Draft
Annex I

CALL FOR TENDER EEA/EAS/001/02

STANDARD FRAMEWORK CONTRACT (hereinafter “contract”)
[Goods/Service supply]
CONTRACT REF.

The European Environment Agency, hereinafter called “the Agency”,
whose official address and contact person are:

- Kongens Nytorv 6, DK-1050 Copenhagen K, Denmark,
- [*Name of the contact person*] ....

which, for the purposes of the signature of this contract is represented by
Mr. Domingo JIMÉNÉZ-BELTRÁN, Executive Director of the Agency

on the one part

and ….,
hereinafter referred to as the “Contractor”,
whose official address is: …..,
whose bank account No *is*: …..,
with …… [Name of establishment, agency branch, city, bank identification code]
and whose VAT registration number *is*: ……,
(Registration number under a specific social security system) [optional]

represented by ……

on the other part

have agreed as follows :

ARTICLE 1 – SUBJECT

1. In the framework of this contract, the contractor hereby undertakes, subject to the conditions laid down in this contract and the annexes thereto, which form an integral part thereof, and in accordance with the *specific agreements/order forms concluded/placed* for its execution, to perform the following tasks:

- ***.

The detailed program of work is set out in Annex ****

<u>ARTICLE 2 - DURATION OF CONTRACT</u>

1. This contract is concluded for an initial period of **** months with effect from the date on which it is signed by the contracting parties.

2. *It may be renewed twice, tacitly, each time for a period of one year. It may be terminated by either of the parties by sending the other party a registered letter no later than **** months before the expiry of the contract period/It may be renewed annually by agreement between the parties in the form of an exchange of letters.*

3. The total duration of the contract cannot exceed five consecutive years.

4. Once the contract has come to expiry:

   a. No new *specific agreement/order* may be *concluded/placed*,

   b. The provisions of the contract shall continue to apply to any *specific agreement/order* still in force until the date of its expiry.

5. *Specific agreements/orders* shall enter into force no earlier than the date on which they are signed. Their validity shall not extend beyond one year from the date of expiry of the contract.

<u>ARTICLE 3 – FINANCIAL PROVISIONS</u>

1. Prices shall be expressed in euro (€) and shall not be affected by any changes in the rate of the euro against other currencies. Prices shall be fixed and not subject to revision for the first year of performance of the contract. Prices shall not vary according to the amount of services requested.

2. The Contractor may not assign financial claims on the Agency.

3. All invoices or other requests for payment shall indicate the contract number. They shall be drawn up in triplicate and sent to the Agency at the address and for the attention of the contact person as referred above.

4. Payments shall be made into the *contractor's* bank account whose references are mentioned above.

<u>ARTICLE 4 - REVISION OF PRICES</u>

1. From the beginning of the second year of the contract, prices may be revised upwards or downwards each year on the anniversary of the date on which it was signed, where such revision is requested by one of the parties by registered letter no later than three months before that date.

2. The adjustment shall be determined by the trend in consumer prices in the country of origin of the services offered, as expressed in euro and published for the first time by the Office for Official Publications of the European Communities, in the Eurostat

monthly bulletin (Theme 2 – Economy and Finance, collection Detailed Tables, *Money, Finance and the Euro: Statistics*).

For the purposes of this contract, revision shall be based on the consumer price index and calculated in accordance with the following formula:

$$P = Po\ (0{,}2 + \frac{0.8\ I}{Io})$$

Where

P is the new price;

Po is the price in the original tender;

Io is the harmonized consumer price index [for the Member State where the contractor's registered office is located] for the month in which the validity of the tender expires, expressed in euro and published for the first time by the Office for Official Publications of the European Communities, in the Eurostat monthly bulletin (Theme 2 – Economy and Finance, collection Detailed Tables, *Money, Finance and the Euro: Statistics*);

I is the index for the month corresponding to the date of receipt of the letter requesting a revision of prices.

3. Index Euro 15 shall be used when the contractor's registered office is located in a Member State not participating in the Euro.

Index Euro 11 shall be used when the contractor's registered office is located in a Member State participating in the Euro.

ARTICLE 5 – IMPLEMENTATION OF THE CONTRACT

1. Whenever the Agency wishes tasks to be performed in accordance with article 1, it shall *conclude a specific agreement with /send an order form to* the contractor specifying the terms and conditions, including at least its duration of validity, the period of performance, the price, timetables for delivery, and place of delivery.

2. Within **** working days of the *specific agreement/order* being notified by the Agency, the contractor shall return it, duly signed and dated, thereby acknowledging receipt of this *specific agreement/order* and acceptance of the terms and conditions.

3. The *specific agreement/order* takes effect as from the date it has been signed by both parties.

ARTICLE 6 - GENERAL CONDITIONS

1. The Contractor hereby declares that he is familiar with and accepts the "General terms and conditions applicable to contracts awarded by the European Environment Agency", which shall apply in respect of all matters not specifically covered by this contract or the specifications (Annex II), and govern as well *specific agreements concluded/orders placed* under it.

2. Signature of the contract does not place the Agency under any obligation whatsoever to *conclude specific agreements/place orders*. It does not confer on the contractor any exclusive right to perform the tasks referred to above.

3. Acceptance of this contract and conclusion of *specific agreements/orders resulting from it* imply that the Contractor waives all other terms of business.

ARTICLE 7 – OBLIGATIONS OF THE CONTRACTOR

Further to obligations specified in the "General terms and conditions applicable to contracts awarded by the European Environment Agency", the Contractor hereby declares that::

1. He is insured against any claims resulting from damages caused to himself, his employees, or a third party which may arise in relation to the execution of the present contract;

2. He shall maintain complete independence in relation to all individuals, organizations or government bodies;

3. He shall respect all laws and regulations in force in the Member State(s) where the present contract will be executed.

ARTICLE 8- TERMINATION

1. The Agency may terminate this contract and any *specific agreement concluded /order placed* under it, in whole or in part, with immediate effect and without being required to pay compensation in the event of a judicial settlement order, bankruptcy or liquidation.

2. If the contractor fails to perform his obligations under a *specific agreement concluded /an order placed* pursuant to the standard form general contract, the Agency may suspend payment.

3. In the event of such failure, the Agency may, after notice has been given and if no action has been taken by the contractor within fifteen working days, terminate the contract and any *specific agreement concluded /order placed* under it, by registered letter with acknowledgment of receipt.

ARTICLE 9 – ADMINISTRATIVE PROVISIONS

All communications, reports, and complaints concerning the performance of this contract or arising from a *specific agreement/an order* shall be in written form and indicate its number as well as its subject and shall be sent to the address of the interested contracting party and for the attention of the contact person as mentioned above.

ARTICLE 10 – TAXATION

1. The Agency is exempt from duties, levies and taxes, including value added tax, pursuant to Article 3 and 4 of the Protocol on the Privileges and Immunities of the European Communities and the Headquarters Agreement between the Agency and the Government of Denmark of 17 August 1995. The contractor shall accordingly

complete the necessary formalities with the relevant authorities to ensure that the goods and services required for the performance of the contract are exempt from tax and customs charges, including VAT.

2. The VAT number of the Agency is: DK 18 13 98 39.

ARTICLE 11 - ANNEXES

The following annexes are an integral part of this contract:

Annex I The tender

Annex II Specifications

Annex III General terms and conditions applicable to contracts awarded by the European Environment Agency.

In case of conflict between the provisions of the contract and those of the *specific agreements/orders*, the provisions of the latter shall take precedence.

In case of conflict between the provisions of the above-mentioned annexes and either of these documents, the latter shall take precedence.

Done in triplicate in English
In Copenhagen on ……

For the contractor:

For the Agency:

D. JIMÉNÉZ-BELTRÁN
Executive Director

Draft

ANNEX II

GENERAL TERMS & CONDITIONS APPLICABLE TO CONTRACTS AWARDED BY THE EUROPEAN ENVIRONMENT AGENCY

Article 1 - Performance of the contract

(1) The contract shall be performed in such a way as to exclude the possibility of the Contractor or his staff supplying services under conditions identical to those governing the supply of services by a member of the European Environment Agency's staff. The Contractor and his staff may not be members of the European Environment Agency's staff.

(2) If the Contractor is a natural person, he shall be required to provide proof of his status either as a self-employed person or an employee for the duration of the contract. To this end, he shall provide the Agency with information about his occupation.

Article 2 - Secondary obligations of the Contractors

(1) The contractor shall perform the contract according to the highest professional standards and in accordance with the principles of sound financial management. In performance of the contract, the Contractor is required, depending on the circumstances, to use only his own highly qualified, professional staff.

(2) The Contractor to the European Environment Agency undertakes to provide the Agency with any information it may request for the management of the contract.

(3) In the event of termination of the contract for one of the reasons referred to in Article 7 of these terms and conditions, the Contractor to the European Environment Agency shall undertake to send the Agency all information and documents in his possession on the tasks assigned to him.

Article 3 - Confidentiality

(1) The Contractor undertakes not to make use of and not to divulge to third parties any facts, information, knowledge, documents or other matters communicated to him or brought to his attention during the performance of the contract or any matter arising therefrom. He shall continue to be bound by this undertaking after the expiry of the contract.

(3) If the Contractor uses his own staff in the performance of the contract, he shall obtain from each staff member a written undertaking that they will respect the confidentiality of any information brought to their attention during the performance of the work and that they will not divulge to third parties or use for their own benefit or that of any third party any document or information not available publicly, even after completion of their assignment. A copy of the undertaking shall be sent to the European Environment Agency.

(4) If the Contractor's staff is working in the Agency buildings, the contractor shall replace, immediately and without compensation, at the Agency's request any person considered undesirable by the latter.

Article 4 - Permits and licences

(1) The Contractor shall be solely responsible for taking the necessary steps to obtain any permit or licence required for the performance of the contract under the laws and regulations in force at the place where the tasks assigned to the Contractor are to be performed.

Article 5 - Spread of risk

(1) The Contractor shall not be entitled to payment if he is prevented by force majeure from performing the tasks assigned to him. Part performance only of any such task shall result in part payment. Provided it is specified in the contract, the above provisions shall not affect the Contractor's entitlement to reimbursement of travel and subsistence expenses and of costs for the shipment of equipment incurred in the performance of the contract.

Article 6 - Liability of the contracting parties

(1) The European Environment Agency may not under any circumstances or for any reason whatsoever be held liable for damage sustained by the Contractor himself or by his staff during the performance of the contract. The European Environment Agency shall not accept any claim for compensation or repairs in respect of such damage.

(2) Except in case of force majeure, the Contractor shall be required to indemnify the European Environment Agency for any damage they may sustain during the performance, poor or otherwise, of the contract.

Article 7 - Termination of contract

(1) Each contracting party may, of his own volition and without being required to pay compensation, terminate the contract by serving formal notice two months in advance. If the contract is terminated by the European Environment Agency, the Contractor shall be entitled to payment for the part performance of the contract only.

(2) In the event of a serious failure by the Contractor to the European Environment Agency, duly noted by the European Environment Agency, to fulfil his obligations under the contract, the contract may be terminated at any time by registered letter without formal notice or payment of any compensation whatsoever by the European Environment Agency. This provision shall not affect the application of Article 6(2) of these General Terms & Conditions.

(3) In the event of non performance of the contract by the contractor, except for reasonable and justifiable technical or economic reasons, of any of his obligations, and after having given notice by registered mail requiring performance of the obligations concerned, the Agency may terminate the contract if the contractor is still in breach of his obligations one month after receiving formal notice

(4) In the event of circumstances which are liable to prejudice or delay the performance of the contract, the contractor shall forthwith inform the Agency, with the relevant details. The parties shall agree together on the measures to be taken.If no agreement can be reached, the Agency may terminate the contract without recourse to any legal proceedings, where no action is taken by the contractor within one month of receiving formal notice by registered mail.

(5) The European Environment Agency may terminate the contract without notice if the Contractor is unable, through his own fault, to obtain any permit or licence required for the performance of the contract as referred in article 4 above.

(6) Without prejudice to the termination referred to in paragraphs 3 and 4 above, the Agency may require reimbursement of all or of part of the amounts paid, having regard to the nature and the scale of the work carried out, before the date of termination of the contract.

Article 8 - Assignment and services to third parties

(1) The Contractor to the European Environment Agency shall not, without the prior and written approval of the European Environment Agency, assign the rights and obligations arising out of the contract in whole or in part or sub-contract any part of the contract to third parties.

(2) Even where the European Environment Agency authorises the Contractor to sub-contract part or all of the work to third parties, he shall nonetheless remain bound by his obligations to the European Environment Agency under the contract.

(3) Save where the European Environment Agency expressly authorises an exception, the Contractor shall be required to include in any sub-contracts for all or part of the work such provisions as enable the European Environment Agency to enjoy the same rights and guarantees in relation to the sub-contractors as it enjoys in relation to the Contractor himself.

Article 9 - Ownership

(1) Any result or patent obtained by the Contractor in the performance of the contract shall belong to the European Environment Agency which may use them as it sees fit.

(2) Copyright and any other rights of ownership in respect of manuscripts or parts thereof shall belong exclusively to the European Environment Agency except where copyright or other property rights already exist.

(3) On the date of acceptance of the manuscripts and subject solely to the exception referred to in paragraph (2) above, all rights in respect of manuscripts, including amongst others the right to use, print, publish and sell all or part thereof in any manner and in any language whatsoever, shall be acquired by the European Environment Agency which may transfer all or part of such rights to third parties on its own terms.

(4) The Contractor shall specify any parts of manuscripts, including illustrations, maps and graphs, in which copyright or any other right of ownership already exists and hereby affirms that he has obtained permission to use such parts from the titular holder(s) of such rights or from his or their legal representatives. Any cost for which the Contractor may become liable for such permission shall be paid by him. Save as otherwise provided for in paragraph (2), the Contractor hereby affirms that he is entitled to transfer the copyright or other rights of ownership in respect of the subject matter of the manuscript.

(5) The European Environment Agency shall not be required to publish manuscripts or documents supplied in the performance of the contract. If it is decided not to publish the manuscripts or documents supplied, the Contractor shall not have them published elsewhere without the written approval of the European Environment Agency.

Article 10 – Payments

(1) Payments shall be made in euro (€).

(2) At the request of the Contractor, the Agency may pay him an advance equal to 30% of the amount due on completion of the contract. In addition to the requirement of the second paragraph of Article 45 of the Financial Regulation applicable to the Budget of the European Environment Agency, payment of the advance may be made conditional upon the furnishing by the Contractor of proof that he has lodged a deposit equal to the amount of the advance. The advance shall be deducted from subsequent payments in such a manner that it is fully recovered on exhaustion of the funds provided for such payments.

(3) In the event of termination of the contract under Article 7 of these General Terms & Conditions, no payment shall be due except for services actually rendered up to the date of termination. In such an event, the amount due shall be calculated after deducting any payments already made. If the payments made prior to termination exceed the sum finally due, the additional amount shall be repaid by the Contractor to the European Environment Agency within 60 days of receipt of a request for repayment. If payment is not made within this period, the sum owed by the Contractor shall start to bear interest at the euro rate applied by the European Central Bank on the last day of the period allowed for repayment, as published in the C series of the Official Journal.

(4) Where appropriate, invoices shall detail the dates and the number of hours or days of work spent by the contractor to perform the tasks under the contract.

(5) Reimbursable travel and subsistence expenses shall be paid, where appropriate, on production of supporting documents including receipts, used tickets and boarding pass.

(6) Payments shall be made within 60 days of receipt of the invoice by the Agency and shall be deemed to have been made on the date on which the Agency's account is debited.

(7) Upon expiry of the time-limits set above, the contractor may, within two months of receiving the late payment, claim interest, applied by the European Central Bank to its operations in Euro, plus one and a half percentage points.

(8) However, the Agency is not bound to comply with the 60 day payment period if the invoice has not been presented or sent to the correct address as required by the contract or if the contractor has not fulfilled his obligations so that the debt cannot be confirmed or quantified and is not due. The Agency shall inform without delay the contractor that he has failed to meet these requirements. A new 60 day payment period as stated above shall start to run again upon fulfillment by the contractor of his obligations.

(9) The Contractor, whose registered office or place of abode shall be situated within the territory of one of the Member States of the European Environment Agency, shall be required to name a bank within the territory of his country of domicile for the payment of the sums due to him under the contract.

<u>Article 11 – Audits and controls</u>

(1) The Agency and such persons who are authorised for this purpose by the Executive Director shall be entitled to carry out audits and controls, have access to all books, papers, records and files kept by the contractor relating to expenditure incurred in performing the contract during the contractual period and for a period of five years after such period.

<u>Article 12 - Provisions relating to taxation</u>

(1) The amount of VAT shall not be included in the sums due to the contractor except when the tasks envisaged with the present contract are not directly exonerated from VAT under the terms of the tax laws applicable to the contractor.

(2) The Contractor shall be responsible for complying with the national tax laws applicable to him in respect of revenue received under the contract with the European Environment Agency.

(3) The contractor shall, at the request of the European Environment Agency, make available to the latter all vouchers which it might require in order, where necessary, to apply for reimbursement by the fiscal authorities of levies and taxes which have been paid in execution of this contract, pursuant to Articles 3 and 4 of the Protocol on the Privileges and Immunities of the European Communities.

<u>Article 13 – Applicable Law and Jurisdiction</u>

(1) This contract shall be subject to Danish law.

(2) Any dispute between the Agency and the contractor or any claim by one party against the other which cannot be settled amicably shall be brought before the Copenhagen courts exclusively, at the initiative of either party.

Article 14 – Amendments

(1) Any amendment to this contract shall be the subject of an additional written agreement. Oral agreements shall not be binding on the contracting parties.

Draft
Annex III

FRAMEWORK CONTRACT No. XXXX/BXXXX.EEA.XXXXX

****** SPECIFIC AGREEMENT No XXXX/BXXXX.EEA.XXXXX**

The European Environment Agency, hereinafter called "the Agency",
Whose official address and contact person are:

- *Kongens Nytorv ,DK-1050 Copenhagen K, Denmark,*
- *[contact person]………………*

which, for the purpose of the signature of this contract, is represented by Mr Domingo JIMENEZ-BELTRAN, Executive Director of the Agency,

of the one part,

and ………..

hereinafter referred to as "the contractor"

whose official address is: …………

whose bank account No is:…….

with ………[Name of establishment, city, Bank identification code]

VAT registration number:……….

represented by: ……….

of the other part,

have agreed as follows:

Article 1 – Subject

Pursuant to the terms of the framework contract No ****, and in accordance with the terms and conditions set out in this specific agreement and its annexes, which form an integral part of the said agreement, the contractor hereby undertakes to perform the tasks specified in Annex I.

Article 2 – Duration

As from the date it takes effect, this specific agreement is awarded for a period of …….. [months/years].

Article 3 – Reports

In case the specific agreement requires the submission of reports or time sheets, the specifications of these requirements are described in Annex ……

Article 4 - Financial provisions

1. *In consideration of the tasks performed under this specific agreement, the Agency shall pay to the contractor a lump sum of up to a maximum of EURO …………covering all expenses incurred in the course of execution of this specific agreement, including all travel and subsistence expenses.*

Or

1. *In consideration of the tasks performed under this specific agreement, and up to a maximum of EURO ………, the Agency shall pay to the contractor:*

    a) the sum of EURO………… [extra muros work] and/or the sum of EURO………… [intra muros work] for each day of work.

    [amount in figures] (…[amount in words]…) (VAT [included/excluded]);

    b) [except intra muros work under consultancy contracts] a sum of up to a maximum of EURO ………… covering travel and subsistence expenses incurred in the course of execution of the contract.

2. Payments shall be made as follows:

    EURO ……. , payable within 60 days *upon receipt* by the Agency of an invoice, following the signature of the contract [**** %],

    *EURO ……. , payable within 60 days upon receipt by the Agency of an invoice, following the signature of the contract [**** %],*

    …………

    (consultancy)

………. [mention the period: monthly etc ….], within 60 days upon receipt by the Agency of an invoice following approval of the supporting time sheets.

Article 5 – Annexes

The following are annexes to this specific agreement:

- Annex I	Technical annex
- [Annex …	Reports and documents]
- Annex [II]	General terms and conditions applicable to contracts awarded by the Agency
- [Annex ….	Reimbursement of travel expenses

Done in *triplicate* in English
at Copenhagen on ……..[date]

For the contractor:

For the Agency:

D. Jimenez-Beltran
Executive Director

ANNEX IV

REIMBURSEMENT OF TRAVEL EXPENSES

The reimbursement of travel & 'per diem' expenses occasioned by a convocation of a Contractor to the European Environment Agency is paid in euro (EUR) at the rate of exchange in force against the euro (EUR) for the month in which the liquidation is effected (rate applied by the European Central Bank). All accounts must be in the currency in which they were paid.

a) Travel expenses

by train:	First class fare (used ticket with claim),
by air:	Economy class where available (used ticket with claim),
by car:	The equivalent of first class rail fare.

b) Transfer of professional materials or non-accompanied luggage

Subject to prior approval by the Agency.

c) Daily allowance

The daily allowance is to include **all** expenses relating to:
- accommodation;
- meals;
- local transport including taxis.

NOTES:

Taxis are not chargeable.

