8	4.7	3.1	1.3	8.8	4.5
	renew.	3.4	7.4	8.1	7.4	10.0	10.6	9.5
	Total	32.5	46.9	49.8	42.8	68.5	59.9	41.4
IRE	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	solids	7.8	10.0	11.8	8.4	19.4	16.4	10.7
	oil	1.7	4.2	4.2	4.2	1.1	1.1	1.1
	gas	3.1	2.9	4.0	3.7	1.9	5.3	4.1
	renew.	1.1	1.1	1.1	1.1	1.3	1.3	1.3
	Total	13.7	18.2	21.1	17.4	23.7	24.1	17.2
IT	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	solids	39.0	89.5	69.9	70.0	161.4	95.5	106.6
	oil	94.1	79.6	78.9	77.1	50.5	44.1	45.5
	gas	32.4	52.7	65.1	51.2	67.2	97.7	63.8
	renew.	48.9	56.1	56.1	56.1	59.2	59.2	59.2
	Total	214.4	277.9	270.0	254.4	338.3	296.5	275.1

Table 5.4b Electricity production by fuel DG XVII scenarios I, III, IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country/fuel			[TWh]				
LUX nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
oil	0.1	0.1	0.1	0.1	0.1	0.1	0.1
gas	0.5	0.6	0.6	0.6	0.6	0.6	0.6
renew.	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total	1.2	1.3	1.3	1.3	1.3	1.3	1.3
NL nuclear	3.5	3.1	3.1	3.1	25.5	33.3	8.5
solids	21.6	45.2	40.3	41.1	47.5	25.9	40.5
oil	3.0	8.5	8.4	6.1	2.6	2.6	2.6
gas	38.4	21.3	28.6	21.3	27.9	28.2	27.9
renew.	0.5	0.9	0.9	0.9	1.4	1.4	1.4
Total	67.0	79.0	81.3	72.5	104.9	91.4	80.9
P nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
solids	7.0	10.6	13.2	9.6	28.4	19.6	10.8
oil	6.2	8.1	8.1	6.5	2.3	1.3	2.3
gas	0.1	1.4	1.4	1.4	0.1	6.5	2.2
renew.	10.8	12.9	14.4	13.0	14.4	15.9	14.4
Total	24.1	33.0	37.1	30.5	45.2	43.3	29.7
ES nuclear	48.2	62.9	62.9	55.5	91.1	112.6	55.9
solids	49.0	65.6	92.6	62.0	79.4	79.9	38.8
oil	6.1	10.1	12.4	7.1	3.5	2.9	3.1
gas	3.8	3.4	6.4	4.5	7.0	10.0	4.7
renew.	33.6	39.8	41.4	39.9	43.2	44.7	40.7
Total	140.7	181.8	215.7	169.0	224.2	250.1	143.2
UK nuclear	61.3	65.3	65.3	65.3	93.0	132.6	55.5
solids	205.0	242.0	225.8	222.2	249.9	161.9	200.9
oil	28.2	45.7	45.3	41.6	12.7	14.3	12.7
gas	7.3	13.1	26.1	13.1	41.2	55.1	41.2
renew.	7.5	7.0	7.0	7.0	7.2	7.3	7.3
Total	309.3	373.1	369.5	349.2	404.0	371.2	317.6
EC-12							
nuclear	603.6	739.3	745.8	722.4	949.4	1013.2	724.4
solids	621.6	822.3	818.7	716.5	1030	698.2	692.6
oil	176.9	192.7	188.5	170.2	85.4	76.9	79
gas	115.3	161.3	211.7	165	211.9	299.4	227.5
renew.	199.6	223.8	227.6	224.9	240.2	245.5	240.3
Total	1717	2139.4	2192.3	1999	2516.9	2333.2	1963.8

Table 5.5a Electricity production by fuel shares DG XVII scenarios I, III, IV

Year		1990	2000			2010		
Scenario		all	I	III	IV	I	III	IV
Country/fuel		[%]						
B	nuclear	58.4	46.8	47.7	49.4	53.9	62.4	50.8
	solids	25.2	31.8	26.7	27.4	30.7	15.0	21.8
	oil	8.6	8.4	8.5	6.7	3.2	3.0	3.5
	gas	5.3	10.3	14.2	13.3	9.2	16.2	19.4
	renew.	2.5	2.7	2.8	3.2	3.0	3.4	4.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
DK	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	solids	92.4	84.8	84.0	83.0	79.6	69.3	69.1
	oil	4.3	3.2	3.2	3.5	3.1	2.7	3.3
	gas	1.7	7.7	8.6	8.9	14.3	20.0	19.0
	renew.	1.7	4.3	4.3	4.6	2.9	7.9	8.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
F	nuclear	74.3	76.9	78.6	79.1	77.0	82.0	80.1
	solids	6.9	6.1	5.0	4.4	10.0	3.4	4.0
	oil	0.4	2.5	1.3	1.2	0.1	0.1	0.1
	gas	0.8	1.4	1.9	1.4	2.0	2.5	2.4
	renew.	17.6	13.2	13.3	13.9	10.9	12.1	13.4
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
D	nuclear	37.6	33.3	31.7	35.7	35.9	40.9	34.0
	solids	46.8	49.7	50.9	45.8	50.7	42.0	47.2
	oil	5.3	2.5	2.6	2.7	1.0	0.7	1.2
	gas	5.3	9.6	10.1	10.3	7.1	10.7	10.9
	renew.	5.0	4.9	4.7	5.5	5.4	5.7	6.8
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GR	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	solids	68.6	73.1	67.1	67.5	79.9	62.9	60.1
	oil	20.9	7.2	7.2	7.9	3.6	4.7	6.0
	gas	0.0	3.8	9.4	7.2	1.9	14.7	10.9
	renew.	10.5	15.8	16.3	17.3	14.6	17.7	22.9
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IRE	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	solids	56.9	54.9	55.9	48.3	81.9	68.0	62.2
	oil	12.4	23.1	19.9	24.1	4.6	4.6	6.4
	gas	22.6	15.9	19.0	21.3	8.0	22.0	23.8
	renew.	8.0	6.0	5.2	6.3	5.5	5.4	7.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IT	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	solids	18.2	32.2	25.9	27.5	47.7	32.2	38.7
	oil	43.9	28.6	29.2	30.3	14.9	14.9	16.5
	gas	15.1	19.0	24.1	20.1	19.9	33.0	23.2
	renew.	22.8	20.2	20.8	22.1	17.5	20.0	21.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5.5b Electricity production by fuel shares DG XVII scenarios I, III, IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country/fuel	[%]						
LUX nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
solids	0.0	0.0	0.0	0.0	0.0	0.0	0.0
oil	8.3	7.7	7.7	7.7	7.7	7.7	7.7
gas	41.7	46.2	46.2	46.2	46.2	46.2	46.2
renew.	50.0	46.2	46.2	46.2	46.2	46.2	46.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NL nuclear	5.2	3.9	3.8	4.3	24.3	36.4	10.5
solids	32.2	57.2	49.6	56.7	45.3	28.3	50.1
oil	4.5	10.8	10.3	8.4	2.5	2.8	3.2
gas	57.3	27.0	35.2	29.4	26.6	30.9	34.5
renew.	0.7	1.1	1.1	1.2	1.3	1.5	1.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
P nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
solids	29.0	32.1	35.6	31.5	62.8	45.3	36.4
oil	25.7	24.5	21.8	21.3	5.1	3.0	7.7
gas	0.4	4.2	3.8	4.6	0.2	15.0	7.4
renew.	44.8	39.1	38.8	42.6	31.9	36.7	48.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ES nuclear	34.3	34.6	29.2	32.8	40.6	45.0	39.0
solids	34.8	36.1	42.9	36.7	35.4	31.9	27.1
oil	4.3	5.6	5.7	4.2	1.6	1.2	2.2
gas	2.7	1.9	3.0	2.7	3.1	4.0	3.3
renew.	23.9	21.9	19.2	23.6	19.3	17.9	28.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
UK nuclear	19.8	17.5	17.7	18.7	23.0	35.7	17.5
solids	66.3	64.9	61.1	63.6	61.9	43.6	63.3
oil	9.1	12.2	12.3	11.9	3.1	3.9	4.0
gas	2.4	3.5	7.1	3.8	10.2	14.8	13.0
renew.	2.4	1.9	1.9	2.0	1.8	2.0	2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EC-12							
nuclear	35.2	34.6	34.0	36.1	37.7	43.4	36.9
solids	36.2	38.4	37.3	35.8	40.9	29.9	35.3
oil	10.3	9.0	8.6	8.5	3.4	3.3	4.0
gas	6.7	7.5	9.7	8.3	8.4	12.8	11.6
renew.	11.6	10.5	10.4	11.3	9.5	10.5	12.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5.6a Electricity production by fuel DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/fuel		[TWh]								
B	coal	17.2	21.1	8.9	8.3	8.3	10.8	8.3	0.8	0.0
	oil	0.6	0.8	0.8	0.8	0.8	0.3	0.0	0.0	0.0
	gas	2.8	8.1	12.8	13.3	13.3	31.4	26.7	26.9	25.0
	nuclear	39.2	44.4	44.4	44.4	44.4	50.6	50.6	50.6	50.6
	renew	0.6	0.6	2.2	2.2	2.2	0.6	1.9	3.3	5.6
	Total	60.3	75.0	69.2	69.2	69.2	93.6	87.5	81.7	81.1
DK	coal	30.0	28.1	26.9	21.4	15.3	26.9	26.1	13.6	2.5
	oil	1.7	0.8	0.8	0.8	0.8	0.6	0.6	0.3	0.0
	gas	0.0	0.8	0.6	1.1	7.8	0.8	0.8	14.7	24.2
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	renew	0.8	1.4	0.8	5.0	5.3	6.9	6.9	6.9	6.9
	Total	32.5	31.1	29.2	28.3	29.2	35.3	34.4	35.6	33.6
F	coal	47.2	54.7	42.5	46.1	46.4	45.6	37.2	21.4	1.4
	oil	0.3	9.4	9.2	10.8	10.8	0.0	0.0	0.0	0.6
	gas	0.0	3.1	0.6	3.9	3.3	67.2	61.9	47.8	31.9
	nuclear	258.1	335.3	329.4	317.5	316.1	331.4	291.9	314.7	343.1
	renew	60.3	64.7	63.1	64.7	64.7	68.3	68.3	68.1	76.4
	Total	365.8	467.2	444.7	443.1	441.4	512.5	459.4	451.9	453.3
D	coal	215.6	221.7	221.1	210.6	208.3	234.2	234.2	195.3	113.1
	oil	0.0	0.8	0.6	0.6	1.4	0.3	0.3	0.3	0.3
	gas	60.6	85.3	77.5	87.8	89.2	64.2	47.2	80.3	122.5
	nuclear	162.5	162.5	162.5	162.5	162.5	160.3	160.3	160.3	160.3
	renew	25.6	30.3	30.3	30.3	30.3	48.6	48.9	41.9	86.9
	Total	464.2	500.6	491.9	491.7	491.7	507.5	490.8	478.1	483.1
GR	coal	23.6	35.0	15.0	13.6	13.6	52.5	7.2	0.0	0.0
	oil	3.9	2.5	7.8	11.1	11.1	0.3	1.9	6.4	6.4
	gas	0.0	2.2	5.3	5.3	5.3	0.8	26.4	25.6	25.6
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	renew	3.9	7.8	13.1	11.7	11.7	10.0	18.6	21.7	21.7
	Total	31.4	47.5	41.1	41.7	41.7	63.6	54.2	53.6	53.6
IRE		n.a.								
IT	coal	36.9	93.1	16.1	22.2	23.1	137.8	3.9	0.0	0.0
	oil	69.2	33.9	55.0	25.0	25.0	52.5	100.0	11.7	11.1
	gas	55.6	85.0	99.4	123.1	122.2	68.3	109.2	203.9	205.6
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	renew	46.4	74.4	75.6	75.0	75.0	78.1	89.4	89.4	89.4
	Total	208.1	286.4	246.1	245.3	245.3	336.7	302.5	305.0	306.1
LUX		n.a.								

Table 5.6b Electricity production by fuel DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/fuel					[TWh]					
NL	coal	22.5	27.5	22.8	23.1	23.1	28.9	3.3	1.4	1.4
	oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	gas	42.2	44.4	44.2	45.0	45.0	71.4	90.3	91.4	91.4
	nuclear	3.6	3.6	3.6	3.6	3.6	0.0	0.0	0.0	0.0
	renew	1.4	5.6	5.6	4.7	4.7	7.5	8.1	7.5	7.5
	Total	69.7	81.1	76.1	76.4	76.4	107.8	101.7	100.3	100.3
P	coal	7.2	10.3	10.3	10.3	10.3	17.2	0.0	0.0	0.0
	oil	6.4	8.1	4.4	4.4	4.4	1.4	0.0	0.0	0.0
	gas	0.0	0.3	0.0	0.0	0.0	5.0	18.3	18.3	18.3
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	renew	12.2	15.0	15.6	15.6	15.6	18.6	18.6	18.6	18.6
	Total	25.8	33.6	30.3	30.3	30.3	42.2	36.9	36.9	36.9
ES	coal	62.8	58.9	26.4	26.9	26.9	79.4	19.4	25.3	25.3
	oil	0.8	15.3	2.2	2.5	2.5	1.7	0.0	0.0	0.0
	gas	3.6	30.8	39.4	40.0	40.0	28.3	63.1	68.1	68.1
	nuclear	38.9	36.7	50.8	50.8	50.8	63.6	63.6	63.6	63.6
	renew	30.0	40.8	40.8	40.8	40.8	44.7	44.7	46.1	46.1
	Total	136.1	182.5	159.7	161.1	161.1	217.8	190.8	203.1	203.1
UK	coal	204.7	201.7	200.0	199.2	198.3	103.1	102.8	102.5	58.3
	oil	15.3	28.6	16.7	13.6	13.3	38.6	14.4	14.2	0.0
	gas	11.9	38.9	38.6	38.6	39.7	144.4	145.8	137.2	178.9
	nuclear	68.9	56.9	56.9	56.9	56.9	39.4	39.4	39.4	39.4
	renew	3.6	33.9	29.7	33.6	33.6	71.1	71.1	78.9	95.0
	Total	304.4	360.0	341.9	341.9	341.9	396.7	373.6	372.2	371.7
EC-10										
	coal	667.8	751.7	589.7	581.7	573.6	736.1	442.8	360.0	201.7
	oil	98.1	100.0	97.5	69.7	70.3	95.6	117.2	32.8	18.3
	gas	176.4	298.6	318.6	358.1	365.8	482.2	589.4	714.2	791.1
	nuclear	571.1	639.4	647.8	635.8	634.4	645.0	605.8	628.6	656.9
	renew	184.7	274.4	276.7	283.6	283.9	354.7	376.4	382.8	454.2
	Total	1698.1	2064.2	1930.3	1928.9	1928.1	2313.6	2131.7	2118.3	2122.2

Table 5.7a Electricity production by fuel shares DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/fuel		[%]								
B	coal	28.6	28.1	12.9	12.0	12.0	11.6	9.5	1.0	0.0
	oil	0.9	1.1	1.2	1.2	1.2	0.3	0.0	0.0	0.0
	gas	4.6	10.7	18.5	19.3	19.3	33.5	30.5	33.0	30.8
	nuclear	65.0	59.3	64.3	64.3	64.3	54.0	57.8	61.9	62.3
	renew	0.9	0.7	3.2	3.2	3.2	0.6	2.2	4.1	6.8
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
DK	coal	92.3	90.2	92.4	75.5	52.4	76.4	75.8	38.3	7.4
	oil	5.1	2.7	2.9	2.9	2.9	1.6	1.6	0.8	0.0
	gas	0.0	2.7	1.9	3.9	26.7	2.4	2.4	41.4	71.9
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	renew	2.6	4.5	2.9	17.6	18.1	19.7	20.2	19.5	20.7
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
F	coal	12.9	11.7	9.6	10.4	10.5	8.9	8.1	4.7	0.3
	oil	0.1	2.0	2.1	2.4	2.5	0.0	0.0	0.0	0.1
	gas	0.0	0.7	0.1	0.9	0.8	13.1	13.5	10.6	7.0
	nuclear	70.5	71.8	74.1	71.7	71.6	64.7	63.5	69.6	75.7
	renew	16.5	13.9	14.2	14.6	14.7	13.3	14.9	15.1	16.9
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
D	coal	46.4	44.3	44.9	42.8	42.4	46.1	47.7	40.8	23.4
	oil	0.0	0.2	0.1	0.1	0.3	0.1	0.1	0.1	0.1
	gas	13.0	17.0	15.8	17.9	18.1	12.6	9.6	16.8	25.4
	nuclear	35.0	32.5	33.0	33.1	33.1	31.6	32.7	33.5	33.2
	renew	5.5	6.0	6.2	6.2	6.2	9.6	10.0	8.8	18.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GR	coal	75.2	73.7	36.5	32.7	32.7	82.5	13.3	0.0	0.0
	oil	12.4	5.3	18.9	26.7	26.7	0.4	3.6	11.9	11.9
	gas	0.0	4.7	12.8	12.7	12.7	1.3	48.7	47.7	47.7
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	renew	12.4	16.4	31.8	28.0	28.0	15.7	34.4	40.4	40.4
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IRE		n.a.								
IT	coal	17.8	32.5	6.5	9.1	9.4	40.9	1.3	0.0	0.0
	oil	33.2	11.8	22.3	10.2	10.2	15.6	33.1	3.8	3.6
	gas	26.7	29.7	40.4	50.2	49.8	20.3	36.1	66.8	67.2
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	renew	22.3	26.0	30.7	30.6	30.6	23.2	29.6	29.3	29.2
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
LUX		n.a.								

Table 5.7b Electricity production by fuel shares DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/fuel					[%]					
NL	coal	32.3	33.9	29.9	30.2	30.2	26.8	3.3	1.4	1.4
	oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	gas	60.6	54.8	58.0	58.9	58.9	66.2	88.8	91.1	91.1
	nuclear	5.2	4.5	4.7	4.7	4.7	0.0	0.0	0.0	0.0
	renew	2.0	6.8	7.3	6.2	6.2	7.0	7.9	7.5	7.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
P	coal	28.0	30.6	33.9	33.9	33.9	40.8	0.0	0.0	0.0
	oil	24.7	24.0	14.7	14.7	14.7	3.3	0.0	0.0	0.0
	gas	0.0	0.8	0.0	0.0	0.0	11.8	49.6	49.6	49.6
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	renew	47.3	44.6	51.4	51.4	51.4	44.1	50.4	50.4	50.4
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ES	coal	46.1	32.3	16.5	16.7	16.7	36.5	10.2	12.4	12.4
	oil	0.6	8.4	1.4	1.6	1.6	0.8	0.0	0.0	0.0
	gas	2.7	16.9	24.7	24.8	24.8	13.0	33.0	33.5	33.5
	nuclear	28.6	20.1	31.8	31.6	31.6	29.2	33.3	31.3	31.3
	renew	22.0	22.4	25.6	25.3	25.3	20.5	23.4	22.7	22.7
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
UK	coal	67.2	56.0	58.5	58.2	58.0	26.0	27.5	27.5	15.7
	oil	5.0	7.9	4.9	4.0	3.9	9.7	3.9	3.8	0.0
	gas	3.9	10.8	11.3	11.3	11.6	36.4	39.0	36.9	48.1
	nuclear	22.6	15.8	16.7	16.7	16.7	9.9	10.6	10.6	10.6
	renew	1.2	9.4	8.7	9.8	9.8	17.9	19.0	21.2	25.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EC-10										
	coal	39.3	36.4	30.6	30.2	29.8	31.8	20.8	17.0	9.5
	oil	5.8	4.8	5.1	3.6	3.6	4.1	5.5	1.5	0.9
	gas	10.4	14.5	16.5	18.6	19.0	20.8	27.7	33.7	37.3
	nuclear	33.6	31.0	33.6	33.0	32.9	27.9	28.4	29.7	31.0
	renew	10.9	13.3	14.3	14.7	14.7	15.3	17.7	18.1	21.4
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5.8 Electricity production per capita per country
DG XVII scenarios I, III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country	[MWh/capita]						
B	6.60	8.34	8.17	7.89	10.43	9.02	7.35
DK	5.89	7.29	7.25	6.72	8.81	7.21	6.66
F	7.04	9.28	9.22	8.81	11.12	10.04	9.04
D	6.85	7.75	8.13	7.23	8.76	8.31	7.26
GR	3.22	4.53	4.81	4.14	6.43	5.62	3.89
IRE	3.87	4.96	5.75	4.74	6.32	6.43	4.59
IT	3.74	4.79	4.66	4.39	5.80	5.09	4.72
LUX	3.24	3.51	3.51	3.51	3.51	3.51	3.51
NL	4.49	5.03	5.18	4.62	6.52	5.68	5.02
P	2.33	3.12	3.51	2.89	4.03	3.86	2.65
ES	3.58	4.49	5.33	4.17	5.44	6.07	3.48
UK	5.44	6.44	6.38	6.03	6.94	6.38	5.46
EC-12	5.27	6.47	6.63	6.04	7.60	7.04	5.93