For information only:

The current daily allowances are as follows (*)

Austria	:	EUR	89,42	Belgium	:	EUR	149,63
Denmark	:	EUR	179,28	Finland	:	EUR	158,97
France	:	EUR	130,29	Germany	:	EUR	127,10
Greece	:	EUR	113,19	Ireland	:	EUR	165,20
Italy	:	EUR	129,82	Luxembourg	:	EUR	143,48
Netherlands	:	EUR	147,69	Portugal	:	EUR	142,98
Spain	:	EUR	141,30	Sweden	:	EUR	158,97
United Kingdom	:	EUR	199,21				

(*) Rates are decreased with 25% when the mission exceeds 4 weeks.

ANNEX V

INFORMATION REQUIRED FOR CONSULTING TASKS (per task)

Reference number: ______________________________

Company name: ______________________________

Address: ______________________________

____

Telephone/fax: ______________________________

Director: ______________________________

Consultant(s): ______________________________

VAT N^{o}: ______________________________

Bank details (address, account no and BIC code: ______________________________

____

Stamp and signature:

____

Energy and Environment in the European Union

DRAFT
(for external review)

February 2002

European Environment Agency

Content and key messages

Introduction

This is the first indicator based report produced by the European Environment Agency (EEA) in the area of energy and the environment. It covers the European Union and has been designed to provide policy makers with an analysis of:

- historic trends in the environmental performance of energy supply and consumption activities;
- future prospects, taking account of the main driving forces affecting the demand for energy services and the choice of energy supply options;
- the impact of present policy measures and targets aimed at improving the environmental performance of energy production and consumption.

The report develops a set of indicators that measure the most important aspects of environmental performance, at both EU and Member State level, for all key areas of energy supply and demand (i.e. energy supply including electricity production, and energy demand from manufacturing industry, households, services and transport). These indicators are based on the EEA's established system for reporting on environmental issues; the DPSIR framework. This system covers five fundamental aspects of socio-economic interactions with the environment – **D**rivers, **P**ressures, **S**tate, **I**mpact and **R**esponses – as shown in Figure 1

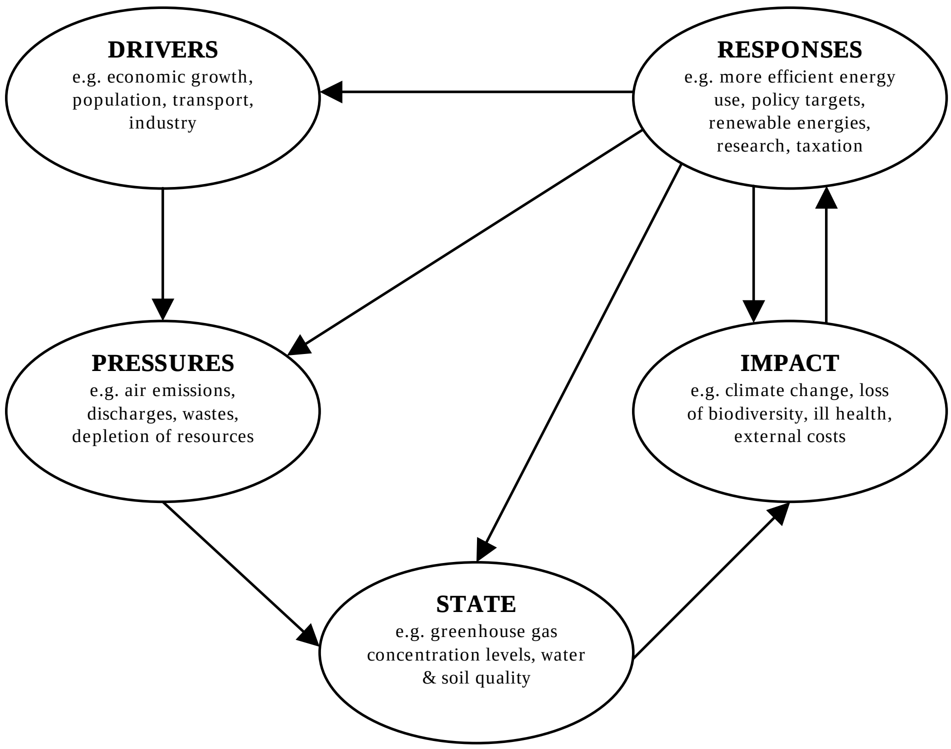


Figure 1 The DPSIR Assessment Framework

The report concentrates on measuring and analysing, with the help of indicators, the factors affecting energy use (driving forces), the emissions and waste resulting from energy production and consumption (pressures), impacts on the environment and human health (impacts) and the contribution of policy measures designed to mitigate environmental impacts (responses).

The report builds on statistics contained in the Eurostat / European Commission publication: ‘Integration – indicators for energy. Data 1985-98’ (Eurostat, 2001) and on projections used in the report ‘Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change’, produced by ECOFYS, AEAT and NTUA on behalf of the European Commission’s Environment Directorate General (ECOFYS, 2001). The information presented in this report is also drawn from working documents, in the form of detailed indicator fact sheets, prepared by the EEA and the EEA’s European Topic Centres and reviewed by the EEA’s European Environment Information Observation Network (EIONET), and from a number of EEA reports on greenhouse gas emissions (EEA, 2001a), atmospheric pollutants (EEA, 2002a), transport and environment (EEA, 2001b).

Energy is central to the social and economic wellbeing of Europe’s people. It provides comfort and warmth in our homes and mobility for both business and recreation. It also provides the energy services essential to most industrial and commercial wealth generation. Energy supply itself is a major source of wealth and employment in the EU. This link between economic and social development and the demand for energy related services has caused energy use to grow steadily across the EU as the economy has expanded and the majority of the population has become better off.

However, all phases of the energy production and consumption chain place pressures on the environment as shown in Figure 2. Many of these pressures are contributing to exceedances of tolerable levels and are contributing to climate change and lasting damage to natural ecosystems, the built environment, agriculture and human health. Therefore a key challenge for economic, energy and environmental policy is to develop policies and measures to encourage further economic development, while reducing and ultimately breaking the linkage with environmental pressures.

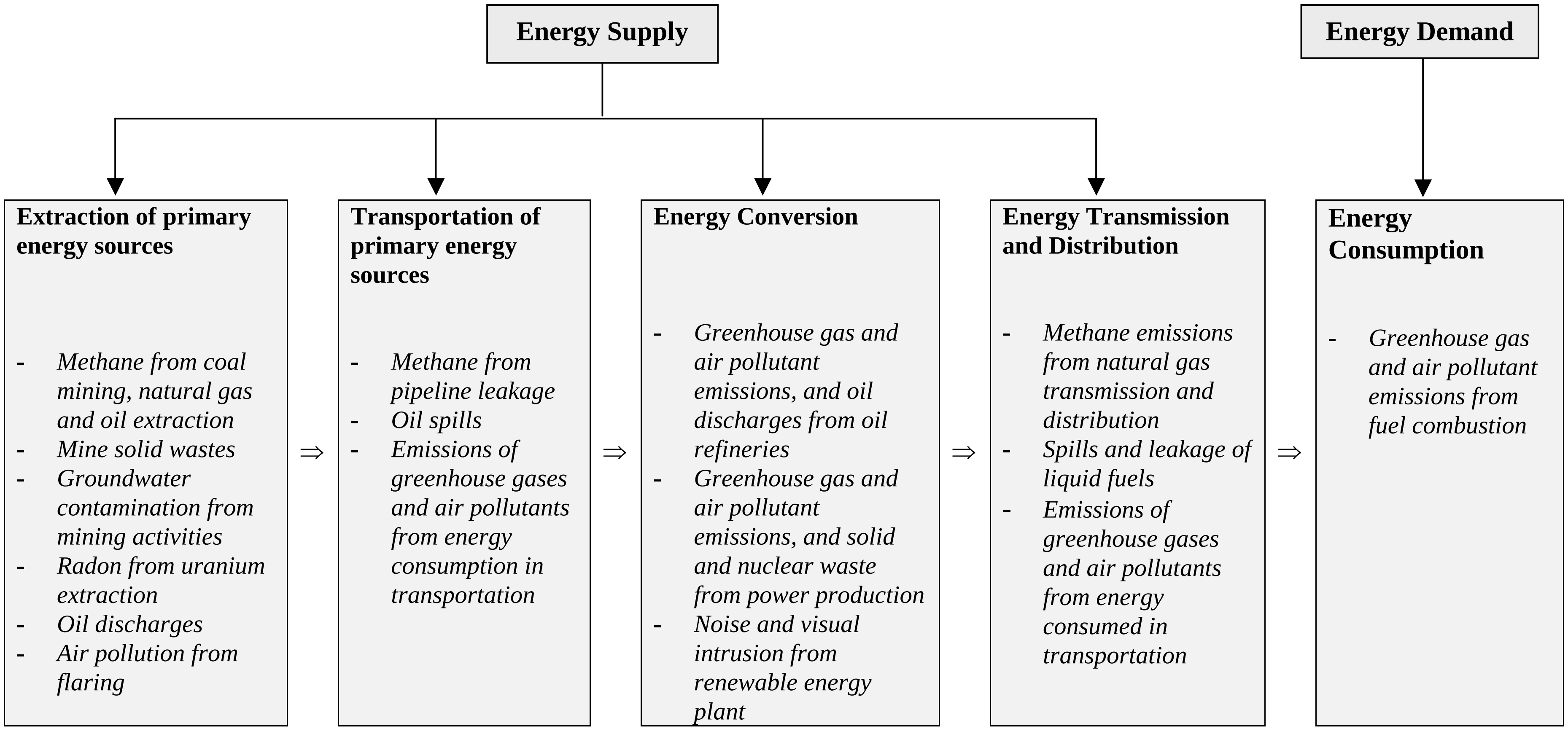


Figure 2 Examples of the Environmental Pressures imposed at different stages of the energy supply and demand chain

The link between these pressures and the drivers for energy demand can be represented by the generic relationship:

$$\text{PRESSURE} = \underset{\text{(Pressure Intensity)}}{\frac{\text{PRESSURE}}{\text{ENERGY}}} \times \underset{\text{(Energy Intensity)}}{\frac{\text{ENERGY}}{\text{DRIVER}}} \times \text{DRIVER}$$

This relationship indicates that the magnitude of the pressure placed on the environment by any activity using energy will depend on:

- Pressure Intensity – the pressure on the environment (emissions, discharges, wastes) from using one unit of energy
- Energy Intensity – the amount of energy required per unit of the driver
- Driver - volume of the activity that generates demand for an energy related service (e.g. GDP, industrial value added, demand for road freight delivery, demand for passenger transportation)

This points to a set of generic options for reducing the environmental pressures associated with the use of energy (energy production and consumption):

- Reduce the Driver by adopting alternative social or economic practices (e.g. a modal switch from private to public transport)
- Reduce the linkage between the Driver and the use of energy (i.e. the Energy Intensity) through greater energy efficiency and the use of less energy intensive processes
- Reduce the environmental pressure generated by the use of energy (i.e. the Pressure Intensity) by for example:

  – Less dependence on the more polluting fuels through the development of alternative energy sources
  – Deployment of advanced conversion and end-use technologies that are less polluting.

This report examines each of the factors in the above relationship and the associated options for improving environmental performance. It does this by addressing six fundamental questions relating to energy and the environment:

- Is the use of energy having less impact on the environment, i.e. is the Pressure being reduced? (See Section 1.)
- Are we using less energy, i.e. are the Driver and Energy Intensity being reduced? (See Section 2.)
- How efficiently do we use energy, i.e. is the Energy Intensity being reduced? (See Section 3.)
- Are we switching to less polluting fuels, i.e. is the Pressure Intensity being reduced? (See Section 4.)
- How rapidly are renewable energy technologies being implemented, i.e. to what extent are we taking up this option for reducing the Pressure Intensity? (See Section 5.)
- Are economic decisions taking account of the Pressures energy related activities place on the environment, i.e. to what extent do pricing systems incorporate environmental costs? (See Section 6.)

Each question is answered by a set of indicators that are designed to measure progress, project future performance and identify the main factors affecting change.

Special attention has been paid to the electricity production industry, due to its growing share of energy use in the EU, and because it is a key option for introducing less polluting energy sources into the economy. The transport sector also has a growing share of energy use. This sector is dealt with in detail in the European Environment Agency's report *TERM 2001. Indicators tracking transport and environment integration in the European Union* (EEA, 2001 b). It will also be the theme of EEA's upcoming report on transport and environment indicators in accession countries.

1. Is the use of energy having less impact on the environment?

$$\boxed{\text{PRESSURE}} = \boxed{\frac{\text{PRESSURE}}{\text{ENERGY}}} \times \boxed{\frac{\text{ENERGY}}{\text{DRIVER}}} \times \boxed{\text{DRIVER}}$$

The production and consumption of energy places a broad range of pressures on both the natural and built environment, as well as on human health. Because fossil fuels (i.e. coal, lignite, oil and natural gas) account for the bulk of energy supplies in the EU (80 % in 1999) most attention in this section focuses on the environmental pressures arising from fossil fuel use, including a range of greenhouse gas emissions and air and water pollutants:

Greenhouse Gas (GHG) Emissions – Energy production and consumption accounted for 82 % of the EU's GHG emissions in 1999. The main component of the energy related emissions is carbon dioxide with the rest made up of methane and nitrous oxide.

Acidifying Substances – Combustion of fossil fuels results in the emission of sulphur dioxide, nitrogen oxides and very small quantities of ammonia which contribute to acidification and eutrophication causing damage to soil, aquatic and terrestrial eco-systems, buildings and materials, and which cause increases in air pollution and thus have adverse effects of human health.

Ozone Precursors – Non-methane volatile organic compounds (NMVOCs), nitrogen oxides, carbon monoxide and methane contribute to ground level ozone, which can have adverse effects on human health (WHO-UNECE, 2001) (e.g. chronic respiratory illness and premature deaths) and on terrestrial eco-systems.

Particulate Matter – Small particulates (PM10 – particles with a size less than 10μm) are produced directly during fossil fuel combustion and by the transformation of nitrogen oxides, sulphur dioxide and ammonia by chemical reactions in the atmosphere. These particulates have been associated with adverse effects on human health including a significant number of premature deaths and chronic respiratory illness (WHO-UNECE, 2001).

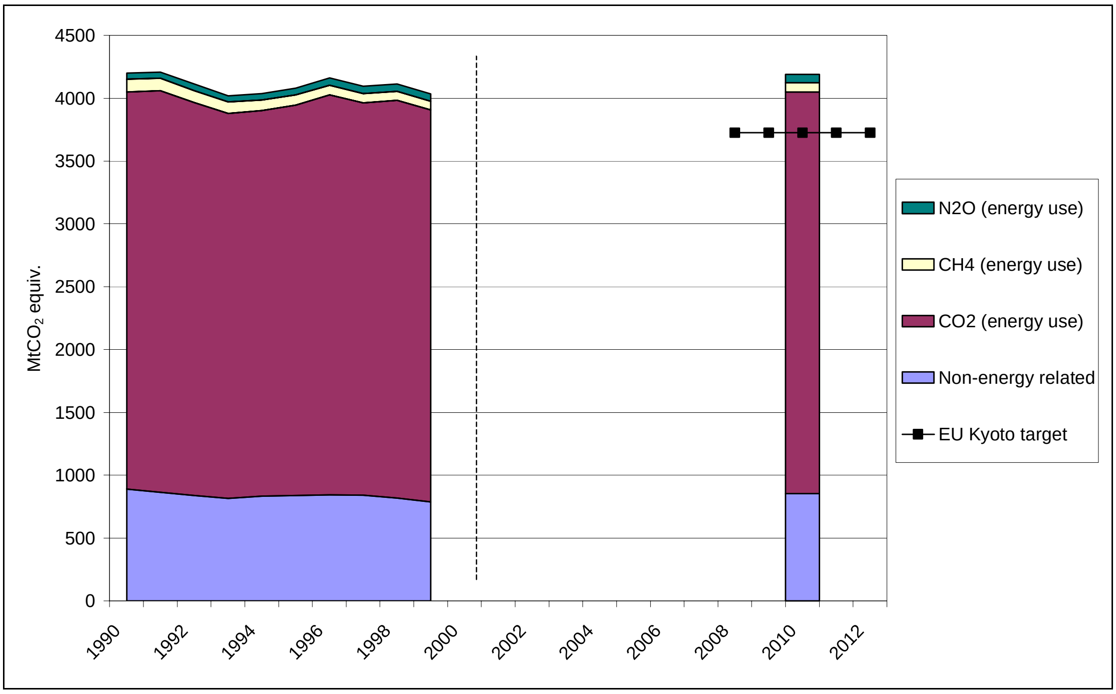
Oil Discharges – Managed and accidental discharges from tankers and other shipping, off-shore installations and refineries can have adverse effects on aquatic systems and sea bird populations as well as the loss of coastal amenities.

Options for reducing these pressures can be broadly classified into improved management and maintenance, end of pipe clean up, new less polluting technologies and switching to cleaner fuels. The pressures can also be reduced indirectly through improved energy efficiency and the use of less energy intensive processes.

Some of the pollutants mentioned here are responsible for more than one effect. For example methane is both a greenhouse gas and an ozone precursor, while sulphur dioxide contributes to air pollution (directly and also indirectly by forming fine particulates) and acidification. Therefore the reduction of one pollutant may yield benefits in relation to more than one impact. Furthermore, policies and measures to reduce greenhouse gas emissions (e.g. switching from coal to natural gas) often, as a side effect, also lead to reduction of emissions of air pollutants. In contrast, however, in some exceptional cases, actions to reduce one pollutant may cause an increase in another. For example the use of three-way catalysts has reduced emissions of carbon monoxide, nitrogen oxides (NO_X) and non-methane volatile organic compounds from petrol cars, but with an increase in nitrous oxide emissions. This inter-linkage between pollutants has been recognised with the shift to a multi-pollutant, multi-effect approach to the development of air pollution strategy in recent years.

Not all pollution from energy related activities arises from the combustion of fossil fuels. Some combustion related emissions, such as nitrogen oxides, arise from the use of biomass and waste as fuels. Also, while nuclear power produces negligible emissions during normal operation, it is accumulating substantial quantities of long-lived and highly radioactive waste for which no generally acceptable disposal route has been developed at present.

😐 **Total EU greenhouse gas emissions fell by 3.9 % between 1990 and 1999, but energy related greenhouse gas emissions showed only a 1.9 % reduction. This raises serious doubts over the EU's ability to reduce greenhouse gas emissions in coming decades**



Notes:

1. The Kyoto target is for total emissions of carbon dioxide, methane, nitrous oxides and fluorinated gases.
2. The 'baseline projections' for 2010 are taken from the report "Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change" produced by Ecofys – Energy and Environment, AEA Technology and NTUA on behalf of the European Commission's Directorate General Environment. (ECOFYS, 2001). See Annex1 for an outline of the scenario assumptions underlying these projections. Greenhouse gas emissions for 1990 to 1999 are taken from the EEA "European Community and Member States greenhouse gas emission trends 1990-1999 (EEA, 2001 a) and the underlying EU Greenhouse Gas inventory maintained by EEA, assisted by the European Topic Centre on Air and Climate Change (ETC/ACC).

Figure 3 Annual greenhouse gas emissions
Source: EEA, ECOFYS

The EU is a major source of greenhouse gases accounting for about 15 % of global emissions yet only having 5 % of the world's population (European Commission, 2001a). Accordingly the EU is committed to taking a lead in reducing emissions. The first step is to meet the target set for the EU under the Kyoto Protocol for an 8 % reduction in total greenhouse gas emissions by 2008-2012 compared to the 1990 level. Although challenging this should only be regarded as a first step, since it is estimated that global emissions will

[2] This statement is based on the assumption, for the purpose of this report, that the EU will meet its Kyoto Protocol target by using only domestic policies and measures (including emissions trading within the EU). At the seventh Conference of the Parties to the UN Framework Convention on Climate Change (Marrakesh, November 2002) the Parties agreed to the rules for the use of both the flexible mechanisms (joint implementation, clean development mechanism, international emissions trading) and the sinks for meeting the Kyoto targets (UN 2001a, UN 2001b). After ratification (expected in 2002), the European Community and the EU Member States could therefore also use these options to meet their targets, although it is not known yet to what extent this will take place.

need to be reduced by about 70 % in the long term if the atmospheric greenhouse gas concentration is to be stabilised at an acceptable level (IPCC, 2001). The European Commission has acknowledged this by proposing that "the EU should aim to reduce atmospheric greenhouse gas emissions by an average of 1 % per year over the 1990 levels up to 2020" and by proposing a global target of 20-40 % over 1990 by 2020 (European Commission, 2001a and 2001b). Such major reductions will require fundamental changes in the way we produce and consume energy

It is encouraging that the EU's total emission of greenhouse gases (i.e. carbon dioxide, methane, nitrous oxide and the fluorinated gases) fell by 3.9 % between 1990 and 1999 (EEA, 2001a). Moreover, the EU seems likely to achieve its original commitment to stabilise carbon dioxide (CO_2) emissions in 2000 at 1990 levels. These early successes might suggest that the EU is on track to achieve its Kyoto Protocol target and to accomplish more ambitious greenhouse gas emission reductions in the longer term.

This is far from being the case[2], for two reasons. Firstly the reduction in greenhouse gas emissions to date has mainly come from a reduction of 13.9 % from non-energy sources with energy related emissions falling by only 1.9 %. Since non-energy sources only accounted for 18 % of GHG emissions (in 1999) energy production and consumption will have to make a bigger contribution in future if the Kyoto target, and any more ambitious abatement target in the future, are to be attained. Secondly the stabilisation of CO_2 emissions at 1990 levels by 2000 was partly due (approximately 50 %) to one off reductions in Germany and the UK. Indeed preliminary estimates suggest that CO_2 emissions have increased in the EU between 1999 and 2000 (DIW, 2001).