Table 5.9 Electricity production per capita per country
DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scenario	all	REF	CON	10%	20%	REF	CON	10%	20%
Country	[MWh/capita]								
B	6.11	7.46	6.87	6.87	6.87	9.52	8.86	8.48	8.48
DK	6.28	5.98	5.64	5.51	5.63	6.98	6.82	6.99	6.61
F	6.34	8.07	7.68	7.66	7.62	8.71	7.81	7.69	7.71
D	7.49	8.47	8.06	8.05	7.96	8.70	8.41	8.20	7.32
GR	3.12	4.59	3.96	4.05	4.05	5.98	5.11	5.02	5.02
IRE	n.a.								
IT	3.63	4.94	4.25	4.23	4.23	5.78	5.19	5.23	5.25
LUX	n.a.								
NL	5.03	5.74	5.43	5.45	5.45	6.70	6.30	6.24	6.24
P	2.50	3.18	2.86	2.86	2.86	3.76	3.29	3.29	3.29
ES	3.46	4.51	3.95	3.98	3.98	5.28	4.63	3.25	4.92
UK	5.36	6.22	5.91	5.90	5.91	6.82	6.42	6.41	6.38
EC-10	5.26	6.39	5.93	5.92	5.90	7.06	6.50	6.47	6.31

Table 5.10 Electricity production per GDP per country
DG XVII scenarios I, III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country	[kWh/ECU-87]						
B	0.48	0.45	0.42	0.43	0.42	0.34	0.30
DK	0.33	0.32	0.30	0.29	0.29	0.22	0.22
F	0.47	0.50	0.46	0.47	0.47	0.38	0.38
D	0.39	0.33	0.33	0.31	0.27	0.24	0.23
GR	0.72	0.80	0.71	0.73	0.87	0.61	0.52
IRE	0.47	0.47	0.43	0.45	0.47	0.37	0.34
IT	0.29	0.29	0.26	0.27	0.28	0.22	0.22
LUX	0.20	0.17	0.16	0.17	0.13	0.12	0.13
NL	0.33	0.31	0.30	0.28	0.31	0.25	0.24
P	0.67	0.59	0.56	0.55	0.54	0.44	0.35
ES	0.49	0.46	0.42	0.43	0.42	0.33	0.27
UK	0.49	0.46	0.42	0.43	0.40	0.32	0.31
EC-12	0.42	0.40	0.37	0.37	0.36	0.30	0.28

Table 5.11 Electricity production per GDP per country
DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scenario	all	REF	CON	10%	20%	REF	CON	10%	20%
Country	[kWh/ECU-87]								
B	0.44	0.41	0.37	0.37	0.37	0.38	0.36	0.34	0.34
DK	0.35	0.26	0.25	0.24	0.25	0.23	0.22	0.23	0.22
F	0.42	0.43	0.41	0.41	0.41	0.37	0.33	0.32	0.32
D	0.43	0.36	0.35	0.35	0.34	0.27	0.26	0.26	0.23
GR	0.70	0.81	0.70	0.71	0.71	0.81	0.69	0.68	0.68
IRE	n.a.								
IT	0.28	0.30	0.26	0.26	0.26	0.28	0.25	0.25	0.25
LUX	n.a.								
NL	0.37	0.35	0.33	0.33	0.33	0.32	0.30	0.29	0.29
P	0.71	0.60	0.54	0.54	0.54	0.50	0.44	0.44	0.44
ES	0.47	0.46	0.40	0.41	0.41	0.40	0.35	0.38	0.38
UK	0.48	0.45	0.43	0.42	0.43	0.39	0.37	0.36	0.36
EC-10	0.41	0.39	0.36	0.36	0.36	0.33	0.31	0.31	0.30

6. PRIMARY ENERGY CONSUMPTION PER COUNTRY

Table 6.1a Primary energy consumption by fuel DG XVII scenarios I, III, IV

Year		1990	2000			2010		
Scenario		all	I	III	IV	I	III	IV
Country/fuel				[PJ]				
B	solids	418.7	498.3	443.8	406.1	548.5	322.4	309.8
	oil	858.3	879.3	912.8	762.0	762.0	594.6	494.1
	gas	364.3	464.8	485.7	452.2	506.6	519.2	489.9
	nuclear	418.7	418.7	418.7	418.7	586.2	586.2	389.4
	others	0.0	16.7	16.7	20.9	20.9	16.7	29.3
	Total	2060.0	2277.7	2277.7	2060.0	2424.3	2039.1	1712.5
DK	solids	322.4	360.1	355.9	322.4	397.8	288.9	259.6
	oil	448.0	443.8	448.0	410.3	473.1	318.2	293.1
	gas	75.4	129.8	138.2	125.6	163.3	188.4	167.5
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	4.2	16.7	16.7	16.7	33.5	37.7	37.7
	Total	850.0	950.4	958.8	875.1	1067.7	833.2	757.8
F	solids	799.7	850.0	753.7	632.2	1218.4	535.9	477.3
	oil	3680.4	3772.5	3806.0	3286.8	3429.2	2378.2	1930.2
	gas	1193.3	1411.0	1561.8	1318.9	1658.1	1741.8	1448.7
	nuclear	3324.5	4630.8	4702.0	4522.0	5639.9	5418.0	4769.0
	others	146.5	62.8	29.3	71.2	29.3	-20.9	41.9
	Total	9144.4	10727.1	10852.7	9831.1	11974.8	10053.0	8667.1
D	solids	3106.8	3291.0	3433.3	2822.0	3475.2	2709.0	2575.0
	oil	5217.0	4882.0	4911.4	4408.9	4459.2	3173.7	2805.3
	gas	1896.7	2252.6	2503.8	2110.2	2261.0	2679.7	2340.5
	nuclear	1683.2	1662.2	1662.2	1662.2	1938.6	2093.5	1519.9
	others	117.2	146.5	150.7	154.9	167.5	192.6	213.5
	Total	12020.9	12234.4	12661.5	11158.4	12301.4	10848.5	9454.2
GR	solids	318.2	456.4	452.2	389.4	690.9	502.4	339.1
	oil	527.6	598.7	644.8	540.1	623.9	544.3	376.8
	gas	4.2	83.7	146.5	92.1	104.7	205.2	100.5
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	16.7	58.6	62.8	58.6	87.9	96.3	92.1
	Total	866.7	1197.5	1306.3	1080.2	1507.3	1348.2	908.6
IRE	solids	159.1	184.2	201.0	121.4	268.0	221.9	129.8
	oil	192.6	238.7	255.4	217.7	226.1	180.0	121.4
	gas	71.2	87.9	108.9	92.1	96.3	125.6	87.9
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	4.2	4.2	4.2	4.2	4.2	4.2	4.2
	Total	427.1	515.0	569.4	435.4	594.6	531.7	343.3
IT	solids	661.5	1130.5	917.0	908.6	1808.8	1071.9	1159.8
	oil	3835.3	3588.3	3764.1	3316.1	3228.2	2344.7	2039.1
	gas	1465.5	1892.5	2055.8	1800.4	2127.0	2353.1	1917.6
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	376.8	477.3	494.1	481.5	502.4	510.8	510.8
	Total	6339.1	7088.6	7230.9	6506.6	7666.4	6280.5	5627.3

Table 6.1b Primary energy consumption by fuel DG XVII scenario I, III, IV

Year		1990	2000			2010		
Scenario		all	I	III	IV	I	III	IV
Country/fuel				[PJ]				
LUX	solids	50.2	50.2	50.2	41.9	50.2	41.9	37.7
	oil	58.6	62.8	62.8	54.4	58.6	41.9	37.7
	gas	16.7	20.9	25.1	20.9	29.3	25.1	25.1
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	16.7	20.9	25.1	20.9	25.1	33.5	20.9
	Total	142.4	154.9	163.3	138.2	163.3	142.4	121.4
NL	solids	326.6	540.1	494.1	489.9	552.7	330.8	443.8
	oil	1067.7	1164.0	1159.8	1067.7	1105.4	787.2	745.3
	gas	1444.5	1377.5	1503.1	1310.5	1494.8	1448.7	1318.9
	nuclear	37.7	33.5	33.5	33.5	280.5	364.3	92.1
	others	37.7	50.2	50.2	50.2	29.3	37.7	37.7
	Total	2914.2	3165.4	3240.7	2951.8	3462.6	2968.6	2637.8
P	solids	96.3	138.2	163.3	121.4	326.6	226.1	125.6
	oil	414.5	485.7	515.0	435.4	464.8	355.9	284.7
	gas	0.0	54.4	62.8	50.2	83.7	129.8	71.2
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	54.4	71.2	79.6	71.2	87.9	100.5	92.1
	Total	565.2	749.5	820.7	678.3	963.0	812.3	573.6
ES	solids	778.8	921.1	1155.6	841.6	1038.4	929.5	523.4
	oil	1750.2	2018.1	2214.9	1829.7	2097.7	1670.6	1030.0
	gas	154.9	238.7	309.8	234.5	318.2	427.1	209.4
	nuclear	535.9	699.2	699.2	619.7	1017.4	1256.1	623.9
	others	125.6	163.3	175.9	167.5	192.6	209.4	205.2
	Total	3345.4	4040.5	4555.5	3692.9	4664.3	4492.7	2591.8
UK	solids	2805.3	3077.4	2863.9	2734.1	3119.3	2034.9	2340.5
	oil	3617.6	4090.7	4128.4	3726.4	3806.0	2474.5	2131.2
	gas	2219.1	2428.5	2763.4	2252.6	2742.5	2872.3	2219.1
	nuclear	720.2	766.2	766.2	766.2	1067.7	1515.7	649.0
	others	58.6	58.6	50.2	58.6	117.2	117.2	134.0
	Total	9420.8	10421.4	10572.2	9538.0	10852.7	9014.6	7473.8
EC-12								
	solids	9843.6	11497.5	11284.0	9831.1	13494.7	9215.6	8721.5
	oil	21667.7	22224.6	22823.3	20055.7	20734.0	14863.9	12288.8
	gas	8905.7	10442.4	11665.0	9860.4	11585.4	12715.9	10396.3
	nuclear	6720.1	8210.7	8281.9	8022.3	10530.3	11233.7	8043.2
	others	958.8	1147.2	1155.6	1176.5	1298.0	1335.7	1419.4
	Total	48096.1	53522.4	55209.8	48946.0	57642.4	49364.7	40869.3

Table 6.2a Primary energy consumption by fuel DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/fuel				[PJ]						
B	coal	459	453	339	336	342	338	314	216	209
	oil	753	862	788	792	783	715	627	609	564
	gas	374	406	406	406	406	701	644	662	684
	nuclear	436	495	495	495	495	562	562	562	562
	renew	2	3	8	8	8	3	8	85	97
	Total	2024	2219	2036	2037	2034	2319	2155	2134	2116
DK	coal	343	340	332	294	245	310	291	180	80
	oil	251	245	228	229	230	280	259	247	244
	gas	77	101	102	105	151	122	128	230	301
	nuclear	0	0	0	0	0	0	0	0	0
	renew	30	31	29	45	45	42	43	54	62
	Total	701	717	691	673	671	754	721	711	687
F	coal	899	940	817	852	801	914	869	634	300
	oil	3312	3420	3087	3110	3128	3203	2789	2758	2702
	gas	1171	1340	1240	1265	1261	1958	1790	1653	1677
	nuclear	2864	3703	3639	3506	3490	3660	3223	3476	3790
	renew	637	786	760	766	737	814	750	794	806
	Total	8883	10189	9543	9499	9417	10549	9421	9315	9275
D	coal	3394	3198	3192	3081	3058	3268	3268	2840	1990
	oil	4624	4300	4092	4092	4102	3612	3382	3288	3246
	gas	2107	2591	2527	2607	2616	2683	2555	2861	3204
	nuclear	1774	1772	1772	1772	1772	1748	1748	1748	1748
	renew	147	213	213	213	213	257	257	273	552
	Total	12046	12074	11796	11765	11761	11568	11210	11010	10740
GR	coal	374	496	250	232	232	659	168	20	20
	oil	470	584	551	586	586	582	575	599	599
	gas	0	55	68	64	64	57	209	209	209
	nuclear	0	0	0	0	0	0	0	0	0
	renew	15	30	49	44	44	39	71	98	98
	Total	859	1165	918	926	926	1337	1023	926	926
IRE		n.a.								
IT	coal	689	1202	425	484	494	1597	277	279	199
	oil	3613	3229	3361	3037	3029	3265	3774	2430	2350
	gas	1627	2084	2149	2377	2368	2084	2084	3035	3152
	nuclear	0	0	0	0	0	0	0	0	0
	renew	213	391	419	417	417	510	549	549	549
	Total	6142	6906	6354	6315	6308	7456	6684	6293	6250
LUX		n.a.								

Table 6.2b Primary energy consumption by fuel DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/fuel				[PJ]						
NL	coal	323	361	319	321	321	371	140	123	123
	oil	945	924	808	836	836	963	817	748	748
	gas	1320	1435	1426	1400	1400	1693	1723	1684	1684
	nuclear	37	39	39	39	39	0	0	0	0
	renew	18	53	52	43	43	66	65	50	50
	Total	2643	2812	2644	2639	2639	3093	2745	2605	2605
P	coal	144	144	144	144	144	221	35	35	35
	oil	381	477	427	427	427	471	415	415	415
	gas	0	27	25	25	25	125	238	238	238
	nuclear	0	0	0	0	0	0	0	0	0
	renew	96	114	114	114	114	125	125	125	125
	Total	621	762	710	710	710	942	813	813	813
ES	coal	881	804	484	490	490	1053	444	237	237
	oil	1541	2039	1888	1885	1885	2119	1930	1723	1723
	gas	198	421	479	482	482	412	686	660	660
	nuclear	140	132	183	183	183	229	229	229	229
	renew	53	91	95	95	95	122	133	117	117
	Total	2813	3487	3129	3135	3135	3935	3422	2966	2966
UK	coal	2874	2690	2645	2580	2561	1790	1759	1751	1114
	oil	3367	3513	2999	3025	3025	3741	2962	2955	2752
	gas	1985	2469	2168	2182	2206	3320	3093	2986	3497
	nuclear	248	205	205	205	205	142	142	142	142
	renew	15	591	521	591	591	791	791	822	965
	Total	8489	9468	8538	8583	8588	9784	8747	8656	8470
EC-10										
	coal	10380	10628	8947	8814	8688	10521	7565	6315	4307
	oil	19257	19593	18229	18019	18031	18951	17530	15772	15343
	gas	8859	10929	10590	10913	10979	13155	13150	14218	15306
	nuclear	5499	6346	6333	6200	6184	6341	5904	6157	6471
	renew	1226	2303	2260	2336	2307	2769	2792	2967	3421
	Total	45221	49799	46359	46282	46189	51737	46941	45429	44848

Table 6.3a Primary energy consumption by fuel shares DG XVII scenarios I, III and IV

Year		1990		2000			2010	
Scenario		all	I	III	IV	I	III	IV
Country/fuel				[%]				
B	solids	20.3	21.9	19.5	19.7	22.6	15.8	18.1
	oil	41.7	38.6	40.1	37.0	31.4	29.2	28.9
	gas	17.7	20.4	21.3	22.0	20.9	25.5	28.6
	nuclear	20.3	18.4	18.4	20.3	24.2	28.7	22.7
	others	0.0	0.7	0.7	1.0	0.9	0.8	1.7
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
DK	solids	37.9	37.9	37.1	36.8	37.3	34.7	34.3
	oil	52.7	46.7	46.7	46.9	44.3	38.2	38.7
	gas	8.9	13.7	14.4	14.4	15.3	22.6	22.1
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	0.5	1.8	1.7	1.9	3.1	4.5	5.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
F	solids	8.7	7.9	6.9	6.4	10.2	5.3	5.5
	oil	40.2	35.2	35.1	33.4	28.6	23.7	22.3
	gas	13.0	13.2	14.4	13.4	13.8	17.3	16.7
	nuclear	36.4	43.2	43.3	46.0	47.1	53.9	55.0
	others	1.6	0.6	0.3	0.7	0.2	-0.2	0.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
D	solids	25.8	26.9	27.1	25.3	28.3	25.0	27.2
	oil	43.4	39.9	38.8	39.5	36.2	29.3	29.7
	gas	15.8	18.4	19.8	18.9	18.4	24.7	24.8
	nuclear	14.0	13.6	13.1	14.9	15.8	19.3	16.1
	others	1.0	1.2	1.2	1.4	1.4	1.8	2.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GR	solids	36.7	38.1	34.6	36.0	45.8	37.3	37.3
	oil	60.9	50.0	49.4	50.0	41.4	40.4	41.5
	gas	0.5	7.0	11.2	8.5	6.9	15.2	11.1
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	1.9	4.9	4.8	5.4	5.8	7.1	10.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IRE	solids	37.3	35.8	35.3	27.9	45.1	41.7	37.8
	oil	45.1	46.3	44.9	50.0	38.0	33.9	35.4
	gas	16.7	17.1	19.1	21.2	16.2	23.6	25.6
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	1.0	0.8	0.7	1.0	0.7	0.8	1.2
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IT	solids	10.4	15.9	12.7	14.0	23.6	17.1	20.6
	oil	60.5	50.6	52.1	51.0	42.1	37.3	36.2
	gas	23.1	26.7	28.4	27.7	27.7	37.5	34.1
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	5.9	6.7	6.8	7.4	6.6	8.1	9.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 6.3b Primary energy consumption by fuel shares DG XVII scenarios I, III, IV

Year Scenario Country/fuel		1990 all	2000 I	 III [%]	 IV	2010 I	 III	 IV
LUX	solids	35.3	32.4	30.8	30.3	30.8	29.4	31.0
	oil	41.2	40.5	38.5	39.4	35.9	29.4	31.0
	gas	11.8	13.5	15.4	15.2	17.9	17.6	20.7
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	11.8	13.5	15.4	15.2	15.4	23.5	17.2
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NL	solids	11.2	17.1	15.2	16.6	16.0	11.1	16.8
	oil	36.6	36.8	35.8	36.2	31.9	26.5	28.3
	gas	49.6	43.5	46.4	44.4	43.2	48.8	50.0
	nuclear	1.3	1.1	1.0	1.1	8.1	12.3	3.5
	others	1.3	1.6	1.6	1.7	0.8	1.3	1.4
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
P	solids	17.0	18.4	19.9	17.9	33.9	27.8	21.9
	oil	73.3	64.8	62.8	64.2	48.3	43.8	49.6
	gas	0.0	7.3	7.7	7.4	8.7	16.0	12.4
	nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	others	9.6	9.5	9.7	10.5	9.1	12.4	16.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ES	solids	23.3	22.8	25.4	22.8	22.3	20.7	20.2
	oil	52.3	49.9	48.6	49.5	45.0	37.2	39.7
	gas	4.6	5.9	6.8	6.3	6.8	9.5	8.1
	nuclear	16.0	17.3	15.3	16.8	21.8	28.0	24.1
	others	3.8	4.0	3.9	4.5	4.1	4.7	7.9
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
UK	solids	29.8	29.5	27.1	28.7	28.7	22.6	31.3
	oil	38.4	39.3	39.0	39.1	35.1	27.5	28.5
	gas	23.6	23.3	26.1	23.6	25.3	31.9	29.7
	nuclear	7.6	7.4	7.2	8.0	9.8	16.8	8.7
	others	0.6	0.6	0.5	0.6	1.1	1.3	1.8
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EC-12								
	solids	20.5	21.5	20.4	20.1	23.4	18.7	21.3
	oil	45.1	41.5	41.3	41.0	36.0	30.1	30.1
	gas	18.5	19.5	21.1	20.1	20.1	25.8	25.4
	nuclear	14.0	15.3	15.0	16.4	18.3	22.8	19.7
	others	2.0	2.1	2.1	2.4	2.3	2.7	3.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 6.4a Primary energy consumption by fuel shares DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/fuel					[%]					
B	coal	23	20	17	16	17	15	15	10	10
	oil	37	39	39	39	38	31	29	29	27
	gas	18	18	20	20	20	30	30	31	32
	nuclear	22	22	24	24	24	24	26	26	27
	renew	0	0	0	0	0	0	0	4	5
	Total	100	100	100	100	100	100	100	100	100
DK	coal	49	47	48	44	37	41	40	25	12
	oil	36	34	33	34	34	37	36	35	36
	gas	11	14	15	16	23	16	18	32	44
	nuclear	0	0	0	0	0	0	0	0	0
	renew	4	4	4	7	7	6	6	8	9
	Total	100	100	100	100	100	100	100	100	100
F	coal	10	9	9	9	9	9	9	7	3
	oil	37	34	32	33	33	30	30	30	29
	gas	13	13	13	13	13	19	19	18	18
	nuclear	32	36	38	37	37	35	34	37	41
	renew	7	8	8	8	8	8	8	9	9
	Total	100	100	100	100	100	100	100	100	100
D	coal	28	26	27	26	26	28	29	26	19
	oil	38	36	35	35	35	31	30	30	30
	gas	17	21	21	22	22	23	23	26	30
	nuclear	15	15	15	15	15	15	16	16	16
	renew	1	2	2	2	2	2	2	2	5
	Total	100	100	100	100	100	100	100	100	100
GR	coal	44	43	27	25	25	49	16	2	2
	oil	55	50	60	63	63	44	56	65	65
	gas	0	5	7	7	7	4	20	23	23
	nuclear	0	0	0	0	0	0	0	0	0
	renew	2	3	5	5	5	3	7	11	11
	Total	100	100	100	100	100	100	100	100	100
IRE		n.a.								
IT	coal	11	17	7	8	8	21	4	4	3
	oil	59	47	53	48	48	44	56	39	38
	gas	26	30	34	38	38	28	31	48	50
	nuclear	0	0	0	0	0	0	0	0	0
	renew	3	6	7	7	7	7	8	9	9
	Total	100	100	100	100	100	100	100	100	100
LUX		n.a.								