The EU's 1.9 % cut in energy related greenhouse gas emissions between 1990 and 1999 was achieved through reductions in energy supply[3] (10 %), industry[4] (9 %) and households plus services (2 %), but this was off-set by growth of over 19 % in transport[5]. Much of the reduction in the energy supply and industry sectors was achieved in Germany and the UK (the two largest greenhouse gas emitters). The main cause of the reduction in the UK was fuel switching from coal to natural gas for electricity production. In Germany the main driver was the closure of low efficiency lignite power plant and structural changes to less energy intensive manufactured products, particularly in the *New Länder*, and energy efficiency improvements throughout the German economy. These changes are not expected to have the same impact in future.

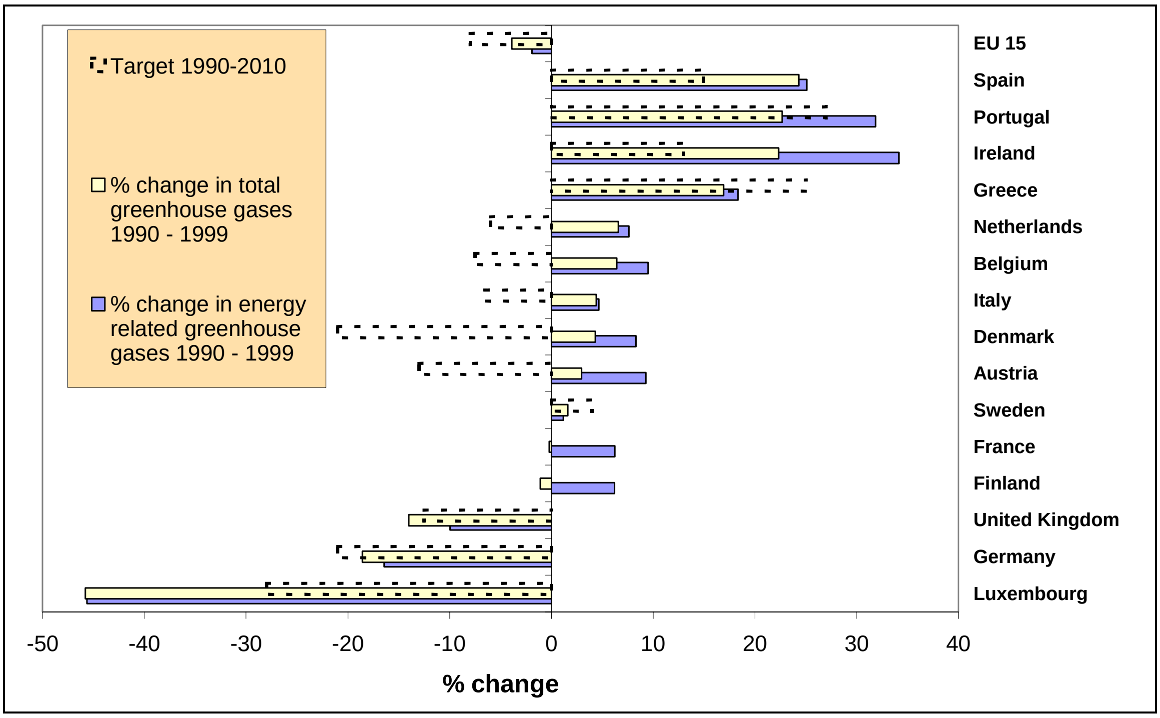
"Baseline" projections (i.e. assuming the policy situation in November 1997 and including the so called ACEA Agreement – see Annex 1) of greenhouse gas emissions, made for the European Commission (ECOFYS, 2001) suggest that total emissions would be about the same in 2010 as in 1990. This projection is in line with recent Member State projections, also based on existing policies and measures (European Commission, 2001c). Underlying this trend is an increase in energy related emissions, which is partially offset by a further reduction in non-energy emissions. The increase in energy related emissions in 2010

[3] The energy supply sector includes coal, oil and gas exploration and extraction, public electricity and heat production, refineries and other industries engaged in transforming primary energy into other energy products.
[4] The industry sector includes all manufacturing industries.
[5] Transport emissions exclude emissions from international transport in accordance with reporting requirements of the EU Greenhouse Gas Monitoring Mechanism (and also the United Nations Framework Convention on Climatic Change (UNFCCC)).

relative to 1990 comes principally from transport, and is partly off-set by a continued reduction in emissions from manufacturing industry.

These trends and projections indicate that the EU will have difficulty meeting its Kyoto target with the policies and measures currently in place. The European Commission reached a similar conclusion in its second draft progress report on monitoring mechanisms (European Commission, 2001c) based on Member State projections. It is also a concern that energy related greenhouse gas emissions are proving particularly difficult to reduce. This suggests that little progress has been made so far with the fundamental restructuring of energy production and consumption, which is vital if the more ambitious long-term reduction targets for greenhouse gas emissions are to be attained.

☹ **Most EU Member States have so far failed to reduce greenhouse gas emissions in line with their share of the EU's commitment under the Kyoto Protocol**



Notes:
1. Target values are for total emissions.
2. The targets for France and Finland are zero.
3. For Denmark, estimates that reflect adjustments for electricity trading (import and export) in 1990, give a reduction in total greenhouse gas emissions of 4.6 % between 1990 and 1999 compared to the increase of 4 % shown in Figure 4. This methodology is used by Denmark to monitor progress towards its national target under the EU "burden sharing" agreement.

Figure 4 Change in total greenhouse gas emissions and energy related greenhouse gas emissions, 1990-1999
Source: EEA

The EU's target under the Kyoto Protocol, to reduce total greenhouse gas emissions by 8 % by 2008-2010 relative to 1990 has been shared amongst Member States so as to allow for their different economic development patterns. These 'burden sharing' targets were reaffirmed in the Commission's proposal for ratification of the Kyoto Protocol by the EU (European Commission, 2001d).

Finland, France, Germany, Luxemburg, Sweden and the UK limited their total greenhouse gas emissions between 1990 and 1999, at least sufficiently to be in line with their targets for 2008-2012 under the EU's burden sharing agreement[6]. The notable improvement in Luxemburg is due to the closure of a primary steel plant (i.e. steel making from iron ore) with partial transfer of production to electric steel making using steel scrape. Germany has also made substantial reductions against a challenging target, and because it is the largest emitter, this, together with the UK reduction, has been responsible for the overall reduction achieved by the EU. However, as discussed previously, many of the factors driving these changes for Germany and the UK are one-off, and preliminary estimates suggest that

[6] This conclusion is based on a 'distance to targets' assessment which assumes that member states will reduce their emissions linearly between 1990 and 2010.

between 1999 and 2000 carbon dioxide emissions have levelled off in Germany and have risen in the UK (DIW, 2001).

Other member states are finding it increasingly difficult to control greenhouse gas emissions.

For all Member States, except Luxemburg, the performance is worse for energy related greenhouse gas emissions than for total emissions (that also include non-energy sources). EU energy related emissions accounted for 79 % of total greenhouse gas emissions in 1990 rising to 82 % in 1999. Therefore further progress towards the Kyoto ‘burden sharing’ targets, and even more for later and bigger reduction targets, will require additional cuts in emissions from energy production and consumption. However, in most Member States growth in energy related emissions is out-stripping the reductions being achieved in non-energy areas.

In line with the previous indicator, this trend underlines the need for further policies and measures in most Member States to reduce energy related greenhouse gas emissions.

☹ The link between energy related greenhouse gas emissions and economic growth needs to be reduced much more in the future than has been achieved so far if the EU and Member State Kyoto targets are to be attained

Previous indicators have demonstrated the importance of reducing greenhouse gas emissions from energy use in order to meet the EU’s Kyoto target, and in particular more ambitious long-term reduction targets for greenhouse gas emissions. Historically energy use has been linked to economic development; as the economy grows more energy is needed to support business activities, and as people become better off they consume more energy in their homes and for travel. If all other things stayed unchanged growth in energy use would result in a corresponding increase in energy related greenhouse gas emissions.

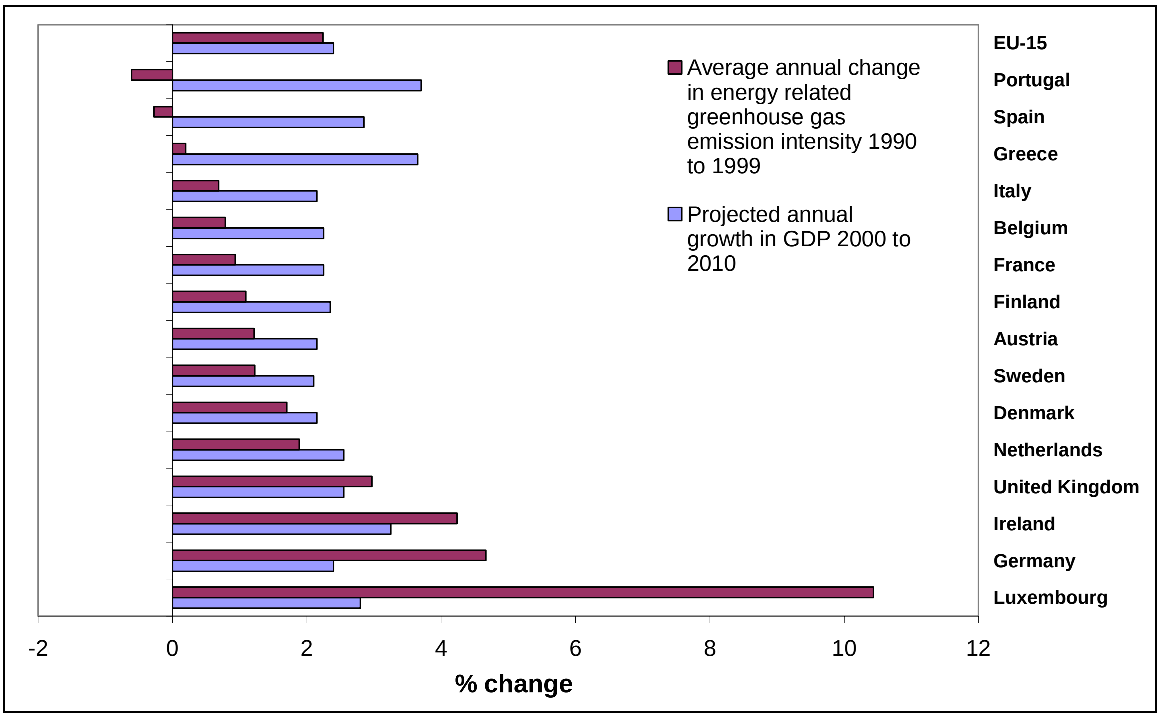
This did not happen between 1990 and 1999. During that period, energy related greenhouse gas emissions reduced (slightly) while energy consumption and GDP grew. This was due to a combination of changes including reduced coal and lignite consumption, closure of some energy intensive industry and improvements in energy efficiency. However, as discussed previously these changes did not occur evenly across Member States and it is doubtful that the changes will be repeated in the future.

Therefore reducing, and ultimately eliminating, the link between energy use, energy related greenhouse gas emissions and economic development is key to meeting the Kyoto targets, and in the longer term, for making more ambitious reductions in greenhouse gas emissions.

‘Energy related greenhouse gas emission intensity’, is defined as energy related greenhouse gas emissions divided by Gross Domestic Product (GDP) (i.e. the energy related greenhouse gas emitted for a unit of wealth (GDP) to be produced). The linkage between economic growth and energy related greenhouse gas emissions is shown by the following relationship:

Energy related greenhouse gas emission	=	Energy related greenhouse gas emission intensity	X	GDP

This relationship shows that to stop growth in energy related greenhouse gas emissions (i.e. simply to stand still), the greenhouse gas intensity must be reduced year on year by a rate equal to the increase in GDP. This can be achieved by using less energy or by using energy sources that produce less greenhouse gas emissions.



Note GDP for Luxemburg is the actual average annual rate of growth for 1995 to 1999.

Figure 5 Annual change in energy related greenhouse gas emission intensity compared to projected annual rate of GDP change
Source: EEA, Eurostat, NTUA

Energy related greenhouse gas emission intensity fell in most EU Member States between 1990 and 1999. However, only Germany, Ireland, Luxembourg and the UK attained intensity reductions over the 1990–1999 period, exceeding their projected economic growth rates over the 2000–2010 period. This comparison of historic rates of reduction of energy related greenhouse gas intensity with projections of future GDP growth rates shows that much faster rates of reduction in intensity will be required in the future simply to stabilise emissions from energy use.

The EU economy is expected to grow on average by about 2.4 % per year between 2000 and 2010. To accommodate this growth, and also meet the Kyoto 8 % reduction target, the EU overall would have to reduce its greenhouse gas emission intensity by about 3 % per year from 2000-2010. This improvement rate is higher than the rate of improvement achieved between 1990 and 1999 of 2.5 % per year. If energy related emissions were to be reduced in line with the 8 % Kyoto target, this would require a reduction in the energy related greenhouse gas emissions intensity of 3.2 % per year, which is significantly higher than the rate of improvement attained between 1990 and 1999 of 2.3 % per year.

☹ **The small reduction in energy related greenhouse gas emissions between 1990 and 1999, was achieved due to significant reductions from manufacturing industry and the energy supply sector which were largely off-set by growth in transport.**

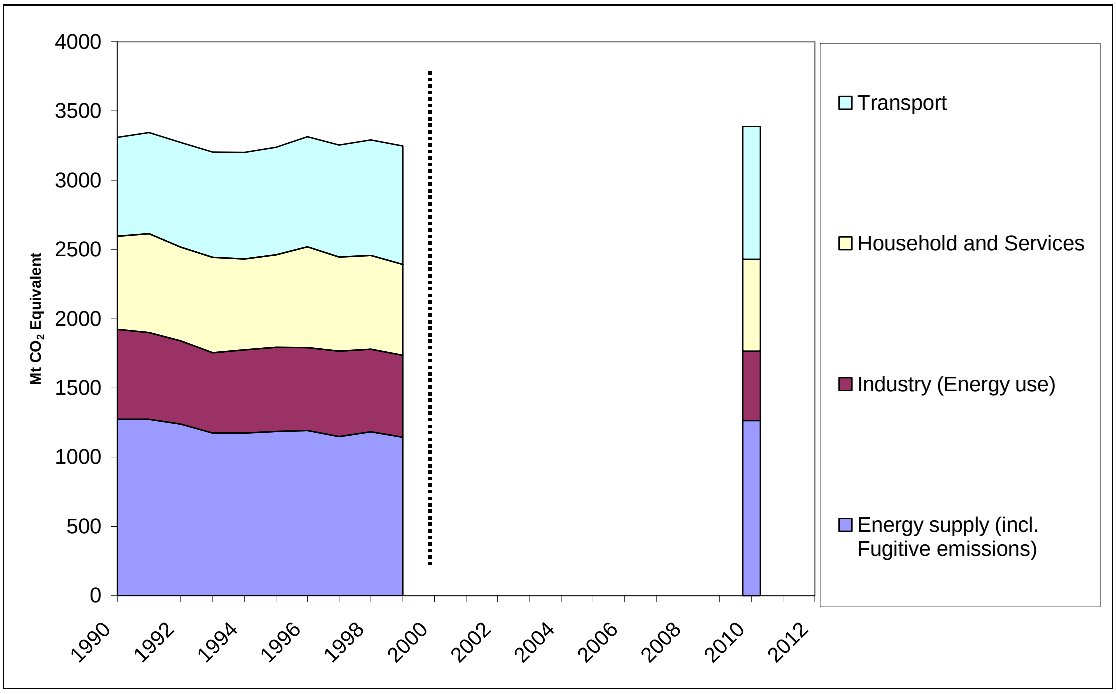


Figure 6 Energy related greenhouse gas emissions per economic sector
Source: EEA, ECOFYS

Previous indicators have shown that the problem area for reducing greenhouse gas emissions is energy consumption. Energy covers a range of energy supply and demand sectors and it is useful for policy development to understand where the growth of energy use, and consequently greenhouse gas emissions, takes place.

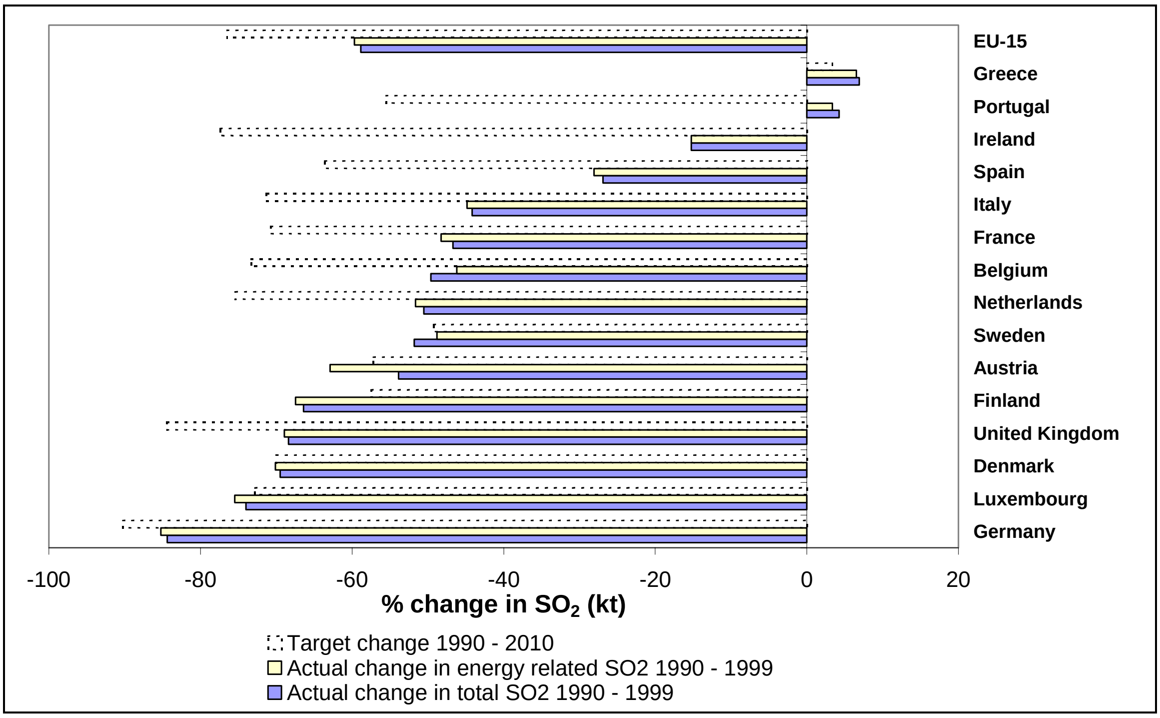
Transport is the main area for growth in energy related greenhouse gas emissions, having increased by 19.5 % across the EU between 1990 and 1999, reflecting the growing demand for both personal mobility and freight delivery. Road transport dominates this sector accounting for 84 % of emissions in 1998. The bulk of the emission is CO_2 (97 %), but transport is also a growing source of N_2O (up from 1.7 % to 2.9 % of transport emissions between 1990 and 1999). This gas is produced in the vehicle exhaust catalysts used to reduce NO_X and CO emissions from passenger cars.

Greenhouse gas emissions from manufacturing industry fell by 8.8 % between 1990 and 1999. The main contributor was Germany as a result of a combination of closures of old plant fuelled with coal and lignite and structural changes towards less energy intensive manufactured products, particularly in the *New Länder*, combined with investment in energy efficiency measures. Without Germany the EU's manufacturing industry greenhouse gas emissions would have been on a rising trajectory by 1999.

Between 1990 and 1999, greenhouse gas emissions from energy supply industries fell by 9 % despite an increase in energy demand of 23 %. The main contribution to this was an 8 % cut in CO_2 emissions from electricity production. This is linked to the reduction of coal and lignite fired electricity production in favour of electricity production from natural gas, increased efficiency in fossil-fuelled power plant and an expansion of electricity production from nuclear and renewable sources.

Looking ahead, the ‘baseline projections’ developed for the European Commission (ECOFYS, 2001) expect total energy related greenhouse gas emissions to grow between 2000 and 2010. This is mainly driven by continued growth of greenhouse gas emissions from transport, although this increase should be less than that experienced between 1990 and 1999 because of the voluntary agreement between the EU and car manufacturers to reduce average carbon dioxide emissions from the new passenger car fleet by an average of 25 % by 2008 (the so called ACEA Agreement). This growth is partially off-set by a continued fall of emissions from manufacturing industry, driven by further structural change and increased investment in energy efficiency. Emissions from the energy supply industries are expected to stay about level between 2000 and 2010 as the demand for energy continues to grow, but is off-set by efficiency improvements and further switching to less carbon intensive fuels.

☺ **Emissions of SO_2 have been reduced appreciably, and most Member States and the EU overall, are on course to achieve the 2010 targets set in the National Emission Ceilings Directive**



Note: Target values are for total emissions.

Figure 7 Change in total and energy related Sulphur Dioxide emissions
Source: EEA

In addition to greenhouse gases the combustion of fossil fuels results in the release of other air pollutants into the environment. Sulphur dioxide is produced by the oxidation of sulphur present mainly in coal, lignite and oil fuels. Together with nitrogen oxides it is the main energy related cause of acid deposition[7] resulting in damage to soil and water quality, crops and other vegetation and terrestrial and aquatic ecosystems. Acid deposition also damages buildings, and both directly, and through particulate formation, is linked to adverse health effects. Sulphur dioxide also causes direct adverse effects on human health. Targets for reducing total sulphur dioxide emissions for the EU and each Member State were set in the National Emission Ceilings Directive (European Community, 2000a)[8].

Energy production and consumption accounted for over 90 % of the EU's SO_2 emissions in 1999 with over half of this coming from power production (51 %) (See Table 1). Total EU emissions have been reduced by 59 % between 1990 and 1999, putting the EU on track to achieve the 77 % reduction by 2010 (relative to 1990) set in the National Emission Ceilings Directive (NECD).

---

[7] Ammonia emissions are also an important source of acid deposition but energy related activities only accounted for 2.4 % of total EU ammonia emissions in 1999.
[8] NECD targets were set in absolute terms, but for comparative purposes they are presented here as percentages. Consequently, should the 1990 emissions inventories be revised, this would result in a change in the percentage targets used here.

With regard to total emissions, most Member States are on track to achieve their respective NECD targets. Exceptions are Greece, Portugal, Ireland and Spain[9]. The same is true for energy related emissions, although Spain's rate of change was marginally better for these emissions.

All energy activities have contributed to the reduction. Energy supply cut emissions by 59 % between 1990 and 1999, encouraged by the requirements of the Large Combustion Plant Directive (European Parliament and Council, 2001a), but still is the main source accounting for 61 % of the total. About 60 % of the decrease can be attributed to the introduction of flue gas desulphurisation (FGD) and the use of low sulphur coal and oil. The remainder is largely due to changes in electricity production including fossil fuel switching (mainly from coal and lignite to natural gas) and improved efficiency in electricity production, with a small element due to growth in electricity production from nuclear and renewable sources (see Box 2).

The fall in energy related emissions from households and services (72 % in total) was mainly due to fuel switching to gas. Manufacturing industry reduced energy related emissions by 59 % by greater use of gas in place of coal, lignite and oil for space and process heating, fitting flue gas desulphurisation and as a result of structural change. The fall in transport (43 %) was achieved mainly through the reduced sulphur content of diesel fuel in response to the 1993 Directive on the Sulphur Content of Liquid Transport Fuels (European Parliament and Council, 1993).

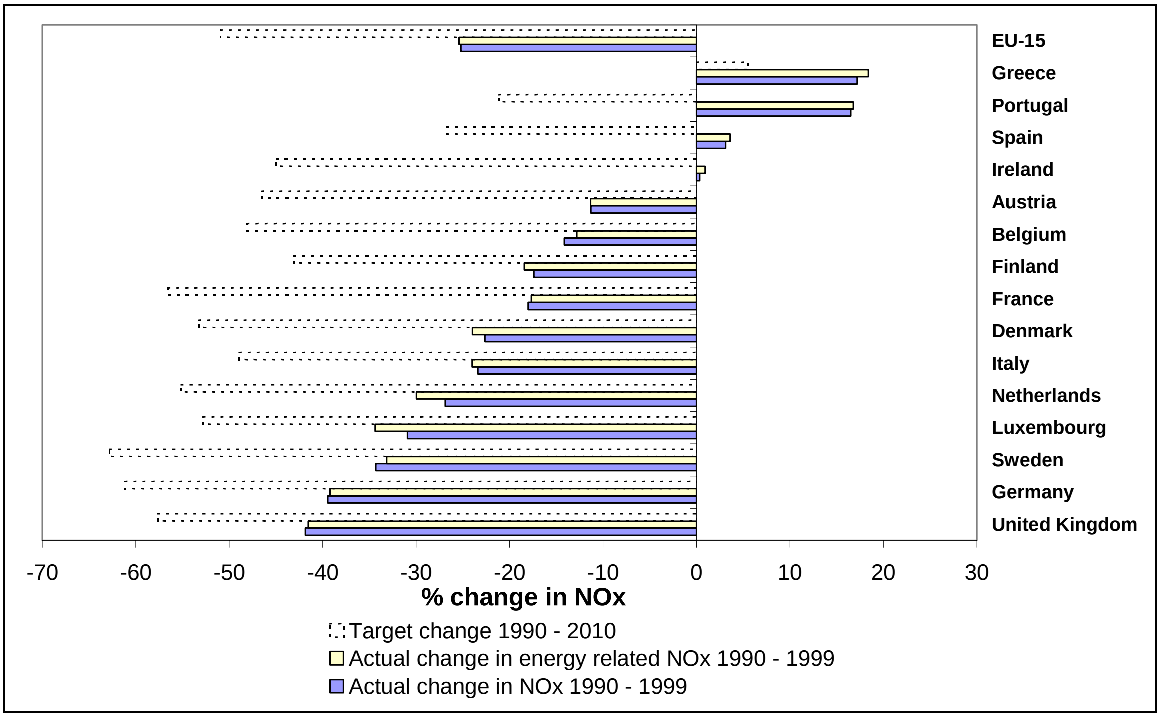
Table 1 Distribution of SO_2 emissions between sources (ktonnes)

	1990	1999
Energy supply	10,104	4,132
Transport	828	469
Industrial energy use	3,023	1,221
Other energy use	1,596	445
Non-energy sources	811	463
Total	16,362	6,730

Note: 'Other energy use' includes households and services.
Source: EEA

[9] This conclusion is based on a "distance to targets" assessment which assumes that member states will reduce their emissions linearly between 1990 and 2010.

☺ **Emissions of NO_X have been considerably reduced and some Member States and the EU overall, are on course to achieve the 2010 reduction targets set in the National Emission Ceilings Directive**



Note: Target values are for total emissions

Figure 8 Change in total and energy related emissions of Nitrogen Oxides
Source: EEA

Acidifying nitrogen oxides (NO_X) are produced by the oxidation of nitrogen present in coal and lignite and in combustion air. They have similar impacts on the environment as sulphur dioxide, which were outlined in the previous section. In addition NO_X is an important precursor for the formation of ground level ozone, which has adverse effects on human health and damages crops and other vegetation.

Energy use accounted for nearly all (97 %) of NOx emissions in 1999 with over half of this coming from transport (65 %) (See Box 1). Total NOx emissions fell by 25 % between 1990 and 1999, which falls short of the 30 % reduction by 2000 targeted in the Fifth EU Environmental Action Plan. However, if the rate of improvement is sustained the National Emission Ceiling Directive (NECD) target for an EU level cut of total emissions by 51 % (relative to 1990) should be attained by 2010[10].

The NECD sets targets at Member State level as well as for the EU overall. The UK, Sweden, the Netherlands, Luxembourg, Italy and Germany are currently on track to attain their targets[11]. Other countries need to accelerate the reduction rates achieved between 1990 and 1999, while Spain, Portugal, Ireland and Greece need to reverse their growing

[10] This conclusion is based on a “distance to targets” assessment which assumes that Member States will reduce their emissions linearly between 1990 and 2010.
[11] See Footnote 7

emission trends. Despite making large reductions, Germany and the UK still accounted for 16.8 % and 16.5 % respectively of all EU energy related emissions in 1999. Other large contributions came from France (15.5 %), Italy (15 %) and Spain (12 %).

Across the EU the greatest absolute reduction came from transport, largely due to the introduction of catalytic converters on motor vehicles. However, some of the benefit to the environment from implementation of this technology has been cancelled out by the growth in road transport. The energy supply and manufacturing industries also considerably reduced their energy related emissions by 43 % and 23 % respectively. This was achieved through a combination of measures, encouraged by the requirements of the Large Combustion Plant Directive (European Parliament and Council, 2001a), including the use of pollution abatement technologies (e.g. low NOx burners, flue gas treatment and selective catalytic converters) and fuel switching from coal and lignite to natural gas and by the requirements of the Integrated Pollution Prevention and Control Directive (European Parliament and Council, 1996a) on the use of best available technology. The reduction in emissions from manufacturing industry was also linked to some structural changes away from energy intensive industries.

☺ **Emissions of Non-Methane Volatile Organic Compounds (NMVOCs) have been reduced and some Member States and the EU overall are on course to achieve the 2010 reduction targets set in the National Emission Ceilings Directive**

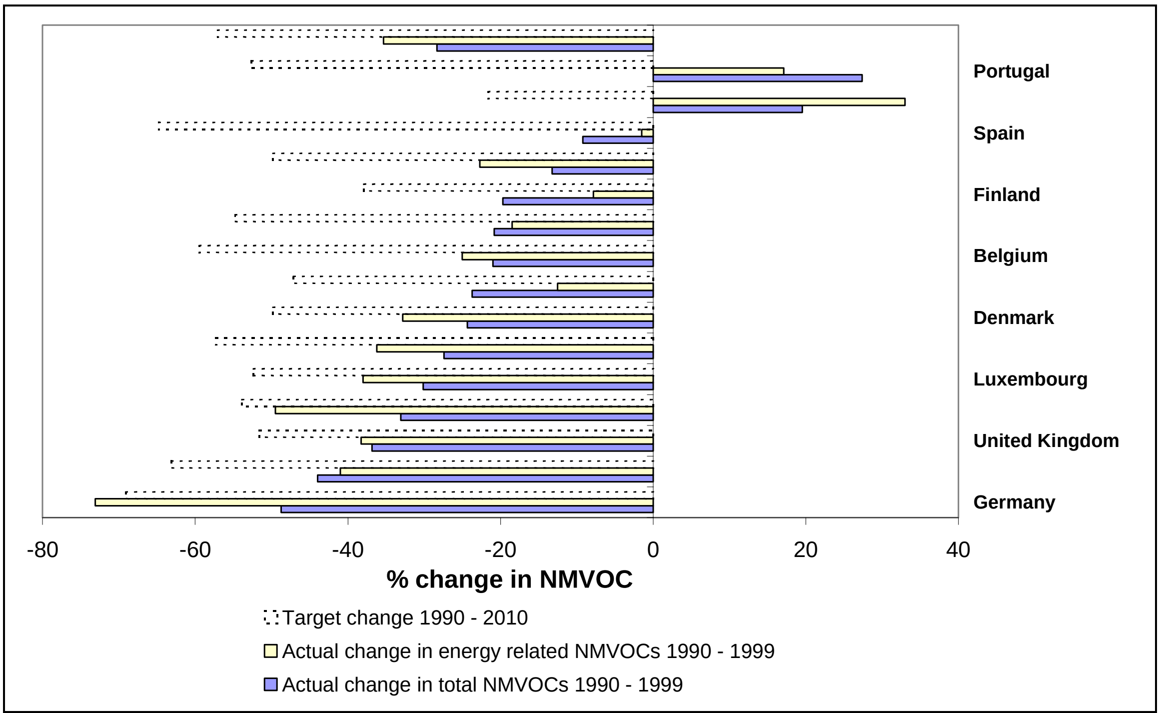


Figure 9 Change in total and energy related NMVOC emissions
Source: EEA

NMVOCs react in the atmosphere with nitrogen oxides in the presence of sunlight to form ozone. Ozone formed by such processes can build up at ground level, particularly in urban areas, having an adverse effect on human health as well as damaging crops and other vegetation.

Energy use accounts for about half of NMVOC emissions with the bulk of this coming from transport (see box 1). Total EU NMVOC emissions have been reduced by 28 % between 1990 and 1999, which falls short of the 30 % reduction targeted for 2000 set in the Fifth EU Environmental Action Plan. However, energy related emissions were reduced by 35 %. The National Emission Ceiling Directive has set a target for a 60 % cut in total emissions, to be attained by 2010, and the EU overall is on course to attain this target[12].

Most Member States have shared in this reduction in NMVOCs led by Germany the UK and the Netherlands. Portugal and Greece increased emissions over the 1990 to 1999 period.

The greatest absolute reduction came from transport (38 %), largely due to the introduction of catalytic converters and other exhaust gas treatments on road vehicles, which was driven by stricter EU standards for both passenger and commercial vehicle emissions. (See Box 1). Nonetheless transport remains the largest source accounting for 74 % of all energy related emissions in 1999. Emissions from the energy supply sector were also reduced (37 %),

[12] See Footnote 7

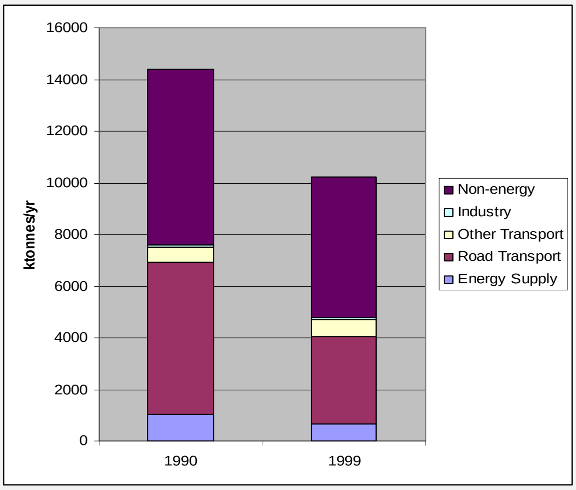
principally through a cut in fugitive emissions from the storage and distribution of petrol driven by implementation of the EU Directive on the control of Volatile Organic Compound (VOC) emissions from petrol (European Parliament and Council, 1994).

BOX 1 - What further improvements can be anticipated in NO_x and NMVOC emissions from energy related activities?

Despite significant improvement between 1990 and 1999 transport remains by far the largest source of NOx, and also is the main energy related source of NMVOCs.

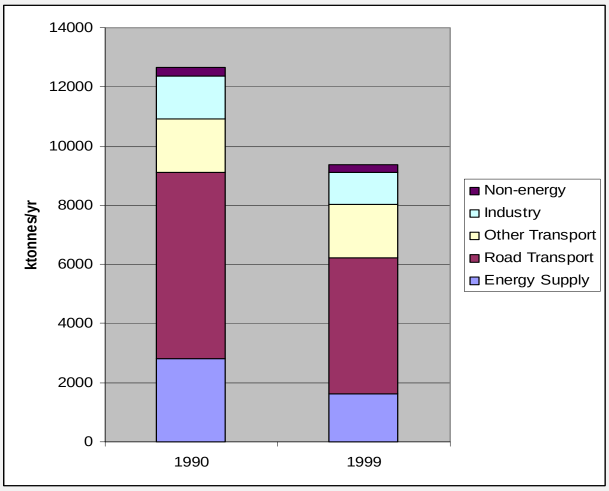
Figure B1/1 NOx and NMVOC emissions

NMVOCs



Source: EEA

NOx



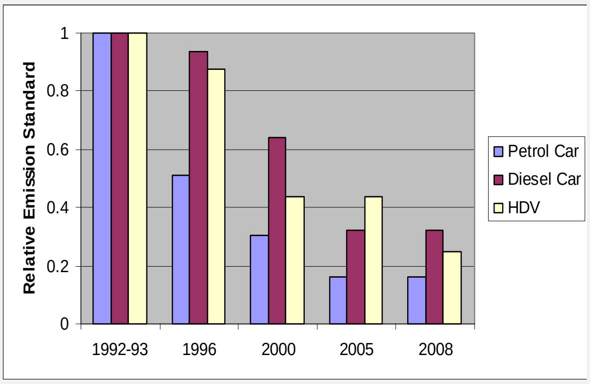
Source: EEA

The downward trend in road transport emissions should be maintained in the future through the increasingly stringent standards for vehicle exhaust emissions set in the Euro I, II, III and IV standards for cars, goods vehicles and heavy duty vehicles (European Parliament and Council 1991, 1993b, 1998 and 1999). Non-road transport emissions arise mainly from off-road vehicles and shipping.

The actual rate of emissions reduction will be determined by the rate of replacement of the EU's vehicle fleet and the rate of growth in demand for mobility. Car life times are of the order of 10 to 15 years, therefore the whole benefit of these improved standards will not be gained in full for sometime. Moreover, there are outstanding uncertainties over the long-term performance of exhaust catalysts under actual operating conditions. However, in the long term the reduction will be substantial in view of the large improvements in emission standards required for 2000 and 2005 vehicles.

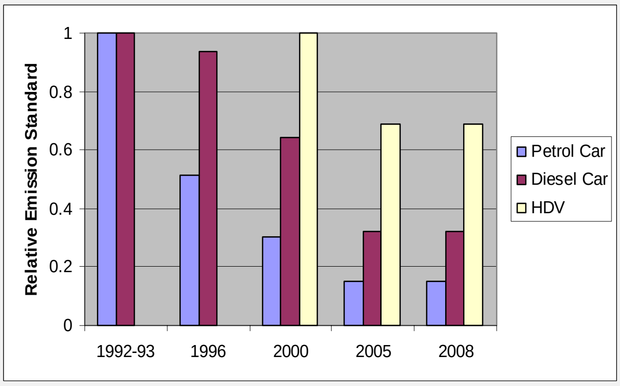
Figure B1/2 Current and future vehicle NOx and NMVOC emission standards

NMVOC



Source: EEA

NOx

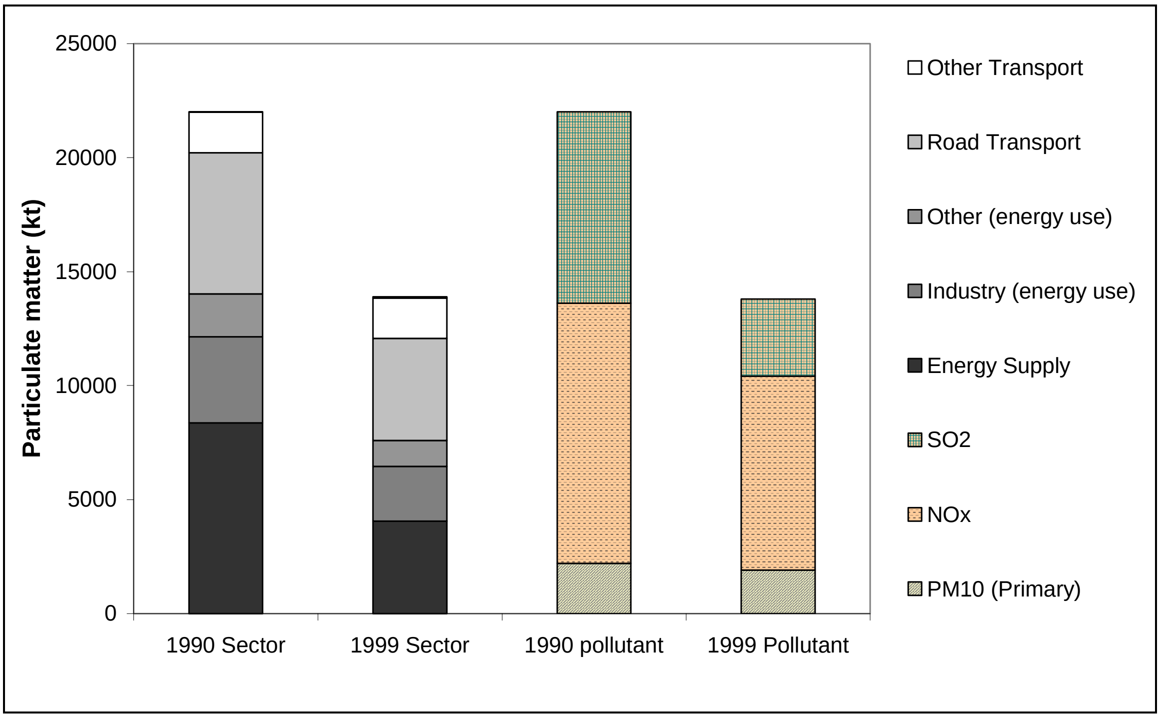


Source: EEA

NB The Relative Emission Standard shows how the standard has been tightened relative to the first standard that was set. For example the emission standard for NVMOCs from petrol cars in 2008 is only 16 % of the 1992-93 standard and therefore has a Relative Emission Standard of 0.16.

HDV = Heavy Duty Vehicles

☺ **Reductions in emissions of Primary and Secondary PM10 from power plant and road transport have contributed significantly to a 37 % reduction of total energy related PM10 emissions from 1990 to 1999**



Notes:
1. PM10 arising from NH3 is included in the totals but because it is a small fraction of the emission it is not visible in the graph.
2. Emissions estimates for particulates are much more uncertain than for emissions of other air pollutants.

Figure 10 Distribution of energy related Primary and Secondary Particulate (PM10) emissions
Source: EEA

Breathing in fine particulate matter can have an adverse effect on human health. The impact is predominantly associated with PM10 (particulate matter with a diameter less than 10µm). Inhalation of such particles can increase the frequency and severity of respiratory symptoms and the risk of premature death.

PM10 results from direct emissions (Primary PM10) and from particulate precursors such as nitrogen oxides, sulphur dioxide and ammonia, which are partly transformed into particles by chemical reactions in the atmosphere (Secondary PM10). Energy related particulate emissions accounted for 87 % of total EU emissions in 1990 falling to 83 % in 1999. It is estimated that for energy related particulate emissions, about 14 % come from primary sources, 61 % from NOx and 24 % from sulphur dioxide. However, these estimates are less accurate than for other pollutants because of uncertainties in emissions of other particulate species, such as organic and inorganic carbon compounds.

Total energy related PM10 emissions are estimated to have fallen by 37 % between 1990 and 1999; with most of the reduction coming from the NOx (13 %) and sulphur dioxide (23 %) precursors. Energy supply, road transport and industry contributed most to this reduction through fuel switching to lower sulphur fuels, end of pipe treatments in industry and power supply and increased penetration of catalytic converters in road vehicles.