Table 6.4b Primary energy consumption by fuel shares DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/fuel				[%]						
NL	coal	12	13	12	12	12	12	5	5	5
	oil	36	33	31	32	32	31	30	29	29
	gas	50	51	54	53	53	55	63	65	65
	nuclear	1	1	1	1	1	0	0	0	0
	renew	1	2	2	2	2	2	2	2	2
	Total	100	100	100	100	100	100	100	100	100
P	coal	23	19	20	20	20	23	4	4	4
	oil	61	63	60	60	60	50	51	51	51
	gas	0	4	4	4	4	13	29	29	29
	nuclear	0	0	0	0	0	0	0	0	0
	renew	15	15	16	16	16	13	15	15	15
	Total	100	100	100	100	100	100	100	100	100
ES	coal	31	23	15	16	16	27	13	8	8
	oil	55	58	60	60	60	54	56	58	58
	gas	7	12	15	15	15	10	20	22	22
	nuclear	5	4	6	6	6	6	7	8	8
	renew	2	3	3	3	3	3	4	4	4
	Total	100	100	100	100	100	100	100	100	100
UK	coal	34	28	31	30	30	18	20	20	13
	oil	40	37	35	35	35	38	34	34	32
	gas	23	26	25	25	26	34	35	34	41
	nuclear	3	2	2	2	2	1	2	2	2
	renew	0	6	6	7	7	8	9	9	11
	Total	100	100	100	100	100	100	100	100	100
EC-10										
	coal	23	21	19	19	19	20	16	14	10
	oil	43	39	39	39	39	37	37	35	34
	gas	20	22	23	24	24	25	28	31	34
	nuclear	12	13	14	13	13	12	13	14	14
	renew	3	5	5	5	5	5	6	7	8
	Total	100	100	100	100	100	100	100	100	100

Table 6.5 Primary energy consumption per GDP per country
DG XVII scenarios I, III and IV

Year	1990	2000			2010		
Scen.	all	I	III	IV	I	III	IV
Country	[MJ/ECU-87]						
B	15.4	12.9	12.3	11.7	10.4	8.3	7.4
DK	9.3	8.1	7.7	7.4	6.9	5.1	4.9
F	10.9	9.9	9.3	9.1	8.6	6.5	6.2
D	11.1	8.7	8.4	7.9	6.6	5.4	5.1
GR	19.3	20.4	18.7	18.4	19.1	13.7	11.5
IRE	14.7	13.3	11.7	11.2	11.8	8.2	6.8
IT	8.7	7.4	7.0	6.8	6.3	4.6	4.6
LUX	24.2	19.8	20.1	17.7	15.8	13.2	11.8
NL	14.4	12.3	11.8	11.4	10.2	8.1	7.7
P	15.6	13.5	12.5	12.2	11.5	8.3	6.8
ES	11.7	10.2	8.9	9.3	8.7	5.9	4.8
UK	15.0	12.9	12.1	11.8	10.6	7.8	7.3
EC-12	11.7	10.0	9.4	9.1	8.2	6.3	5.8

Table 6.6 Primary energy consumption per GDP per country
DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scen.	all	REF	CON	10%	20%	REF	CON	10%	20%
Country	[MJ/ECU-87]								
B	15.1	12.6	11.5	11.5	11.5	10.0	9.3	9.2	9.1
DK	7.7	6.1	5.9	5.7	5.7	4.9	4.6	4.6	4.4
F	10.6	9.4	8.8	8.8	8.7	7.5	6.7	6.7	6.6
D	11.2	8.5	8.3	8.3	8.3	6.2	6.0	5.9	5.8
GR	19.2	19.8	15.6	15.7	15.7	16.9	12.9	11.7	11.7
IRE	n.a.								
IT	8.4	7.2	6.6	6.6	6.6	6.1	5.5	5.1	5.1
LUX	n.a.								
NL	13.0	10.9	10.2	10.2	10.2	9.1	8.1	7.7	7.7
P	17.2	13.7	12.8	12.8	12.8	11.2	9.7	9.7	9.7
ES	9.8	8.8	7.9	7.9	7.9	7.3	6.4	5.5	5.5
UK	13.5	11.8	10.6	10.7	10.7	9.6	8.6	8.5	8.3
EC-10	11.1	9.4	8.7	8.7	8.7	7.5	6.8	6.6	6.5

7. CO_2 EMISSIONS PER COUNTRY

Table 7.1 CO_2 emissions per country DG XVII scenarios I, III and IV

Year	1990		2000			2010	
Scenario	all	I	III	IV	I	III	IV
Country			[Mton]				
B	114	128	126	110	118	91	83
DK	66	72	72	65	79	59	53
F	379	397	397	335	397	287	236
D	725	725	768	654	727	589	534
GR	68	90	96	80	116	97	65
IRE	31	38	42	38	45	39	25
IT	389	435	434	390	484	365	333
LUX	13	13	13	11	12	10	9
NL	155	178	179	163	179	136	140
P	34	46	51	40	64	50	33
ES	187	225	265	203	244	213	122
UK	604	681	677	612	679	488	466
EC-12	2765	3026	3121	2702	3143	2426	2098

Table 7.2 CO_2 emission index per country DG XVII scenarios I, III and IV

Year	1990		2000			2010	
Scenario	all	I	III	IV	I	III	IV
Country			[1990=100]				
B	100	112	110	96	104	80	73
DK	100	109	109	99	120	89	80
F	100	105	105	89	105	76	62
D	100	100	106	90	100	81	74
GR	100	133	142	118	172	144	96
IRE	100	119	133	119	143	125	78
IT	100	112	112	100	124	94	86
LUX	100	100	101	89	98	81	72
NL	100	115	116	105	115	88	90
P	100	133	149	118	186	146	97
ES	100	120	142	109	130	114	65
UK	100	113	112	101	112	81	77
EC-12	100	109	113	97	114	88	76

Table 7.3 CO_2 emissions per country DG XII scenarios REF, CON, 10%, 20% and MAX

Year	1990	2000					2010				
Scen.	all	REF	CON	10%	20%	MAX	REF	CON	10%	20%	MAX
Country					[Mton]						
B	115	126	109	109	109	109	121	109	98	94	94
DK	61	62	60	57	54	54	63	60	54	48	42
F	384	402	359	366	361	361	416	370	337	299	299
D	737	731	712	704	704	705	702	677	646	574	503
GR	88	115	84	84	84	84	137	84	75	75	75
IRE	n.a.										
IT	420	482	399	399	400	400	533	399	360	356	356
LUX	n.a.										
NL	150	159	146	146	146	146	177	146	136	136	136
P	34	45	42	42	42	42	59	42	42	42	42
ES	208	239	190	190	190	190	279	190	171	171	171
UK	583	602	544	538	538	539	577	505	498	449	393
EC-10	2780	2963	2645	2635	2628	2630	3064	2582	2417	2244	2111

Table 7.4 CO_2 emission index per country DG XII scenarios REF, CON, 10%, 20% and MAX

Year	1990	2000					2010				
Scen.	all	REF	CON	10%	20%	MAX	REF	CON	10%	20%	MAX
Country					[1990=100]						
B	100	110	95	95	95	95	105	95	85	82	82
DK	100	102	98	93	89	89	103	98	89	79	69
F	100	105	93	95	94	94	108	96	88	78	78
D	100	99	97	96	96	96	95	92	88	78	68
GR	100	131	95	95	95	95	156	95	85	85	85
IRE	n.a.										
IT	100	115	95	95	95	95	127	95	86	85	85
LUX	n.a.										
NL	100	106	97	97	97	97	118	97	91	91	91
P	100	132	124	124	124	124	174	124	124	124	124
ES	100	115	91	91	91	91	134	91	82	82	82
UK	100	103	93	92	92	92	99	87	85	77	67
EC-10	100	107	95	95	95	95	110	93	87	81	76

Table 7.5a CO_2 emissions per sector per country DG XVII scenarios I, III and IV

Year		1990		2000			2010	
Scenario		all	I	III	IV	I	III	IV
Country/sector				[Mton]				
B	Power	24.8	36.9	33.9	31.8	38.5	22.5	24.8
	IndSup	35.8	35.9	35.2	32.7	29.6	27.9	26.1
	Trans	22.4	24.3	24.3	21.0	23.1	14.8	12.2
	TerDom	31.0	30.5	32.1	24.5	27.3	26.1	19.8
	Total	114.0	127.6	125.5	110.0	118.5	91.3	82.9
DK	Power	30.7	36.2	35.8	33.1	41.3	31.6	28.9
	IndSup	7.1	7.6	7.7	6.8	8.9	6.9	6.3
	Trans	13.5	14.8	14.6	13.4	16.8	9.2	8.1
	TerDom	14.4	13.0	13.8	11.9	11.7	10.9	9.2
	Total	65.7	71.6	71.9	65.2	78.7	58.6	52.5
F	Power	35.7	56.5	50.8	38.8	56.5	38.0	35.8
	IndSup	106.7	105.0	97.0	93.9	105.0	77.2	71.7
	Trans	120.3	130.9	138.7	111.2	130.9	83.0	60.0
	TerDom	115.9	104.8	111.0	91.6	104.8	89.1	68.7
	Total	378.6	397.2	397.5	335.5	397.2	287.3	236.2
D	Power	249.6	249.6	305.8	252.3	299.1	247.3	242.7
	IndSup	155.7	155.7	145.2	133.8	142.1	113.7	107.1
	Trans	147.8	147.8	145.1	130.9	136.6	84.3	70.7
	TerDom	172.3	172.3	172.1	136.7	149.2	143.8	113.3
	Total	725.4	725.4	768.2	653.7	727.0	589.1	533.8
GR	Power	32.4	43.8	45.0	35.0	63.7	50.4	34.1
	IndSup	20.2	15.1	16.5	13.4	18.6	16.5	11.2
	Trans	16.9	24.7	26.5	21.7	27.5	23.7	15.6
	TerDom	6.4	6.4	8.1	5.8	6.0	6.7	3.6
	Total	75.9	90.0	96.1	75.9	115.8	97.3	64.5
IRE	Power	10.9	14.8	16.9	14.8	21.0	19.5	13.6
	IndSup	5.9	7.1	8.3	7.1	7.6	6.7	4.3
	Trans	5.9	6.8	7.4	6.8	7.9	5.9	3.4
	TerDom	8.8	8.9	9.2	8.9	8.6	7.2	3.2
	Total	31.5	37.6	41.8	37.6	45.1	39.3	24.5
IT	Power	123.0	166.4	153.1	145.3	214.1	160.5	158.0
	IndSup	87.9	82.4	85.6	75.9	82.2	68.5	62.7
	Trans	101.6	111.4	114.9	98.6	114.8	67.0	51.3
	TerDom	76.6	75.1	80.7	70.2	72.9	69.4	61.2
	Total	389.1	435.3	434.3	390.0	484.0	365.4	333.2
LUX	Power	1.6	1.5	1.5	1.5	1.4	1.3	1.3
	IndSup	7.3	7.2	7.3	6.4	7.0	6.3	5.6
	Trans	2.4	2.6	2.4	2.2	2.5	1.6	1.4
	TerDom	1.4	1.5	1.5	1.2	1.4	1.1	0.9
	Total	12.7	12.8	12.7	11.3	12.3	10.3	9.2

Table 7.5b CO_2 emissions per sector per country DG XVII scenarios I, III and IV

Year		1990	2000			2010		
Scenario		all	I	III	IV	I	III	IV
Country/sector				[Mton]				
NL	Power	42.8	59.2	57.7	53.9	58.7	38.5	51.7
	IndSup	38.3	41.6	41.8	38.7	44.0	35.8	35.5
	Trans	32.6	34.9	35.4	31.6	33.8	21.5	18.0
	TerDom	41.4	41.8	44.2	38.9	42.1	40.4	34.9
	Total	155.1	177.5	179.1	163.1	178.6	136.2	140.1
P	Power	11.4	16.9	19.5	14.8	29.7	23.2	13.4
	IndSup	8.4	11.2	11.7	9.9	14.0	10.4	8.5
	Trans	11.4	13.9	15.6	12.3	15.4	11.7	7.9
	TerDom	3.0	3.7	4.3	3.4	4.5	4.7	3.3
	Total	34.2	45.7	51.1	40.4	63.6	50.0	33.1
ES	Power	55.8	72.8	100.7	68.0	82.3	79.6	42.6
	IndSup	49.7	52.8	51.8	47.0	52.8	44.0	30.1
	Trans	58.2	74.0	84.9	65.8	83.9	64.0	35.5
	TerDom	23.6	25.0	27.8	22.6	24.8	25.5	13.8
	Total	187.3	224.6	265.2	203.4	243.8	213.1	122.0
UK	Power	238.9	291.9	279.2	268.4	284.3	199.9	233.6
	IndSup	101.8	110.5	110.6	100.7	112.4	88.4	80.3
	Trans	140.1	157.4	159.5	140.8	166.1	93.5	73.2
	TerDom	123.3	120.9	128.0	101.9	115.9	106.5	79.1
	Total	604.1	680.7	677.3	611.8	678.7	488.3	466.2
EC-12	Power	857.6	1046.5	1099.9	957.7	1190.6	912.3	880.5
	IndSup	624.8	632.1	618.7	566.3	624.2	502.3	449.4
	Trans	673.1	743.5	769.3	656.3	759.3	480.2	357.3
	TerDom	618.1	603.9	632.8	517.6	569.2	531.4	411.0
	Total	2773.6	3026.0	3120.7	2697.9	3143.3	2426.2	2098.2

Table 7.6a CO_2 emissions per sector per country DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/sector		[Mton]								
B	Power	18	24	14	14	14	24	20	13	11
	Trans	23	25	21	21	21	25	20	20	19
	TerDom	33	32	30	30	30	28	26	23	23
	IndSup	41	45	44	44	44	44	44	42	41
	Total	115	126	109	109	109	121	110	98	94
DK	Power	32	32	31	28	25	29	28	23	17
	Trans	11	13	12	12	12	15	14	14	14
	TerDom	6	5	5	5	5	5	5	4	4
	IndSup	13	13	13	13	13	13	13	13	13
	Total	62	63	61	58	55	62	60	54	48
F	Power	50	68	55	61	57	87	77	55	21
	Trans	110	120	100	100	100	122	100	100	100
	TerDom	117	104	97	97	94	95	83	79	76
	IndSup	108	110	108	108	111	111	109	102	102
	Total	385	402	360	366	362	415	369	336	299
D	Power	262	266	273	266	265	275	267	237	174
	Trans	139	136	122	122	122	131	117	117	114
	TerDom	157	146	145	145	145	122	120	120	117
	IndSup	179	184	172	172	172	175	174	173	169
	Total	737	732	712	705	704	703	678	647	574
GR	Power	43	55	29	29	29	69	20	15	15
	Trans	17	25	22	22	22	28	25	22	22
	TerDom	8	8	7	7	7	8	7	6	6
	IndSup	20	27	26	26	26	33	32	32	32
	Total	88	115	84	84	84	138	84	75	75
IRE		n.a.								
IT	Power	116	171	102	103	103	227	110	93	92
	Trans	102	112	107	107	107	111	97	84	84
	TerDom	72	71	65	65	65	67	62	62	62
	IndSup	130	128	126	124	125	128	130	121	118
	Total	420	482	400	399	400	533	399	360	356
LUX		n.a.								

Table 7.6b CO_2 emissions per sector per country DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/sector					[Mton]					
NL	Power	45	53	48	48	48	67	53	49	49
	Trans	26	30	26	26	26	36	29	27	27
	TerDom	38	36	35	35	35	34	27	26	26
	IndSup	41	39	37	38	38	40	37	35	35
	Total	150	158	146	147	147	177	146	137	137
P	Power	12	16	14	14	14	21	8	8	8
	Trans	10	12	12	12	12	14	12	12	12
	TerDom	1	2	2	2	2	3	3	3	3
	IndSup	12	15	15	15	15	20	19	19	19
	Total	35	45	43	43	43	58	42	42	42
ES	Power	61	57	16	16	16	78	11	10	10
	Trans	61	86	86	85	85	106	95	87	87
	TerDom	24	25	25	25	25	23	22	17	17
	IndSup	63	71	63	63	63	72	63	57	57
	Total	209	239	190	189	189	279	191	171	171
UK	Power	223	221	210	207	206	179	159	156	121
	Trans	126	145	119	119	119	156	124	124	124
	TerDom	122	119	100	100	100	115	98	95	90
	IndSup	113	118	115	113	112	127	123	123	113
	Total	584	603	544	539	537	577	504	498	448
EC-10										
	Power	862	963	792	786	777	1056	753	659	518
	Trans	625	704	627	626	626	744	633	607	603
	TerDom	578	548	511	511	508	500	453	435	424
	IndSup	720	750	719	716	719	763	744	717	699
	Total	2785	2965	2649	2639	2630	3063	2583	2418	2244

Table 7.7a CO_2 emissions per sector shares per country DG XVII scenarios I, III and IV

Year		1990		2000			2010	
Scenario		all	I	III	IV	I	III	IV
Country/sector				[%]				
B	Power	21.8	28.9	27.0	28.9	32.5	24.6	29.9
	IndSup	31.4	28.1	28.0	29.7	25.0	30.6	31.5
	Trans	19.6	19.0	19.4	19.1	19.5	16.2	14.7
	TerDom	27.2	23.9	25.6	22.3	23.0	28.6	23.9
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
DK	Power	46.7	50.6	49.8	50.8	52.5	53.9	55.0
	IndSup	10.8	10.6	10.7	10.4	11.3	11.8	12.0
	Trans	20.5	20.7	20.3	20.6	21.3	15.7	15.4
	TerDom	21.9	18.2	19.2	18.3	14.9	18.6	17.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
F	Power	9.4	14.2	12.8	11.6	14.2	13.2	15.2
	IndSup	28.2	26.4	24.4	28.0	26.4	26.9	30.4
	Trans	31.8	33.0	34.9	33.1	33.0	28.9	25.4
	TerDom	30.6	26.4	27.9	27.3	26.4	31.0	29.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
D	Power	34.4	34.4	39.8	38.6	41.1	42.0	45.5
	IndSup	21.5	21.5	18.9	20.5	19.5	19.3	20.1
	Trans	20.4	20.4	18.9	20.0	18.8	14.3	13.2
	TerDom	23.8	23.8	22.4	20.9	20.5	24.4	21.2
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GR	Power	42.7	48.7	46.8	46.1	55.0	51.8	52.9
	IndSup	26.6	16.8	17.2	17.7	16.1	17.0	17.4
	Trans	22.3	27.4	27.6	28.6	23.7	24.4	24.2
	TerDom	8.4	7.1	8.4	7.6	5.2	6.9	5.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IRE	Power	34.6	39.4	40.4	39.4	46.6	49.6	55.5
	IndSup	18.7	18.9	19.9	18.9	16.9	17.0	17.6
	Trans	18.7	18.1	17.7	18.1	17.5	15.0	13.9
	TerDom	27.9	23.7	22.0	23.7	19.1	18.3	13.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IT	Power	31.6	38.2	35.3	37.3	44.2	43.9	47.4
	IndSup	22.6	18.9	19.7	19.5	17.0	18.7	18.8
	Trans	26.1	25.6	26.5	25.3	23.7	18.3	15.4
	TerDom	19.7	17.3	18.6	18.0	15.1	19.0	18.4
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
LUX	Power	12.6	11.7	11.8	13.3	11.4	12.6	14.1
	IndSup	57.5	56.3	57.5	56.6	56.9	61.2	60.9
	Trans	18.9	20.3	18.9	19.5	20.3	15.5	15.2
	TerDom	11.0	11.7	11.8	10.6	11.4	10.7	9.8
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7.7b CO_2 emissions per sector shares per country DG XVII scenarios I, III and IV