There are no emission limits or targets for PM10 within the EU, although the area benefits from limits to the precursors under the National Emission Ceilings Directive (European Commission, 2000a). Air quality concentrations limit values are set under the Ambient Air Quality Directive. Despite the improvements described above the Auto-Oil II Programme (European Commission, 2000b) has estimated that these air quality standards are likely to be exceeded in urban locations, mainly as a result of the continued growth of road transport.

☹ Oil pollution from off-shore installations and coastal refineries has been reduced, but major oil tanker spills continue to occur

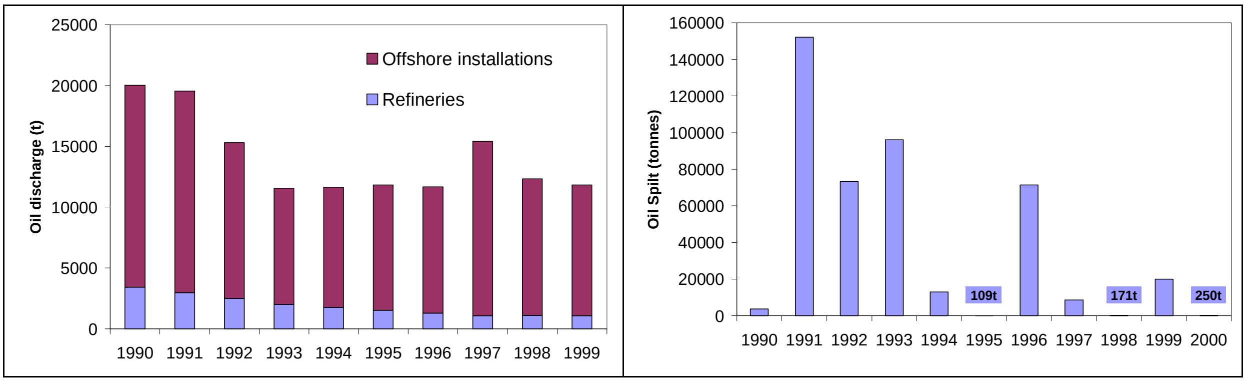


Figure 11 Record of marine environment oil pollution from refineries and offshore installations, and from accidental oil tanker spills (above seven tonnes per spill)
Sources: Eurostat, OSPAR, CONCAWE, DHI, ITOPF

Oil pollution from coastal refineries, offshore installations and maritime transport place significant pressures on the marine environment. Refinery emissions have been controlled under national integrated pollution control regulations and are now also subject to the EU's Directive on Integrated Pollution Prevention and Control, which requires the application of Best Available Technology in new and refurbished plant. Discharges from offshore installations are regulated by the Dangerous Substances Directive (European Parliament and Council, 1974) and the OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic.

Oil discharge from offshore installations and refineries has been reduced by about 40 % between 1990 and 1999. Refineries have reduced their discharges by 68 % while offshore installations have cut back by 35 %. These reductions have been achieved despite increasing production.

Tanker oil spills continue, although both the frequency and amounts involved have declined over the last decade. This may reflect the variability of statistical events, but it is encouraging that the improvement has come despite increasing maritime transport of oil. Increased safety measures implemented in tankers have contributed to this improvement. It should be noted, however, that the data does not include spills and discharges below 7 tonnes, and therefore is an underestimate of oil pollution from maritime transport.

☹ **Highly radioactive waste from nuclear power production continues to accumulate although a generally acceptable disposal route is yet to be identified**

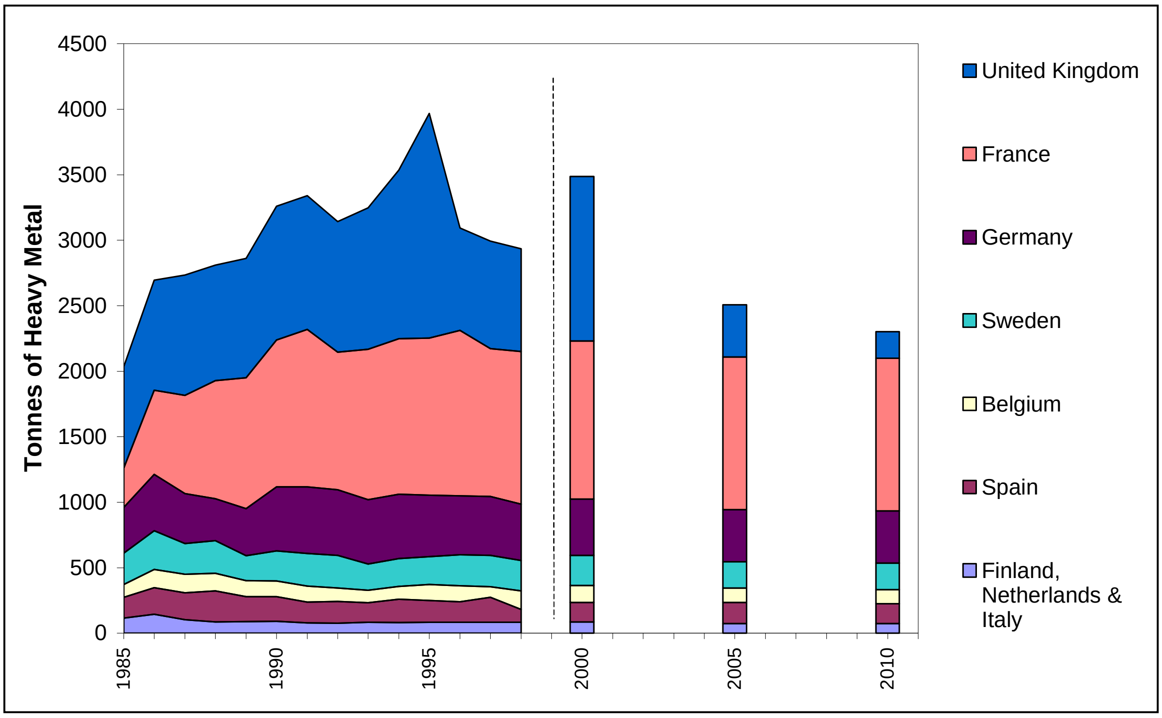


Figure 12 Annual quantities of spent nuclear fuel discharged from nuclear power plant
Source: OECD

Nuclear power produces few direct releases to the environment during normal operation. However it is responsible for a steady accumulation of radioactive waste in storage, for which no generally acceptable disposal route has yet been established. This waste consists of three categories:

- Low Level Waste (LLW) – slightly radioactive materials, such as safety clothing;
- Intermediate Level Waste (ILW) – more radioactive materials such as sludges from water clean up, some reprocessing wastes and decommissioning wastes;
- High Level Waste (HLW) – initially this waste is predominantly spent nuclear fuel. Some fuel is reprocessed to separate plutonium and uranium for re-use as nuclear fuel. The liquid rafinate left over from this process is stored and vitrified into a solid form, which constitutes the second important source of High Level Waste.

Low Level Waste can be disposed of to surface, or near surface burial sites. Plans for the disposal of Intermediate and High Level Waste generally involve deep burial, but at present most waste of this type is held in engineered stores awaiting agreement on the location and design of such repositories. Progress in identifying suitable sites is slow because of a lack of scientific consensus on the methods to be used and public concerns over safety aspects (European Commission, 1998a).

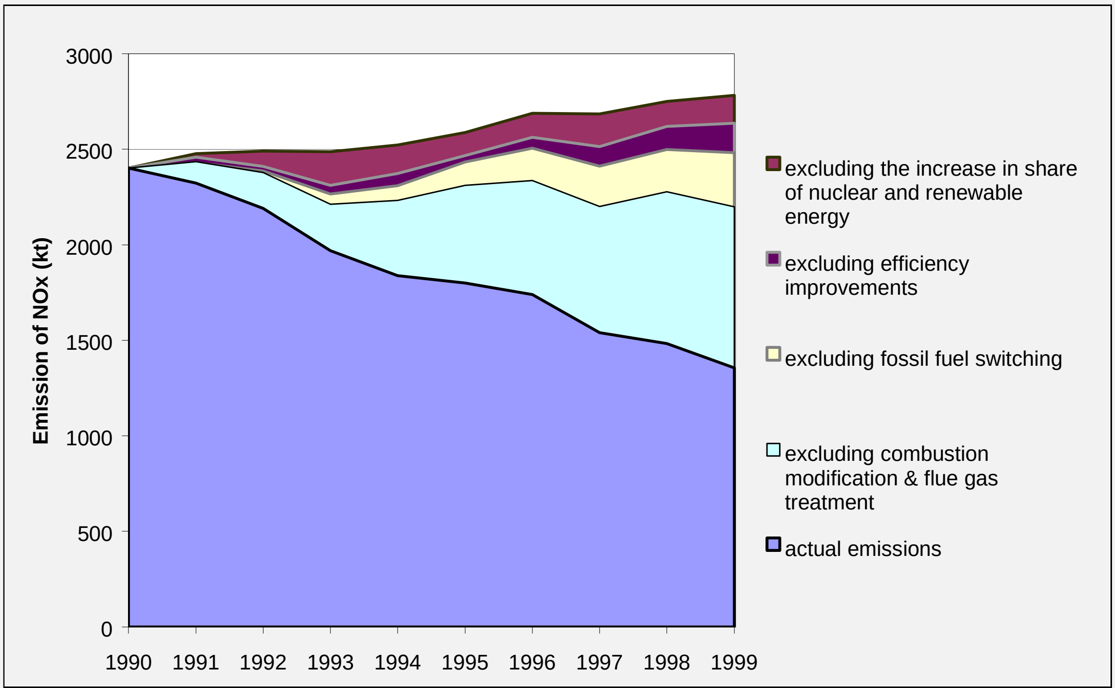
As indicated above, the main source of High Level Waste is the fuel discharged from nuclear power plant after most of its energy has been used up (i.e. spent fuel). This is the most highly radioactive waste and takes several hundred thousands years to decay. It is also the starting point for vitrified High Level Waste, as described above.

The quantity of spent fuel produced provides a ‘reliable representation of the radioactive waste disposal situation and its evolution over time’ (OECD, 1993). The total amount of spent nuclear fuel discharged from nuclear power plant, measured in tonnes of heavy metal, has increased by over 43,000 tonnes between 1985 and 1998 and reflects the total amount of nuclear power produced over that period (OECD, 1999). With only limited potential for increasing the efficiency with which nuclear heat is transformed into electricity in existing power stations or getting more energy out of each tonne of fuel (increased burn-up), a quite similar rate of nuclear fuel discharge can be expected over the next decade for all countries except the UK, reflecting similar rates of nuclear power production. Discharges in the UK decline from 2000 to 2010 as some plants are retired.

BOX 2 - How have the NO_X and SO_2 reductions been achieved in the electricity sector?

NO_x and SO_2 emissions from electricity generation have fallen by 44 % and 60 % respectively over the period 1990 to 1999, despite a 16 % increase in the amount of electricity produced.

Figure B2/1 Explanation for the reduction of emissions of NO_X in the electricity sector



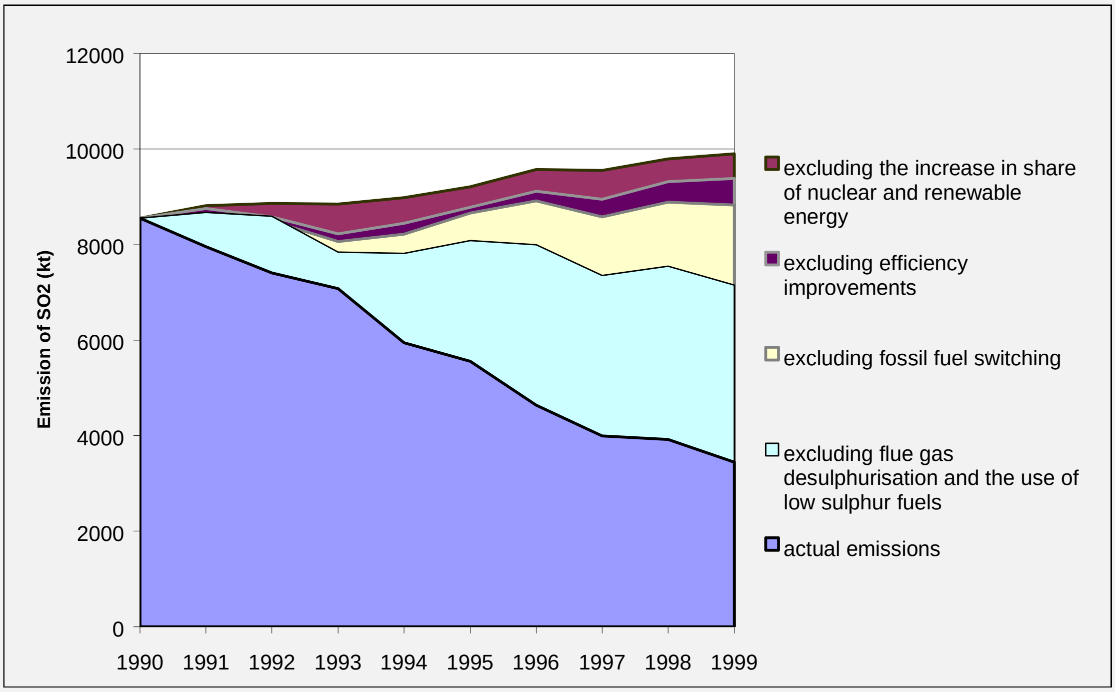
Source: EEA

If the structure of electricity production had remained unchanged from 1990, then by 1999, emissions of NO_x and SO_2 would have increased in line with electricity output by 16 %. In fact, over this period there have been a number of changes in the electricity industry in the EU that have caused annual emissions of NO_x to fall by 44 %, while SO_2 emissions have fallen by 60 %.

For both NO_x and SO_2 emissions, around 60 % of the total decrease is due to the introduction of emission specific abatement measures. In the case of NO_x the most important of these measures are the introduction of flue gas treatment and the use of low NO_x burners. For SO_2 emissions the introduction of flue gas desulphurisation (FGD) and the use of lower sulphur coal and fuel oil have been most significant.

Most of the remaining decrease in emissions of both NO_x and SO_2 has been due to changes in the fossil fuel mix (20–25 %) and, to a lesser extent, improved efficiency of fossil-fuelled electricity production (10 %). The increased shares of non-fossil fuels such as nuclear and renewables have also contributed a similar reduction.

Figure B2/2 Explanation for the reduction of emissions of SO_2 in the electricity sector


12000
10000
8000
6000
4000
2000
0
Emission of SO2 (kt)
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
excluding the increase in share of nuclear and renewable energy
excluding efficiency improvements
excluding fossil fuel switching
excluding flue gas desulphurisation and the use of low sulphur fuels
actual emissions

Source: EEA

2. Are we using less energy?

$$\text{PRESSURE} = \frac{\text{PRESSURE}}{\text{ENERGY}} \times \frac{\text{ENERGY}}{\text{DRIVER}} \times \text{DRIVER}$$

The previous section has shown how energy production and consumption places a broad range of pressures on the environment. All things being equal growth in energy use will result in a corresponding increase in environmental pressures. Therefore one way of reducing the pressures placed on the environment by energy related activities is to use less energy. This in turn can be achieved in two ways. Firstly by reducing the Driver, in other words the demand for energy services (e.g. heat, light, personal mobility, freight delivery, etc.). Secondly by providing these services with more energy efficient devices, thereby using less energy per unit of demand for energy services (i.e. in other words reducing the Energy needed per unit of Driver).

This section takes an overall view of this issue by looking at the pattern of energy consumption. Later sections examine whether we are finding ways of limiting this growing demand and expanding those energy sources that place least pressures on the environment.

☹ **Energy consumption in the EU continued to grow between 1990 and 1999 thereby increasing the pressure on the environment**

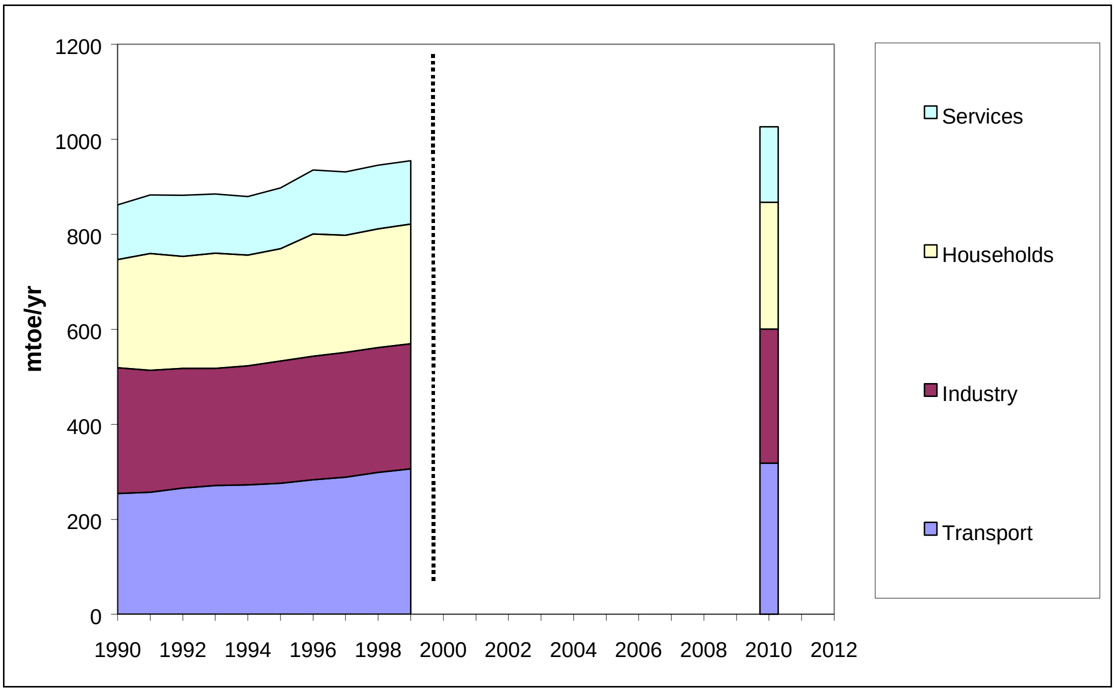


Figure 13 EU Final Energy Consumption[13] by economic sector
Source: Eurostat, Ecofys

Final Energy Consumption in the EU grew by an average of 1.1 % per year between 1990 and 1999. This compares with average EU GDP growth of 2.1 % per year. In absolute terms Final Energy increased in all sectors except manufacturing industry, which had recovered to roughly its 1990 level by 1999. The fastest growth in demand was in transport, which increased its share of Final Energy from 29.4 % to 32 % over the period. The services sector also had faster than average growth, increasing its share from 13.3 % to 14 %.

'Baseline projections' developed for the European Commission[14] (NTUA, 2001) expect continued growth in consumption over the ten years 2000 to 2010, but at a lower rate. Consumption is expected to increase in all sectors. The rate of increase in the transport sector is expected to be less than for 1990 to 1999. This is due to anticipated improvements in road vehicle fuel efficiencies, stemming from the voluntary agreement between car manufacturers and the EU (the ACEA agreement), rather than to a slow down in the growth of demand for mobility.

Within this demand pattern important changes are occurring in the mix of energy sources. Consumption of coal and lignite (outside of electricity production) halved between 1990 and 1999 and is expected to decline further in future years. Coal and lignite are major

[13] Final Energy Consumption is the energy consumption of the transport, industrial, household and services sectors. It includes the consumption of transformed energy (i.e. electricity, publicly supplied heat, refined oil products, coke, etc.) and the direct use of primary fuels such as natural gas or renewables (e.g. solar heat or biomass).
[14] See Annex 1 for information on the 'baseline projections'.

sources of energy related acidifying gases and particulate emissions, as well as releasing more carbon dioxide per unit of energy consumed than other fuels. As shown in the previous section, the environment has already benefited from the trend away from these fuels. In contrast electricity continues to take an increasing share of the market, and if it is produced with the current fuel mix, the pressure on the environment could increase. Oil derived fuel consumption (principally for transport) also grew between 1990 and 1999, and this is expected to continue in absolute terms, although it may take a slightly smaller share of a growing total market by 2010. This reflects the dominance of oil based fuels in transport, with alternative fuels that could place less pressure on the environment only at an early stage of commercial development.