Year		1990	2000			2010		
Scenario		all	I	III	IV	I	III	IV
Country/sector				[%]				
NL	Power	27.6	33.4	32.2	33.0	32.9	28.3	36.9
	IndSup	24.7	23.4	23.3	23.7	24.6	26.3	25.3
	Trans	21.0	19.7	19.8	19.4	18.9	15.8	12.8
	TerDom	26.7	23.5	24.7	23.9	23.6	29.7	24.9
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
P	Power	33.3	37.0	38.2	36.6	46.7	46.4	40.5
	IndSup	24.6	24.5	22.9	24.5	22.0	20.8	25.7
	Trans	33.3	30.4	30.5	30.4	24.2	23.4	23.9
	TerDom	8.8	8.1	8.4	8.4	7.1	9.4	10.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ES	Power	29.8	32.4	38.0	33.4	33.8	37.4	34.9
	IndSup	26.5	23.5	19.5	23.1	21.7	20.6	24.7
	Trans	31.1	32.9	32.0	32.4	34.4	30.0	29.1
	TerDom	12.6	11.1	10.5	11.1	10.2	12.0	11.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
UK	Power	39.5	42.9	41.2	43.9	41.9	40.9	50.1
	IndSup	16.9	16.2	16.3	16.5	16.6	18.1	17.2
	Trans	23.2	23.1	23.5	23.0	24.5	19.1	15.7
	TerDom	20.4	17.8	18.9	16.7	17.1	21.8	17.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EC-12	Power	30.9	34.6	35.2	35.5	37.9	37.6	42.0
	IndSup	22.5	20.9	19.8	21.0	19.9	20.7	21.4
	Trans	24.3	24.6	24.7	24.3	24.2	19.8	17.0
	TerDom	22.3	20.0	20.3	19.2	18.1	21.9	19.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7.8a CO_2 emissions per sector shares per country DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/sector					[%]					
B	Power	15.7	19.0	12.8	12.8	12.8	19.8	18.2	13.3	11.7
	Trans	20.0	19.8	19.3	19.3	19.3	20.7	18.2	20.4	20.2
	TerDom	28.7	25.4	27.5	27.5	27.5	23.1	23.6	23.5	24.5
	IndSup	35.7	35.7	40.4	40.4	40.4	36.4	40.0	42.9	43.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
DK	Power	51.6	50.8	50.8	48.3	45.5	46.8	46.7	42.6	35.4
	Trans	17.7	20.6	19.7	20.7	21.8	24.2	23.3	25.9	29.2
	TerDom	9.7	7.9	8.2	8.6	9.1	8.1	8.3	7.4	8.3
	IndSup	21.0	20.6	21.3	22.4	23.6	21.0	21.7	24.1	27.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
F	Power	13.0	16.9	15.3	16.7	15.7	21.0	20.9	16.4	7.0
	Trans	28.6	29.9	27.8	27.3	27.6	29.4	27.1	29.8	33.4
	TerDom	30.4	25.9	26.9	26.5	26.0	22.9	22.5	23.5	25.4
	IndSup	28.1	27.4	30.0	29.5	30.7	26.7	29.5	30.4	34.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
D	Power	35.5	36.3	38.3	37.7	37.6	39.1	39.4	36.6	30.3
	Trans	18.9	18.6	17.1	17.3	17.3	18.6	17.3	18.1	19.9
	TerDom	21.3	19.9	20.4	20.6	20.6	17.4	17.7	18.5	20.4
	IndSup	24.3	25.1	24.2	24.4	24.4	24.9	25.7	26.7	29.4
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
GR	Power	48.9	47.8	34.5	34.5	34.5	50.0	23.8	20.0	20.0
	Trans	19.3	21.7	26.2	26.2	26.2	20.3	29.8	29.3	29.3
	TerDom	9.1	7.0	8.3	8.3	8.3	5.8	8.3	8.0	8.0
	IndSup	22.7	23.5	31.0	31.0	31.0	23.9	38.1	42.7	42.7
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
IRE		n.a.								
IT	Power	27.6	35.5	25.5	25.8	25.8	42.6	27.6	25.8	25.8
	Trans	24.3	23.2	26.8	26.8	26.8	20.8	24.3	23.3	23.6
	TerDom	17.1	14.7	16.3	16.3	16.3	12.6	15.5	17.2	17.4
	IndSup	31.0	26.6	31.5	31.1	31.3	24.0	32.6	33.6	33.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
LUX		n.a.								

Table 7.8b CO_2 emissions per sector shares per country DG XII scenarios REF, CON, 10% and 20%

Year		1990	2000				2010			
Scenario		all	REF	CON	10%	20%	REF	CON	10%	20%
Country/sector					[%]					
NL	Power	30.0	33.5	32.9	32.7	32.7	37.9	36.3	35.8	35.8
	Trans	17.3	19.0	17.8	17.7	17.7	20.3	19.9	19.7	19.7
	TerDom	25.3	22.8	24.0	23.8	23.8	19.2	18.5	19.0	19.0
	IndSup	27.3	24.7	25.3	25.9	25.9	22.6	25.3	25.5	25.5
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
P	Power	34.3	35.6	32.6	32.6	32.6	36.2	19.0	19.0	19.0
	Trans	28.6	26.7	27.9	27.9	27.9	24.1	28.6	28.6	28.6
	TerDom	2.9	4.4	4.7	4.7	4.7	5.2	7.1	7.1	7.1
	IndSup	34.3	33.3	34.9	34.9	34.9	34.5	45.2	45.2	45.2
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
ES	Power	29.2	23.8	8.4	8.5	8.5	28.0	5.8	5.8	5.8
	Trans	29.2	36.0	45.3	45.0	45.0	38.0	49.7	50.9	50.9
	TerDom	11.5	10.5	13.2	13.2	13.2	8.2	11.5	9.9	9.9
	IndSup	30.1	29.7	33.2	33.3	33.3	25.8	33.0	33.3	33.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
UK	Power	38.2	36.7	38.6	38.4	38.4	31.0	31.5	31.3	27.0
	Trans	21.6	24.0	21.9	22.1	22.2	27.0	24.6	24.9	27.7
	TerDom	20.9	19.7	18.4	18.6	18.6	19.9	19.4	19.1	20.1
	IndSup	19.3	19.6	21.1	21.0	20.9	22.0	24.4	24.7	25.2
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EC-10										
	Power	31.0	32.5	29.9	29.8	29.5	34.5	29.2	27.3	23.1
	Trans	22.4	23.7	23.7	23.7	23.8	24.3	24.5	25.1	26.9
	TerDom	20.8	18.5	19.3	19.4	19.3	16.3	17.5	18.0	18.9
	IndSup	25.9	25.3	27.1	27.1	27.3	24.9	28.8	29.7	31.1
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7.9 CO_2 emission per GDP per country DG XVII scenarios I, III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country			[kg/ECU-87]				
B	0.85	0.72	0.68	0.62	0.51	0.37	0.36
DK	0.72	0.61	0.58	0.55	0.51	0.36	0.34
F	0.45	0.37	0.34	0.31	0.28	0.19	0.17
D	0.67	0.51	0.51	0.46	0.39	0.30	0.29
GR	1.51	1.53	1.38	1.36	1.47	0.99	0.82
IRE	1.08	0.97	0.86	0.97	0.89	0.60	0.49
IT	0.53	0.46	0.42	0.41	0.40	0.27	0.27
LUX	2.15	1.62	1.57	1.44	1.19	0.94	0.88
NL	0.76	0.69	0.65	0.63	0.52	0.37	0.41
P	0.95	0.82	0.78	0.73	0.76	0.51	0.39
ES	0.65	0.57	0.52	0.51	0.45	0.28	0.23
UK	0.96	0.85	0.77	0.76	0.66	0.42	0.46
EC-12	0.67	0.56	0.53	0.50	0.45	0.31	0.30

Table 7.10 CO_2 emission per GDP per country DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scenario	all	REF	CON	10%	20%	REF	CON	10%	20%
Country				[kg/ECU-87]					
B	0.859	0.714	0.618	0.618	0.618	0.520	0.469	0.421	0.404
DK	0.666	0.526	0.509	0.484	0.458	0.406	0.386	0.348	0.309
F	0.457	0.372	0.332	0.339	0.334	0.298	0.265	0.241	0.214
D	0.684	0.517	0.503	0.498	0.498	0.377	0.363	0.347	0.308
GR	1.963	1.956	1.429	1.429	1.429	1.734	1.063	0.949	0.949
IRE	n.a.								
IT	0.576	0.504	0.417	0.417	0.418	0.435	0.326	0.294	0.291
LUX	n.a.								
NL	0.740	0.615	0.565	0.565	0.565	0.520	0.429	0.399	0.399
P	0.940	0.809	0.755	0.755	0.755	0.703	0.500	0.500	0.500
ES	0.726	0.603	0.480	0.480	0.480	0.519	0.353	0.318	0.318
UK	0.927	0.747	0.675	0.668	0.668	0.565	0.495	0.488	0.440
EC-10	0.683	0.557	0.497	0.495	0.494	0.442	0.372	0.348	0.324

Table 7.11 CO_2 emission per GDP index per country DG XVII scenarios I, III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country		[EC-12=100]					
B	126	128	127	124	113	120	119
DK	107	108	109	110	113	117	113
F	67	65	64	62	63	60	56
D	100	91	95	92	87	96	95
GR	224	271	259	270	326	320	272
IRE	161	172	161	192	198	196	162
IT	79	81	79	81	88	87	91
LUX	319	287	295	285	266	306	293
NL	114	122	123	125	117	121	137
P	141	146	146	144	169	165	132
ES	97	101	97	102	101	91	76
UK	143	150	146	151	148	137	152
EC-12	100	100	100	100	100	100	100

Table 7.12 CO_2 emission per GDP index per country DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scen.	all	REF	CON	10%	20%	REF	CON	10%	20%
Country				[EC-10=100]					
B	126	128	124	125	125	118	126	121	125
DK	98	94	102	98	93	92	104	100	96
F	67	67	67	68	68	67	71	69	66
D	100	93	101	101	101	85	98	99	95
GR	288	351	287	288	289	392	286	272	293
IRE	n.a.								
IT	84	91	84	84	85	99	88	84	90
LUX	n.a.								
NL	108	111	114	114	114	118	115	115	123
P	138	145	152	152	153	159	134	144	155
ES	106	108	96	97	97	117	95	91	98
UK	136	134	136	135	135	128	133	140	136
EC-10	100	100	100	100	100	100	100	100	100

Table 7.13 CO_2 emission per capita per country DG XVII scenarios I, III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country	[ton/capita]						
B	11.7	13.3	13.0	11.4	12.6	9.7	8.8
DK	12.8	13.9	13.9	12.6	15.6	11.6	10.4
F	6.7	6.9	6.9	5.8	6.8	4.9	4.0
D	11.7	11.9	12.6	10.7	12.5	10.1	9.2
GR	6.7	8.7	9.3	7.7	10.9	9.1	6.1
IRE	8.9	10.2	11.4	10.2	12.0	10.4	6.6
IT	6.8	7.5	7.5	6.7	8.3	6.3	5.7
LUX	34.1	34.2	34.5	30.4	33.2	27.6	24.5
NL	10.4	11.3	11.4	10.4	11.1	8.5	8.7
P	3.3	4.3	4.8	3.8	5.7	4.5	3.0
ES	4.8	5.5	6.5	5.0	5.9	5.2	3.0
UK	10.6	11.8	11.7	10.6	11.7	8.4	8.0
EC-12	8.5	9.1	9.4	8.2	9.5	7.3	6.3

Table 7.14 CO_2 emission per capita per country DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scenario	all	REF	CON	10%	20%	REF	CON	10%	20%
Country	[ton/capita]								
B	11.82	13.10	11.33	11.33	11.33	12.91	11.63	10.46	10.03
DK	11.87	12.02	11.63	11.05	10.47	12.45	11.86	10.67	9.49
F	6.84	6.94	6.20	6.32	6.23	7.07	6.29	5.73	5.09
D	11.89	11.97	11.66	11.53	11.53	12.04	11.61	11.08	9.85
GR	8.73	11.11	8.12	8.12	8.12	12.86	7.89	7.04	7.04
IRE	n.a.								
IT	7.33	8.32	6.88	6.88	6.90	9.14	6.84	6.17	6.11
LUX	n.a.								
NL	10.05	10.13	9.30	9.30	9.30	10.99	9.07	8.45	8.45
P	3.29	4.26	3.97	3.97	3.97	5.26	3.74	3.74	3.74
ES	5.29	5.90	4.69	4.69	4.69	6.77	4.61	4.15	4.15
UK	10.25	10.40	9.40	9.29	9.29	9.91	8.68	8.56	7.71
EC-10	8.53	8.96	8.00	7.97	7.95	9.25	7.79	7.30	6.77

Table 7.15 CO_2 emission per TJ primary energy consumption per country DG XVII scenarios I, III and IV

Year	1990	2000			2010		
Scenario	all	I	III	IV	I	III	IV
Country		[ton/TJ TPER]					
B	55.3	56.1	55.1	53.3	48.9	44.8	48.4
DK	77.3	75.4	75.0	74.4	73.7	70.4	69.4
F	41.4	37.0	36.6	34.1	33.2	28.6	27.2
D	60.3	59.3	60.7	58.6	59.1	54.3	56.5
GR	77.9	75.1	73.7	74.0	76.9	72.2	71.0
IRE	73.5	72.9	73.4	86.2	75.8	73.6	71.6
IT	61.4	61.4	60.1	59.9	63.1	58.2	59.2
LUX	88.6	81.7	78.1	81.3	75.3	71.8	74.7
NL	53.2	56.1	55.3	55.3	51.6	45.9	53.2
P	60.6	61.0	62.3	59.6	66.1	61.6	57.7
ES	56.0	55.6	58.2	55.1	52.3	47.5	47.1
UK	64.1	65.3	64.1	64.1	62.5	54.2	62.4
EC-12	57.5	56.5	56.5	55.2	54.5	49.1	51.3

Table 7.16 CO_2 emission per TJ primary energy consumption per country DG XII scenarios REF, CON, 10% and 20%

Year	1990	2000				2010			
Scenario	all	REF	CON	10%	20%	REF	CON	10%	20%
Country				[ton/TJ TPER]					
B	56.8	56.8	53.5	53.5	53.6	52.2	50.6	45.9	44.4
DK	87.0	86.5	86.8	84.7	80.5	83.6	83.2	75.9	69.9
F	43.2	39.5	37.6	38.5	38.3	39.4	39.3	36.2	32.2
D	61.2	60.5	60.4	59.8	59.9	60.7	60.4	58.7	53.4
GR	102.4	98.7	91.5	90.7	90.7	102.5	82.1	81.0	81.0
IRE	n.a.								
IT	68.4	69.8	62.8	63.2	63.4	71.5	59.7	57.2	57.0
LUX	n.a.								
NL	56.8	56.5	55.2	55.3	55.3	57.2	53.2	52.2	52.2
P	54.8	59.1	59.2	59.2	59.2	62.6	51.7	51.7	51.7
ES	73.9	68.5	60.7	60.6	60.6	70.9	55.5	57.7	57.7
UK	68.7	63.6	63.7	62.7	62.6	59.0	57.7	57.5	53.0
EC-10	61.5	59.5	57.1	56.9	56.9	59.2	55.0	53.2	50.0

Table 7.17 CO_2 reduction costs [ECU-85] v. reduction in 2010 per country DG XII scenarios MURE, CON and 10%

Scenario	MURE (v. REF)		CON (v. MURE)		10% (v. MURE)	
Country	Cost	Reduction	Cost /tonne	Reduction	Cost /tonne	Reduction
B	-83	11	15	1	20	12
DK	-65	3	0	1	6	7
F	-81	45	0	0	19	33
D	-89	25	0	0	15	31
GR	-85	10	23	43	36	52
IRE	n.a.					
IT	-95	44	22	90	75	129
LUX	n.a.					
NL	-88	12	27	18	132	29
P	n.a.					
ES	-98	14	18	75	137	94
UK	-70	72	0	0	12	7
EC-9	-754	236	21	228	78	393

Table 7.18 CO_2 reduction costs expressed as a percentage of GDP-1990 per country DG XII scenarios CON and 10%

Scenario	CON		10%	
	GDP-%	Red-%	GDP-%	Red-%
Country	(reduction compared to 1990)			
B	0.07	5.20	0.17	14.80
DK	0.00	1.60	0.03	11.50
F	0.00	3.70	0.02	12.20
D	0.00	8.10	0.03	12.40
GR	1.51	4.60	2.56	14.80
IRE	n.a.			
IT	0.16	5.00	0.71	14.30
LUX	n.a.			
NL	0.12	2.00	0.80	8.00
P	n.a.			
ES	0.27	8.70	2.81	17.80
UK	0.00	13.40	0.02	14.60

8. MISCELLANEOUS

Table 8.1 Comparison of CO_2 emission factors [kg/GJ]

Fuel	DG XVII	ECN (NL)	DG XII ETSU (UK)	NTUA (GR)
steamcoal	98.0	94	88.4	107.5
coke	94.2	107		
lignite	99.1			123.0
solid fuels	98.0			
refinery gas	40.0	56		
LPG	63.6	66		
gasoline	73.4	73		
kerosine	73.8	74		
naphta	73.8	74		
diesel	74.0	74	69.7	
residual fuel oil	72.0	78	73.3	
petroleum coke	96.3	96		
oil	72.0			
natural gas	50.0	56	50.6	
coke oven gas	30.0	47		
blast furnace gas	240.0			

Table 8.2 Overview of main assumptions with regard to the development of the energy systems in EC countries used in the DG XII study

	upper limit for new nuclear capacities [1995-2010]	upper limit for natural gas imports (2010)	lower limit for domestic coal or lignite production (2010)	cogeneration	renewables	fossil fuel switching
Belgium	3900 MW (1)	no limit	-	yes but maximum penetration	yes but no waste technologies	limited in the demand sectors
Denmark	0 MW	no limit	-	yes but maximum penetration	yes	limited in the demand sectors
France	no limit (2)	no limit	-	yes	yes but pessimistic for wind and solar	limited in the demand sectors
Germany	0 MW (1)	no limit	lignite: no lower limit coal: 1612 PJ	yes but upper limit on district heat production	yes	limited in the demand sectors
Greece	0 MW (1)	210 PJ	solid fuels: 20 PJ	yes but maximum penetration	yes	limited in the demand sectors
Italy	0 MW (1)	no upper limit	-	yes but maximum penetration	yes but solar & wind limited to 20% of elec. prod.	limited in the demand sectors
The Netherlands	0 MW (1)	no limit	-	yes but maximum penetration	yes	limited in power and demand sectors
Portugal	0 MW	no limit	-	no	yes	free
Spain	3950 MW	500 PJ	coal: 250 PJ lignite: 109 PJ	yes	yes	free
United Kingdom	7175 MW	no limit	880 PJ	yes but maximum penetration	yes but no thermal solar	limited in the demand sectors

(1) sensitivity analysis performed without (Belgium) or with nuclear allowed (other countries)
(2) the share of electricity produced from nuclear limited to 75% of electricity production

COHERENCE S.C.