Table 2 Percentage shares of energy sources in Final Energy Demand

	1990	1999
Coal and Lignite	8 %	4 %
Oil	44 %	46 %
Natural Gas	18 %	21 %
Electricity	18 %	20 %
Other*	12 %	11 %

*Other energy sources are publicly supplied heat and direct use of renewable energy sources such as solar heat and biomass.
Source: Eurostat

☹ **Electricity consumption in the EU grew fast and this trend is expected to continue. This could make it more difficult to reduce environmental pressures and in particular greenhouse gas emissions**

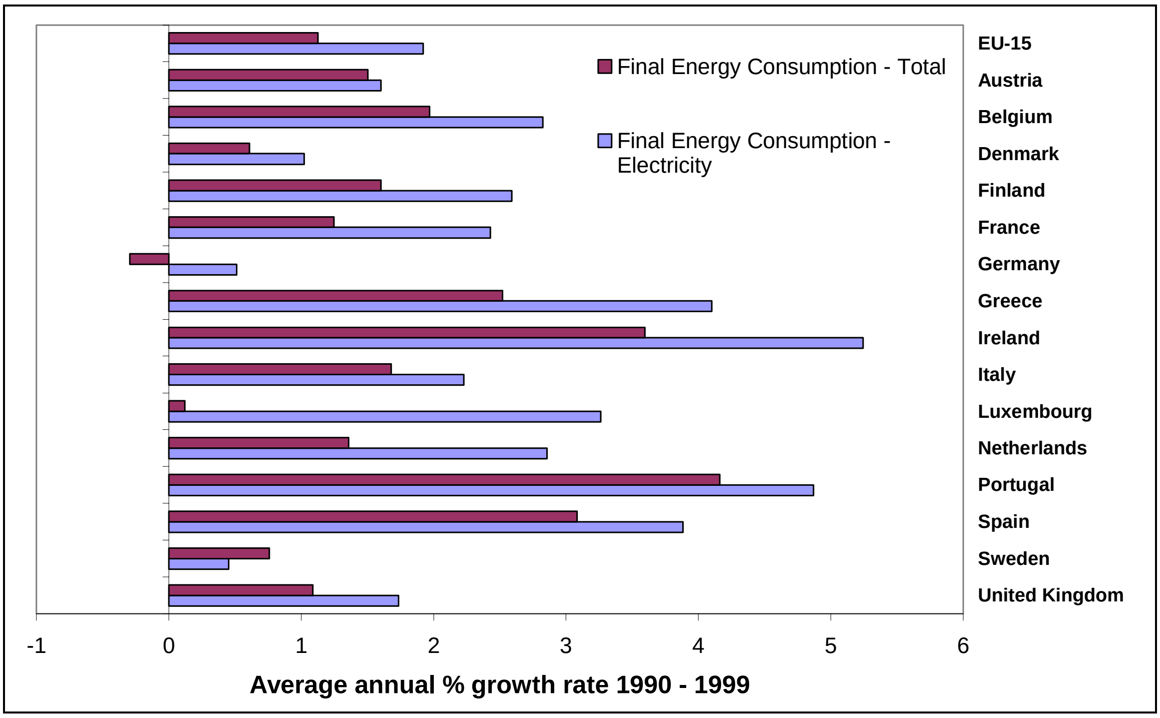


Figure 14 Growth in Final Energy Consumption and in electricity consumption, 1990-1999
Source: Eurostat

Electricity is particularly important to the interaction between energy consumption and the environment for a number of reasons:

- Its flexibility of use, and the importance placed by consumers on the energy services it provides, means that demand is growing significantly faster than for total Final Energy.
- Because electricity is produced from other fuels with a conversion efficiency of typically 30-50 %, consumption of one unit of electricity results in the consumption of two to three units of another energy source. Since most electricity is produced from fossil fuels, without other changes, growth in electricity consumption would result in a disproportionate increase in environmental pressures, in particular, greenhouse gas emissions.
- A large proportion of electricity is produced in large centralised plants that provide better economies of scale for pollution abatement measures.
- There is a strong drive for innovation in electricity production to produce cheaper, cleaner and more efficient technologies.
- Combined heat and power offers substantial energy efficiency gains.
- Electricity offers a route for developing and exploiting non-fossil energy sources.

Consequently an increase in electricity consumption is not necessarily bad news for the environment providing this replaces other energy consumption, and the electricity is supplied by high efficiency and low emissions technologies.

Electricity consumption grew across the EU at an average annual rate of 1.9 % between 1990 and 1999. This compares to a GDP growth rate of 2.1 % per year and overall Final Energy growth of 1.1 % per year, which shows that the linkage between electricity consumption and economic growth remains stronger than for overall Final Energy Consumption. Growth in electricity consumption was particularly strong in the services sector followed by the household sector. In both cases this was linked to additional energy demand rather than the substitution of electricity for another fuel.

Electricity consumption across the EU is projected to continue to grow to 2010 at an annual average rate similar to that between 1990 and 1999 (NTUA, 2001). Once again growth in consumption is expected to be strongest in the economically buoyant services area. Transport related electricity consumption is also expected to expand significantly, driven by further electrification of the rail network, but this occurs from a very low base.

Table 3 Electricity consumption by sector (TWh/year)

	1990	1999	Annual growth in demand 1990-1999 (%)
Household	45	54	2.2
Industry	69	77	1.2
Services	38	49	2.8
Transport	4	5	2.2
Total	156	185	1.9

3. How efficiently do we use energy?

$$\text{PRESSURE} = \frac{\text{PRESSURE}}{\text{ENERGY}} \times \frac{\text{ENERGY}}{\text{DRIVER}} \times \text{DRIVER}$$

Energy efficiency is concerned with minimising the energy needed to meet the demands for energy related services that originate from economic and social drivers (e.g. economic growth, demand for freight transport, demand for personal mobility, demand for warmth and comfort in the home, etc.). Cost effective improvements in the way we use energy offer a "win-win" option for reducing the pressures placed on the environment by the use of energy. In addition energy efficiency also saves money and contributes to the EU's energy security. Energy efficiency applies both to the production and consumption of energy.

Efficiency in the energy supply industries (e.g. electricity production, oil refining) is comparatively easy to measure, being the ratio of the energy input to the energy output.

However, with energy consumption the position is not so simple because there is more than one way to consider and measure energy efficiency. There are two basic sets of indicators for energy efficiency:

- Economic and Social indicators - these are Energy Intensities and measure the energy needed to support economic activity (e.g. energy per unit of GDP or Value Added) or to provide social needs (e.g. energy per capita). They measure changes in energy efficiency arising from both structural and technological change.
- Technical indicators - these are Specific Energy Consumptions and measure the energy needed to produce a unit of physical output (e.g. energy per tonne of steel production). They measure changes in energy efficiency arising from technological changes alone.

The economic and social indicators (Energy Intensities) are more broadly based since they measure both technological improvements (e.g. making steel with less energy) and improvements stemming from structural and social change. For example individual citizens could reduce their energy consumption by, using public transport in preference to their cars or by living in smaller less well heated houses, as well as by using more efficient appliances. Similarly businesses could use less energy per unit of value added not only by cutting their energy consumption, but also by moving production to products that require no more energy but yield a higher added value. As such the economic and social indicators measure energy efficiency improvements stemming from deliberate energy saving actions and policy measures together with improvements driven by factors not related to energy efficiency considerations such as product development and the impacts of foreign competition.

In this report the Energy Intensities (i.e. Economic and Social Indicators) are used to measure trends in energy consumption efficiency, while efficiency in energy supply is measured by the ratio of energy input to energy output. The use of Energy Intensities is partly because both EU and Member State policies aim to reduce the environmental pressures associated with energy consumption while maintaining economic development and the prosperity of the EU's citizens (European Commission, 2001b). It should be noted that at present there is insufficient data to support a comprehensive assessment of technical energy efficiency improvements. Eurostat is currently working to collect such data sets.

☹ **The overall efficiency with which energy is converted for final consumption within the EU economy has not improved between 1990 and 1999. An increase in efficiency would indicate that the pressures on the environment due to energy supply were being reduced per unit of total energy used**

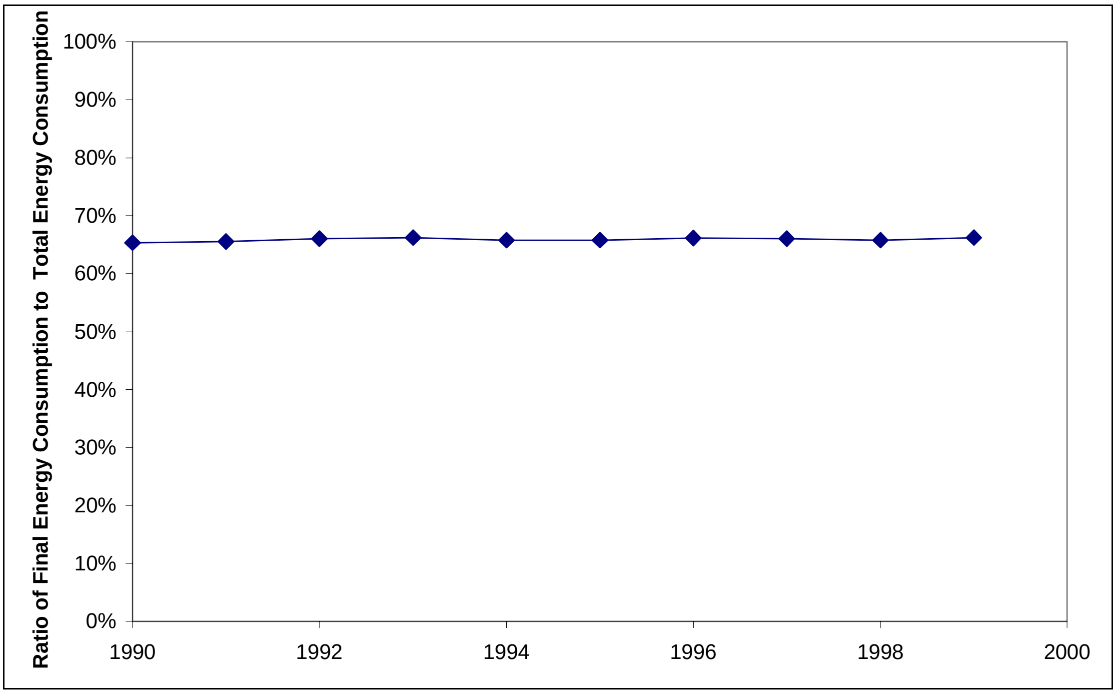


Figure 15 Ratio of Final Energy Consumption to Total Energy Consumption
Source: Eurostat

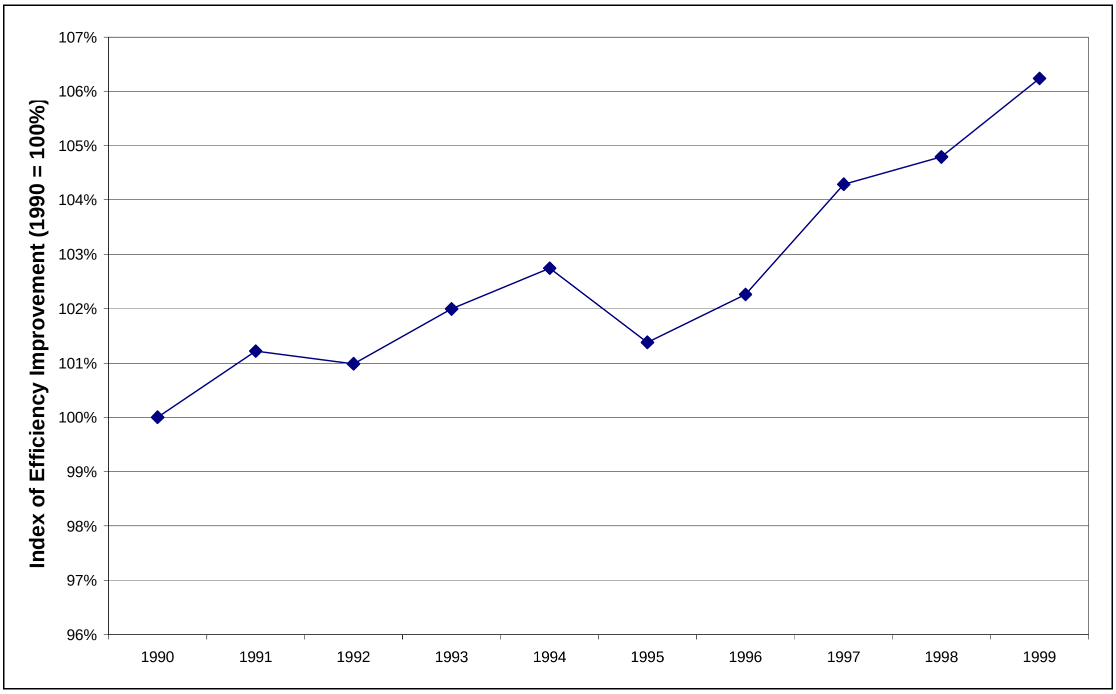
The overall efficiency by which primary energy is converted into usable or Final Energy in the EU can be measured by the ratio of Final Energy Consumption[15] to Total Energy Consumption[16]. The difference between Total and Final consumption is accounted for by the energy used in conversion processes such as electricity generation and oil refining, the energy supply industry's own consumption and losses in delivery and distribution.

This ratio has remained fairly constant for the EU at about 65 % between 1990 and 1999 showing no improvement. This behaviour is due to the efficiency gains in conversion processes being off set by converted fuels (e.g. electricity) taking a larger share of final energy consumption (see Box 3).

[15] See Footnote 10

[16] Total Energy Consumption is also known as Gross Inland Energy Consumption (GIEC). It is a measure of the energy inputs to the economy and can be calculated by adding total indigenous energy production, energy imports minus exports and net withdrawals from existing stocks.

☹ **The overall efficiency of electricity production from fossil fuels improved by 6 % between 1990 and 1999. However, with electricity consumption growing by almost 19 % over the same period, and fossil fuels retaining their share of production, this alone was not sufficient to reduce the pressure placed on the environment by electricity production**



Notes
1. The calculation on the efficiency of electricity production from fossil fuels included fuel inputs for both electricity and heat production from public combined heat and power plant and only electricity output from combined heat and power plant.
4. The fuel input and output data includes biomass/waste which accounted for 3 % of electricity production in 1999.

Figure 16 Improvement in fossil fuel electricity production efficiency
Source: Eurostat

With electricity taking an increasing share of the EU's energy consumption, it is important for electricity production to operate with maximum efficiency. This is doubly important for electricity produced by fossil fuelled plant, which is a major source of greenhouse gas emissions and emissions of air pollutants. The share of electricity produced by fossil fuelled plant has remained steady at a little over 50 % over the period 1990-1999. Some improvement in electricity production efficiency can be gained by better operational management within plant. However, the major improvements come from the retirement of old inefficient facilities when they reach their design lives (i.e. typically 25 to 40 years). Therefore investment decisions on new plant being made now will affect the environmental performance of electricity production for several decades to come.

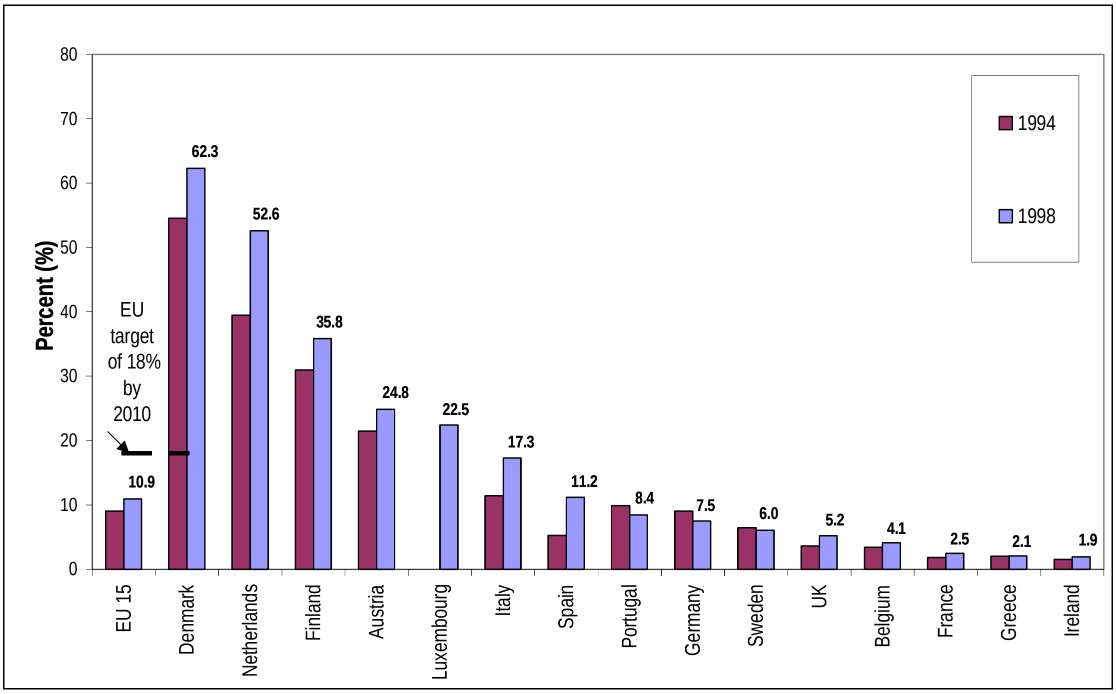
Although production from fossil fuel plant has remained steady there have been significant changes to the mix of fuels used (see later indicator) and in the mix of electricity production technologies in operation (Table 4). The most important changes are the switch to gas firing, which increased from 14 % of production in 1990 to 33 % in 1999, and investment in gas turbine combined cycle plant. Gas turbine combined cycle plant can achieve conversion efficiencies of the order of 50-55 %, with the prospect of even higher efficiencies in future plant, compared to 36-38 % for the steam turbine plant used with coal and lignite (European Commission, 1998b). This has made a significant contribution to the overall improvement in the efficiency of electricity production from fossil fuels recorded between 1990 and 1999.

Table 4 Percentage of fossil fuelled electricity production capacity by technology

	1990	1993	1996	1999
Steam turbines	91 %	88 %	82 %	78 %
Gas turbines (single cycle)	7 %	7 %	8 %	8 %
Gas turbines (combined cycle)	1 %	4 %	8 %	12 %
Oil and gas engines	1 %	1 %	2 %	2 %

Source: Eurostat

☹ **The penetration of Combined Heat and Power increased across the EU between 1994 and 1998, but it needs to grow faster to meet the EU's target to have 18 % electricity production from this technology by 2010. Preliminary information suggests that Combined Heat and Power production has declined between 1998 and 2001.**



Notes:

1. No data for Luxembourg for 1994.
2. The method for data collection by Eurostat on combined heat and power is under revision. This may result in some adjustments of the percentage contributions of CHP electricity in gross electricity generation reported here.
3. The data includes combined heat and power generation from public electricity and heat producers and from autoproducers (at specific industrial sites).

Figure 17 Share of gross electricity production from Combined Heat and Power plant
Source: Eurostat

As its name suggests combined heat and power (CHP) technology uses fossil fuels, biomass or waste to generate a mix of heat and electricity. In so doing it avoids much of the waste heat losses associated with normal power generation, thereby utilising over 80 % of the energy in the input fuel rather than the 35-60 % used in plant producing only electricity. Therefore an expansion of CHP could make an appreciable contribution to energy efficiency and consequently to the environmental performance of electricity and heat production. For this reason the EU has set an indicative target to derive 18 % of all electricity production from CHP by 2010 (European Commission, 1997a).

CHP increased its share of electricity production from 9 % to almost 11 % between 1994 and 1998, although this rate of expansion is not sufficient to achieve the EU's target. Growth was strongest in Member States that have positive programmes and targets for the technology such as The Netherlands, Finland and Denmark. However, progress in other countries with ambitious targets, such as Germany (20 % of power by 2010) or the UK (increase capacity from 3 to 10 GW, 1994-2010) was less.

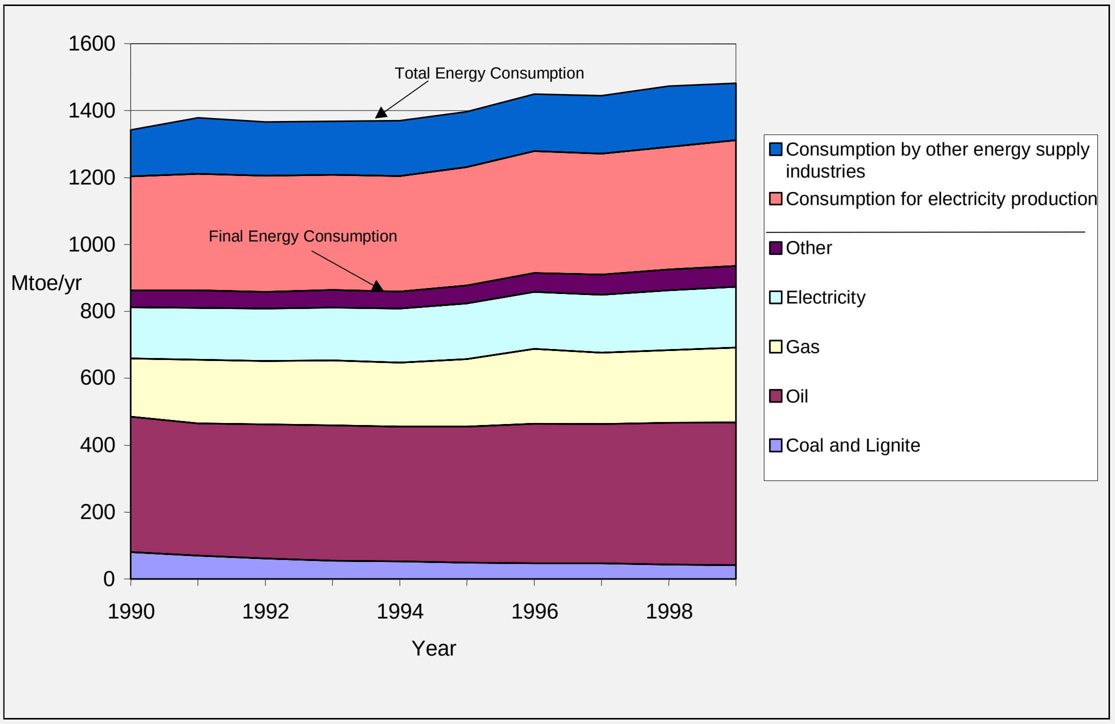
Greater concern is raised by preliminary information for 2001, which suggests that CHP production has declined since 1998 (Cogen Europe, 2001). This reverse is spread across the EU, but has been particularly severe in the Netherlands, the UK and in Germany, which has retired 3GW of coal and lignite fired capacity.

This decline in CHP has been caused by a combination of factors:

- Increasing natural gas prices (gas is the preferred fuel for new CHP) have reduced the cost competitiveness of CHP.
- Falling electricity prices, resulting from market liberalisation and increased competition, have also hit the cost competitiveness of CHP.
- Uncertainty over the evolution of electricity markets as liberalisation is progressively extended is making companies reluctant to invest in CHP.
- Aggressive pricing by electricity utilities to protect their market.

Clearly further measures are needed across the EU if it is to achieve the target of producing 18 % of electricity from CHP, against a background of growing electricity demand and increasing liberalisation of the electricity markets.

BOX 3 - Why is the EU's overall energy conversion efficiency not improving?



Notes:
1. "Consumption of other energy supply industries" includes oil refineries, fossil fuel extraction, heat production by public producers, heat and electricity production by autogenerators and the production of other processed fuels such a smokeless solid fuel.
2. The "Other" category in Final Energy Consumption includes heat and biomass/waste.

Figure B3/1 Components of Total and Final Energy Consumption
Source: Eurostat

The ratio of Final to Total Energy Consumption has remained almost constant at about 65 % over the period 1990-1999. This constant relationship is the result of two approximately equal, but opposing effects.

- The overall efficiency of electricity supply (including own use and distribution) improved by about 5 % between 1990 and 1999. This had reduced the energy consumed by the electricity industry by 5 % compared to what would have been consumed without such an improvement in efficiency. This trend on its own would have increased the ratio of Final to Total energy consumption (i.e. less Total Energy is needed to satisfy the demand from final consumers).
- The share of electricity in final consumption increased by 2 % between 1990 and 1999. This increased the amount of energy consumed in electricity in 1999 by 2 % divided by the overall efficiency of electricity production in 1999 (i.e. about 33 %), which is about 6 % in total. This trend caused the ratio of Final to Total energy consumption to decrease (i.e. more Total energy is needed to satisfy the demand from final consumers).

Outside of electricity the efficiency of oil refining has fallen by about 1 % between 1990 and

1999, reflecting the additional energy needed to produce higher specification fuels (i.e. low sulphur, lead free). Again this would cause a decrease in the ratio of Final to Total energy. However, the energy consumption of other energy supply industries has fallen, due to such factors as the run down of coal mining, which would increase the ratio of Final to Total Energy Consumption.

Overall these trends have effectively cancelled out so resulting in a fairly constant ratio of Final to Total Energy Consumption.

☹ **The linkage between economic growth and energy consumption is being reduced but not fast enough to stop the growth of energy consumption and energy related pressures on the environment**

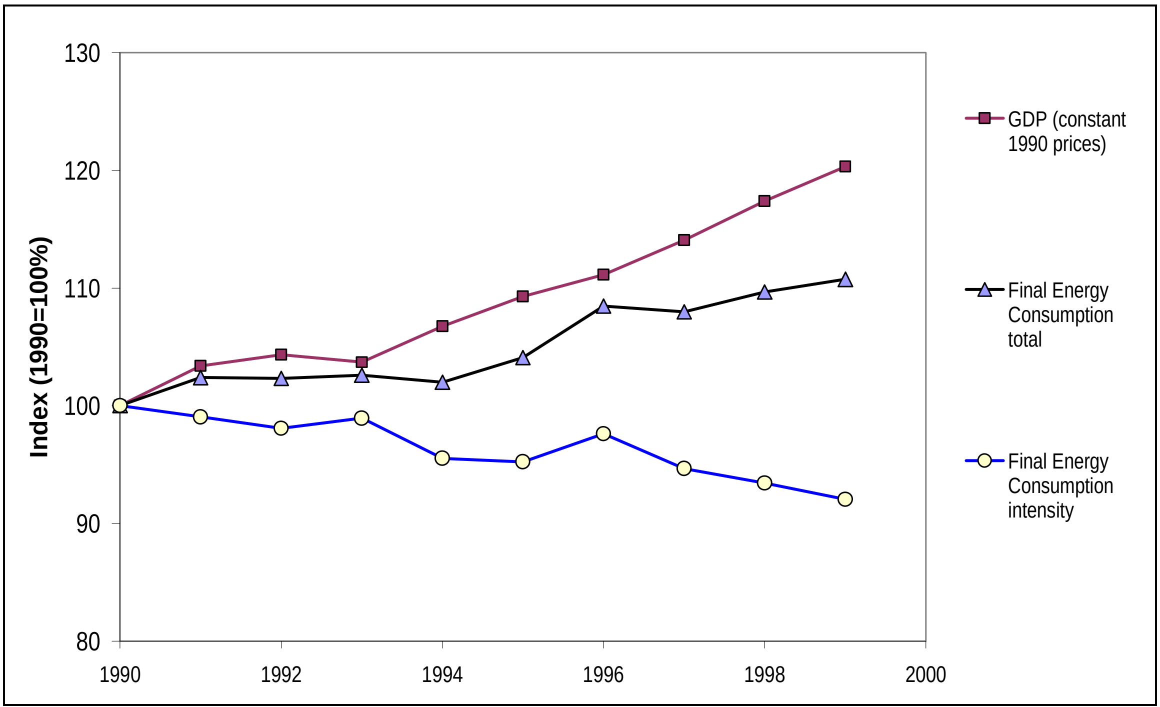


Figure 18 Index of Final Energy Consumption, GDP and Final Energy Intensity
Source: Eurostat

Both the EU and the Member States aim, through a range of policies, to reduce the environmental pressures associated with energy consumption while maintaining economic development and the prosperity of the EU's citizens (European Commission, 2001a). The overall success of these policies can be measured by the Final Energy Intensity (i.e. Final Energy Consumption per unit of GDP). If the energy intensity is reduced by an amount at least equal to the increase in GDP, then energy consumption will not have grown and we will be succeeding in de-coupling energy consumption from economic development.

The EU's Final Energy Intensity fell by an average of 1 % per annum between 1990 and 1999. However, this was not sufficient to prevent an increase in final energy consumption because average GDP growth was higher at 2.1 % per year.

The Final Energy Intensity of Member States in 1999 varied by more than a factor of 2, reflecting differences in their state of development and structure of their economies as well as climate variations. Furthermore, six Member States actually recorded increases in energy intensity over the period, and the overall intensity for the EU would have increased if it were not for the substantial reduction made by Germany.

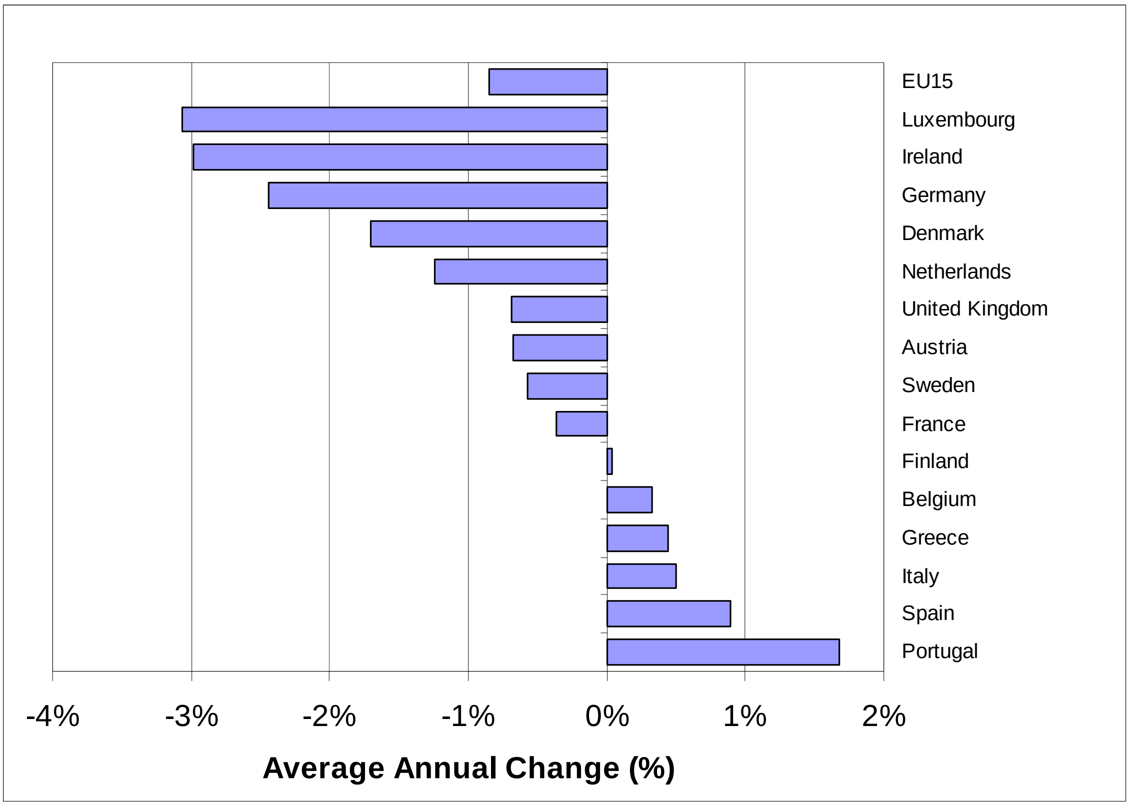


Figure 19 Annual change in Final Energy Intensity, 1990-1999
Source: Eurostat

The rate of improvement in Final Energy Intensity is less than for earlier years. Between 1973 and 1990 the EU achieved an average annual reduction of 1.9 %. This was driven by the oil price rises of the 1970's and early 1980's, which prompted energy saving measures that persisted after oil prices fell once more. However, in the 1990's the combination of adequate supplies, low fossil fuel prices, and a generally low priority for energy saving has resulted in a slower rate of improvement.

Table 5 Average annual rates of change of Final Energy Intensity

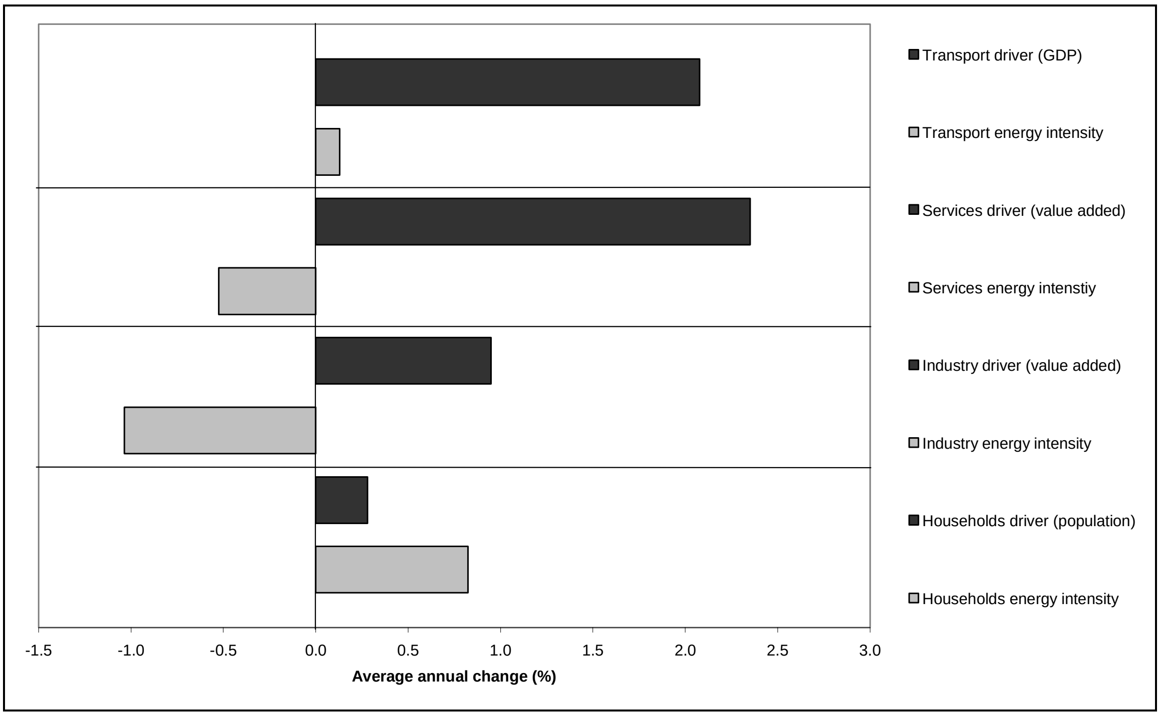
	Change in Final Energy Intensity (%/year)
1973-1990	-1.9
1990-1999	-0.9

Source: Eurostat

Looking ahead the 'baseline projections' developed for the European Commission (NTUA, 2001) were based on an average annual growth in the EU's GDP of 2.4 % per year between 2000 and 2010. If the rate of improvement in Final Energy Intensity continued between 2000 and 2010 at the 0.9 % per year rate recorded from 1990 to 1999, this rate of economic growth would result in a further energy consumption increase between 2000 and 2010.

The European Commission proposed and the Council supported an EU indicative target of reducing final energy intensity by 1 % per year above 'that which would have otherwise been attained' for the period 1998-2010 (The Council of the European Union, 1998 & European Commission, 2000c). However, 'that which would have otherwise been attained' has not yet been defined and so how such a target can be measured and monitored is unclear.

☹ **With the exception of industry, none of the EU's economic sectors have decoupled their economic/social development from their energy consumption sufficiently to stop the growth of their energy consumption**



Note: Energy intensities for the industry and services sectors have been calculated as the ratio of final energy demand to value added. Energy intensity in transport is the ratio of final energy demand to GDP, while for households it is final energy demand per capita. The energy intensities are therefore not directly comparable and have been shown on the graph for illustrative purposes only.

Figure 20 Annual change in sectoral energy intensities and related drivers, 1990-1999
Source: Eurostat

For any sector of the EU's economy to break the linkage between growth and energy consumption the rate of reduction of its energy intensity must at least be equal to its rate of growth.

The industry sector has shown a sustained improvement in energy intensity, averaging 1 % per year between 1990 and 1999, which was sufficient to off-set the rate of growth in the sector measured in terms of value added. A wide range of factors have contributed to this, including structural changes in favour of higher value added products, changes in some industries to less energy intensive processes, direct improvements in energy efficiency and import substitution. There is still a large potential for energy saving in this sector which the EU and national governments are seeking to gain through voluntary agreements with individual production sectors and the promotion of combined heat and power (European Commission 1997a and 2000c).

Services have also shown a reduction in energy intensity averaging 0.5 % per year between 1990 and 1999, mainly due to a more rapid rate of improvement in the last three years of

[18] This figure excludes fuels for international shipping from total transport energy use. Including fuels for international shipping changes this figure to 74 %.

that period. About 84 % of energy consumption in this sector is associated with installed devices such as space heating/cooling, water heating, lighting, etc. (European Commission 2001e) with the remaining 16 % mainly made up of office equipment. Energy saving in these areas will benefit from the proposed directive on the energy performance of buildings, which has suggested that a 22 % reduction on present consumption by installed devices in service sector and domestic buildings can be achieved by 2010 (European Commission, 2001c). The service sector is also leading the growth in electricity demand particularly for office equipment and lighting. This trend is being addressed through the EU's plans to strengthen the energy efficiency labelling scheme for office equipment (Council, 2001), and the requirement to assess the economic potential for combined heat and power in new buildings and major refurbishments (European Commission 2001e).

Decoupling transport growth from economic growth, and stabilising the modal split at 1998 levels by 2010 are important objectives of the revised Common Transport Policy and the proposed EU strategy for sustainable development (European Commission, 2001g and 2001h). Overall the energy intensity of the transport sector has stayed fairly constant between 1990 and 1999. In 1998 85 %[18] of transport energy use was associated with roads. Technical developments with passenger cars may have yielded some improvement in fuel efficiency between 1990 and 1999 although this has been partly offset by the use of heavier and more powerful vehicles, and devices that increase comfort and safety. Passenger car fuel efficiencies should improve further in the next ten years through the voluntary agreement between the EU and the car manufacturers (the ACEA agreement). This aims to reduce the average carbon dioxide emission of new cars to 140 g CO_2/km by 2008-2009 (equivalent to a 25 % improvement on 1995 vehicles). However, these technical developments alone are not sufficient to yield an improvement in road transport energy intensity (ADEME, 1999). This is because energy consumption is also dependent on other factors including driver behaviour, congestion, journey types, choice of vehicle, vehicle maintenance, rate of replacement of old cars, etc. Taking account of these factors, and the expected growth of demand for both passenger and freight transport, energy consumption is expected to continue to increase in the transport sector. More detailed analysis of the transport sector is given in the TERM 2001 indicators report (EEA 2001b).

Household sector energy intensity, measured as household energy use per capita, has increased between 1990 and 1990. This is because improvements in house insulation and the efficiency of appliances have been off-set by an increase in the number of dwellings (up by 10 % between 1990 and 1999), an increase in the average size of dwelling, increased comfort levels (e.g. home heating) as living standards improve and growth in the purchase and use of appliances including televisions, computers, freezers, air conditioning, etc. The potential for energy savings in the household sector is high (~ 22 %), and will be encouraged by the proposed Directive on the energy performance of buildings, which includes minimum standards of energy performance for new buildings and for certain existing buildings when they are renovated, and the requirement for all buildings to have energy performance certificates (European Commission 2001e). The sector should also benefit from the EU's appliance labelling scheme (European Commission, 2000d).

4. Are we switching to less polluting fuels to meet our energy needs?

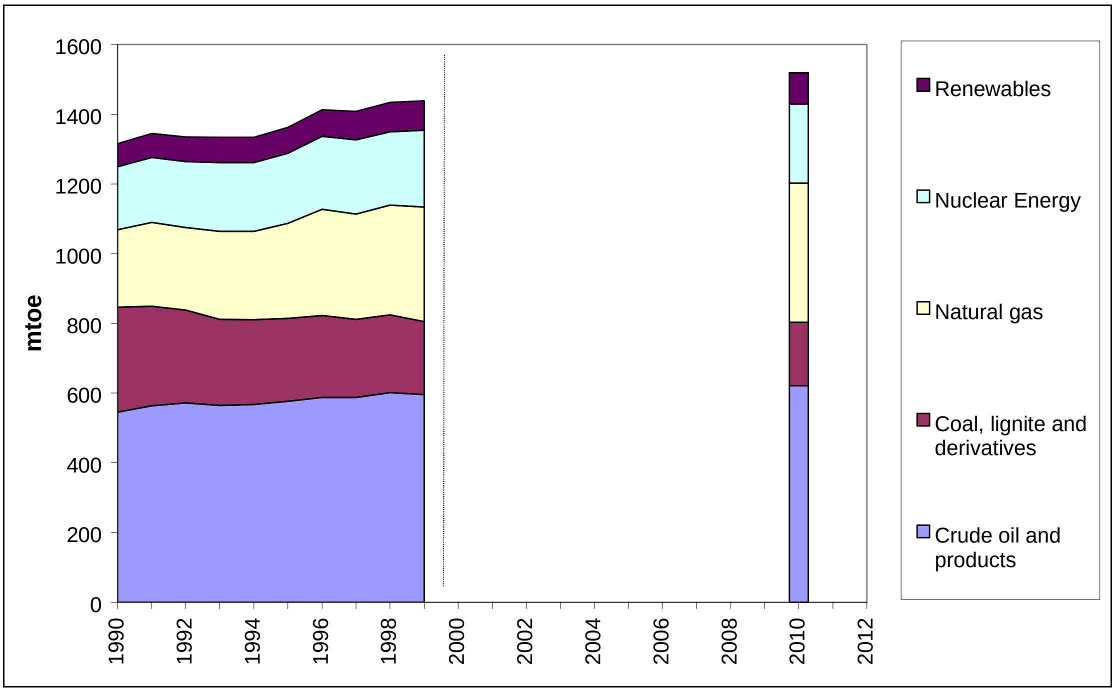
$$\boxed{\text{PRESSURE}} = \boxed{\frac{\text{PRESSURE}}{\text{ENERGY}}} \text{ x } \boxed{\frac{\text{ENERGY}}{\text{DRIVER}}} \text{ x } \boxed{\text{DRIVER}}$$

The production and consumption of energy places a broad range of pressures on the environment. The main source of such pressures is fossil fuels that release gaseous, liquid and solid phase pollutants. The magnitude of these pressures can be reduced by adopting advanced technologies that limit such releases either by cleaner combustion techniques or with end-of-pipe treatments. An additional, or in some cases alternative approach, is to use more clean fuels in the first instance. This section examines this second option with indicators of the trends in the mix of fuels being used across the EU.

Pollution arising from the combustion of fossil fuels includes emissions of sulphur dioxide, nitrogen oxides, particulates, liquid effluents and solid wastes. Coal and lignite are generally the most polluting fuels followed by oil, with natural gas being the cleanest of the fossil fuels. This merit order also applies in relation to greenhouse gas emissions with natural gas typically producing only 63 % and oil 80 % of the emissions of coal per unit of energy. It is therefore beneficial from an environmental perspective to have fuel switching from coal and lignite to relatively cleaner natural gas.

Renewable sources of energy such as biomass, wind energy and hydro-power produce comparatively little air pollution or greenhouse gas emissions. Therefore their deployment would have an even greater benefit in reducing pollution than a switch to natural gas, although they can have some adverse impacts on the environment such as loss of natural amenities, loss of habitat, visual intrusion and noise. Nuclear power also produces little pollution under normal operations. However, there is a risk of accidental radioactive releases and highly radioactive wastes are accumulating for which no generally acceptable disposal route has yet been established.

☹ **Fossil fuels continue to dominate the energy we use but the environmental pressures they cause have been limited by switching from coal and lignite to relatively cleaner natural gas**



Note: Fuels other than those listed in the legend have been included in the diagram but their share is too small to be visible

Figure 21 Distribution of Total Energy Consumption by fuel type
Source: Eurostat, NTUA

The EU's Total Energy Consumption[19] continued to increase between 1990 and 1999 at an average rate of 1 % per year. Moreover, the share taken by fossil fuels declined only slightly from 81 % in 1990 to 79 % in 1999. This small loss of market share was taken up by increases in nuclear and renewable energy. Although small in terms of market share, the growth in renewable energy represented a 29 % increase over the period (see renewable energy indicator, Figure 23).

Within the share of Total Energy Consumption supplied by fossil fuels there was a major change in fuel mix, with coal and lignite loosing about one third of their market, and being replaced by natural gas. This was mainly due to fuel switching in power generation. Oil retained its share of the energy market, reflecting its continued dominance in road and air transport. This growing dependence on oil and gas, with a substantial share of both met by imports, means that the EU's dependence on imported fossil fuels has increased between 1990 and 1999.

Looking to the future, the 'baseline projections' for the European Commission (NTUA, 2001) indicate Total Energy Consumption continuing to increase to 2010, but at a reduced rate. Natural gas is expected to continue to replace coal and lignite, but not so fast as in the 1990 to 1999 period, while oil products continue to dominate road transport. Renewable energy is also expected to increase, but the rate of growth is not sufficient to increase its share of total consumption.

[19] See Footnote 11.

Policies aimed at influencing the types of energy we use are pursued at EU and Member State levels. These policies seek to take an integrated approach in order to accommodate concerns over security of supply, and the provision of energy at reasonable prices, as well as environmental concerns. Renewable energy sources benefit both security of supply and the environment, and consequently have been an important target for recent policy action (European Parliament and the Council, 2001 and European Commission, 2001f).

The ‘baseline projections’ were based on policies and measures adopted by November 1997 (plus the ACEA Agreement). The fact that they suggest only limited changes in the energy mix by 2010, underlines the need to strengthen support for renewable energy.

☹ **Fossil fuels and nuclear power continue to dominate electricity production, although the environment has benefited from a switch from coal and lignite to natural gas**

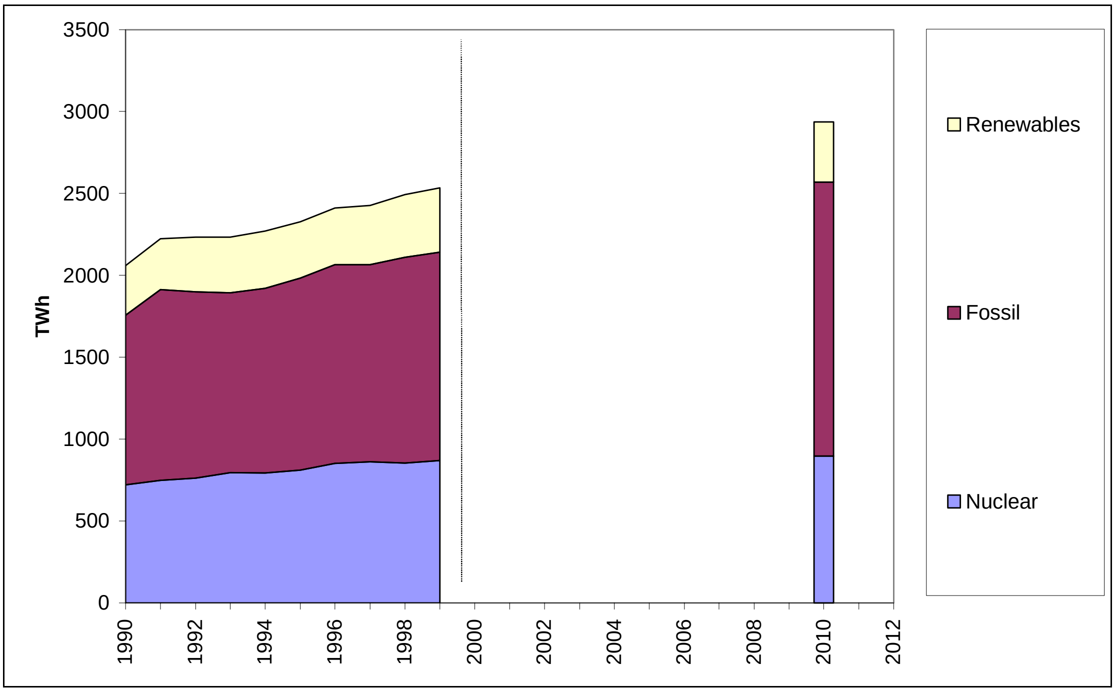


Figure 22 Breakdown of electricity production by fuel
Source: Eurostat, NTUA

EU electricity production remains a major source of pollution emissions. However, because of the limited number of facilities involved, and the rapid rate of technological advance, it is a key area to achieve improvements in environmental performance. One such option is to switch production to high efficiency plant using less polluting fossil fuels (e.g. natural gas) or renewable energy sources.

Between 1990 and 1999 electricity production grew at an annual rate of 2.3 %, and fossil fuels maintained their share of output at a little over 50 %. However, major changes occurred in the mix of fossil fuels used for electricity production with coal and lignite, and to a lesser extent oil, being replaced by natural gas. This switch has yielded environmental benefits, as discussed previously, in terms of reduced emissions of carbon dioxide, acidifying gases and particulates. This trend has been driven by a combination of factors:

- The high efficiency and low capital cost of gas combined cycle plant.
- Liberalisation of the electricity supply market bringing in new generators, ready to invest in low capital cost gas plant.
- Low gas prices in the early 1990s.
- The EU's Large Combustion Plant Directive that sets emissions limits that are more easily attained with modern and cleaner natural gas technologies.

Nuclear power increased its output by an average of 2.1 % per year between 1990 and 1999 through a combination of the commissioning of new plant and the improved performance of existing facilities. The other major source of electricity production was renewable sources, which increased their market share from 14.7 % in 1990 to 15.5 % in 1999[20]. Hydro was by far the largest of the renewable energy sources accounting for 85 % of renewable electricity production. However, this figure hides remarkable growth in the production from certain of the “new renewable” sources, which are discussed in the next section.

Projections of future trends in electricity production from the European Commission’s ‘baseline projections’ (NTUA, 2001) anticipate fossil fuels taking an increasing share of a market that continues to grow at a similar rate to 2010. This is because the projections are based on the policies and measures in place in November 1997, plus the ACEA Agreement, (see Annex 1), and neither nuclear power nor renewable energy sources are expected to expand significantly under these policies. The trend to switch to natural gas electricity production is also expected to continue, although this projection is particularly sensitive to future fossil fuel prices.

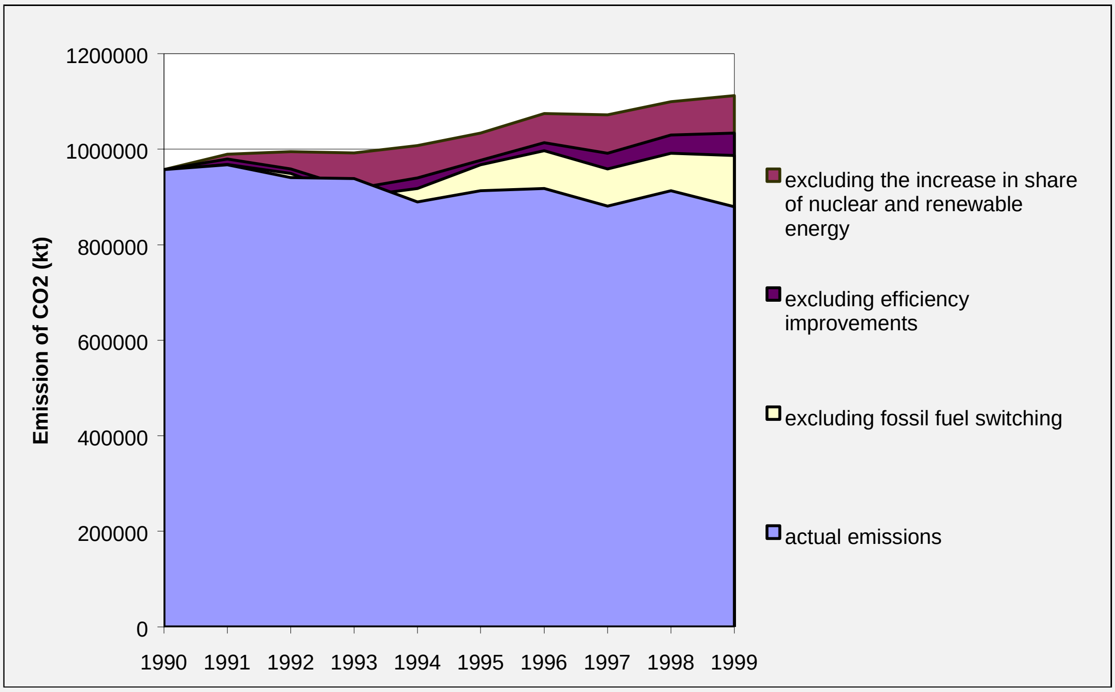
The switch from coal and lignite to natural gas for electricity production will clearly bring environmental benefits in terms of reduced emissions of carbon dioxide, acidifying gases and particulates. However, looking beyond 2010 the trend for increased electricity production from fossil fuels, and in particular the slow growth of renewable electricity production is a matter for concern. After 2010 nuclear plant will start to be decommissioned, and if this capacity is also replaced by fossil plant it seems inevitable that there will be a growth in carbon dioxide and other emissions. Once again this highlights the importance of policies and measures to stimulate the development and deployment of renewable energy technologies.

[20] Note that electricity production is equal to electricity consumption less imports plus exports and so the share of renewables in electricity production stated here is not equal to the share of renewables in electricity consumption in Figure 24.

BOX 4 - How have CO_2 emissions been reduced in the electricity production sector?

CO_2 emissions from electricity generation have fallen by 8 % over the period 1990-1999, despite a 16 % increase in the amount of electricity produced.

Figure 4/1 Explanation for the reduction of emissions of CO_2 in the EU electricity sector.



Source: EEA

If the structure of electricity production had remained unchanged from 1990, then by 1999, emissions of CO_2 would have increased in line with electricity output by 16 %. In fact, over this period there have been a number of changes in the electricity industry in the EU that have caused annual emissions of CO_2 to fall by 8 %.

46 % of this reduction can be attributed to changes in the fossil fuel mix from coal and lignite to natural gas. A further 20 % of the improvement came from an increase in the efficiency of fossil fuelled electricity production and much of this is also linked to the switch to high efficiency gas turbine combined cycle technology. The remaining 34 % of the reduction is attributable to the increased share of nuclear power and renewable energy sources in the fuel mix.

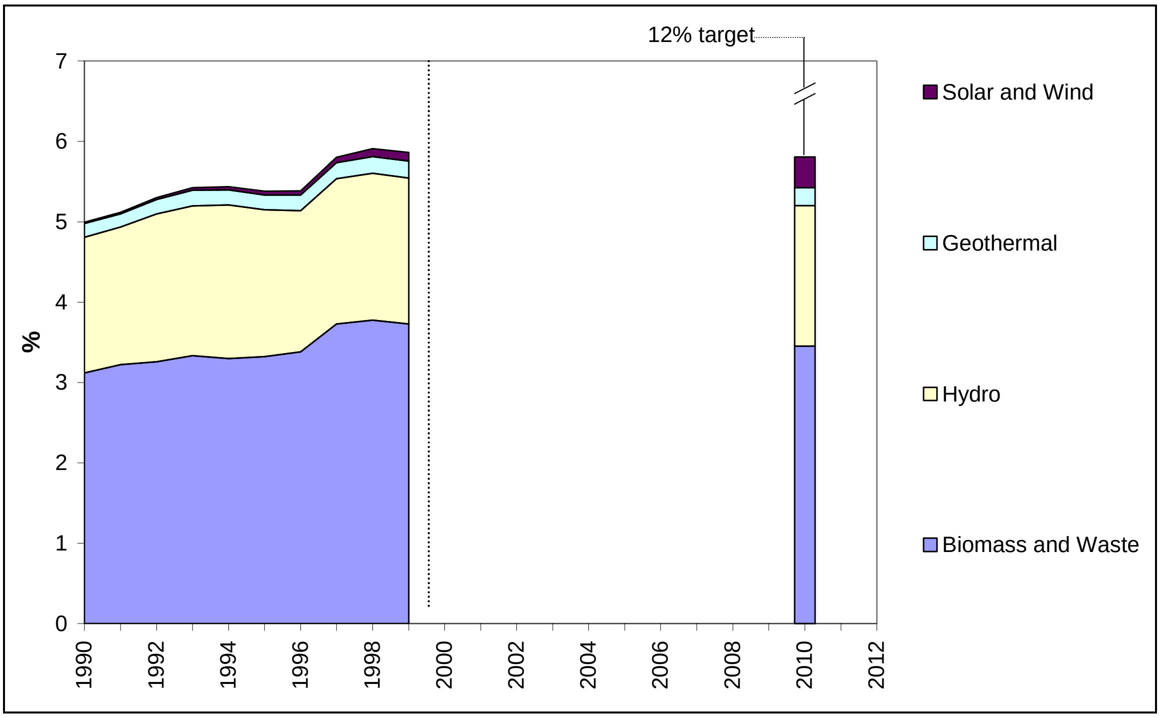
Note The figures in Box 4 are subject to review and may be revised slightly

5. How rapidly are renewable energy technologies being implemented?

$$\boxed{\text{PRESSURE}} = \boxed{\frac{\text{PRESSURE}}{\text{ENERGY}}} \times \boxed{\frac{\text{ENERGY}}{\text{DRIVER}}} \times \boxed{\text{DRIVER}}$$

Renewable energy sources offer one important option for reducing the pressures placed on the environment through energy use. They can also contribute to the energy security of the EU by replacing imported fossil fuels. The significance of renewable energy has been recognised in a number of EU policy documents concerned with accelerating its deployment; notably the Renewable Energies White Paper (European Commission, 1997b), the Directive on the Promotion of Electricity from Renewable Energy Sources (European Parliament and Council, 2001b), and the proposed Directive on the promotion of the use of biofuels for transport (European Commission, 2001f). However, the promotion of renewable energy is also a matter for Member States since the resources vary between countries as do the infra-structures and market conditions into which they need to fit.

☹ **The share of Total Energy Consumption met by renewable energy has grown only slightly between 1990 and 1999, and on current trends will fall well short of the 12 % indicative target proposed for the EU by 2010**



Note: Biomass/wastes include wood, wood wastes, other biodegradable solid wastes, industrial and municipal waste (of which only part is bio-degradable), biofuels and biogas.

Figure 23 Share of Total Energy Consumption provided by renewable energy sources
Source: Eurostat, NTUA

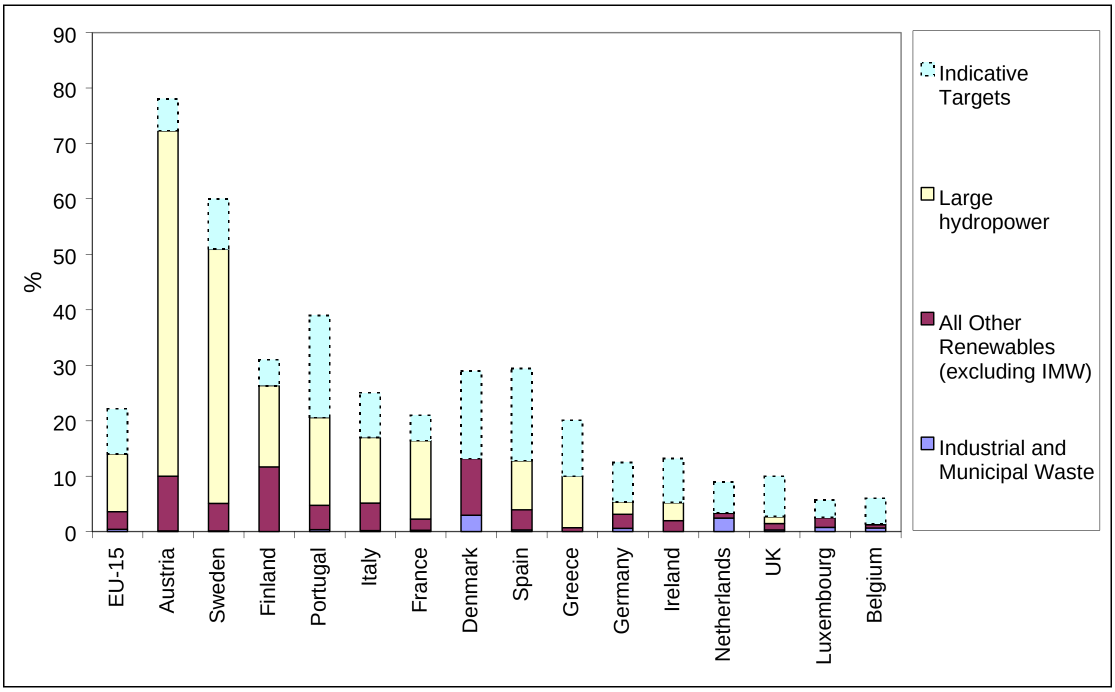
In 1999 renewable energy sources were used mainly to supply heat and electricity, with roughly a 50:50 split. Overall renewable energy output grew by an average of 2.8 % per year over the 1990 to 1999 period, which increased its share of Total Energy Consumption from 5.0 % to 5.9 %. Taking account of the projected expansion in energy consumption, this growth rate needs to be increased to over 7 % per year if the EU's indicative target to derive 12 % of Total Energy Consumption from renewable sources is to be met by 2010. However, the 'baseline projections' for the European Commission (NTUA, 2001) suggest that renewable energy growth will be much less than this, and probably will only be sufficient to maintain current market share to 2010.[21]

The main sources of renewable energy are biomass/waste (63.5 %) and hydro-power (31 %), although wind energy (1.5 %) and solar power (0.5 %) recorded the fastest growth rates between 1990 and 1999, albeit from low initial bases. At present the distribution of renewable energy production is uneven across Member States, mainly reflecting their access to biomass/waste and hydro resources.

[21] These 'baseline projections' missed the trend of increased renewable electricity production in the second half of the 1990s. The updated, new version of the 'baseline projections', to be released in the second half of 2002, will show a slight increase of renewables' contribution to total energy consumption by 2010.
[23] These conclusions hold true at the EU overall level. Different conclusions may be drawn for individual Member States.

Road transport is a major and growing area for energy consumption and consequently of emissions of carbon dioxide and pollutants. However, it is an area which is the almost exclusive preserve for oil derived fuels with little substitution from renewable energy sources. In 1999 only 463ktoe of renewable biofuels were used in road transport representing less than 0.1 % of energy consumption by road transport. The European Commission has recently proposed a directive aimed at promoting the use of biofuels in transport (European Commission, 2001f), with an indicative target of replacing 2 % of petrol and diesel consumption with biofuels in 2005, increasing to over 5 % by 2010. This action highlights the pressing need to begin to replace fossil fuels in road transport, however, there is much debate over whether biofuels are the best option. This arises because biofuels are energy intensive in their production, requiring a third to half their energy content for cultivation, fertilisers, harvesting, transport, etc. Moreover, there maybe competition for growing land with other energy crops that would be used for power and/or heat production. Finally, there are concerns over the level of nitrous oxide and particulate emissions from biofuels.

☹ **The share of renewable energy in the EU's electricity consumption grew slightly from 13.4 % to 14 % between 1990 and 1999, but this growth rate will need to double o attain the EU's indicative target of 22.1 % by 2010**



Note 1: Industrial and Municipal Waste (IMW) includes electricity from both biodegradable and non-biodegradable energy sources, as there are no separate data available for the biodegradable part. The EU's 22.1 % indicative target for the contribution of renewable electricity to Gross Electricity Consumption by 2010 only classifies biodegradable waste as renewable. The share of renewable electricity in Gross Electricity Consumption is therefore overestimated by an amount equivalent to the electricity produced from non-biodegradable IMW.
Note 2: National indicative targets shown here represent reference values that Member States agreed to take into account when setting their indicative targets by October 2002, according to the renewable electricity EU Directive.

Figure 24 Share of electricity consumption met by renewable energy sources, 1999
Source: Eurostat

Renewable energy sources supplied 14 % of the EU's Gross Electricity Consumption in 1999. This was attained through an average annual growth in output of 2.8 % per year over the 1990-1999 period. Renewable electricity was dominated by large hydro-power, which had a 74 % share of output in 1999, followed by small hydro (11 %) and biomass/waste (10 %). Large hydro is an established technology, but its capacity is not expected to increase substantially in future because of concerns linked to its impact on the environment through the loss of land and the resultant destruction of natural habitats and ecosystems. Therefore future growth in renewable electricity will have to come from renewable energy sources such as wind energy, solar power, biomass and small hydro.

The share of electricity from renewable sources varies considerably between countries reflecting the resources within their boundaries. In its Directive on the promotion of electricity from renewable sources the EU proposed indicative targets for Member States and agreed to an EU overall indicative target of 22.1 % of Gross Electricity Consumption from renewable sources by 2010 (European Parliament and the Council, 2001b). Taking account of projected growth rates for electricity consumption to 2010, the indicative target will require the rate of growth of renewable electricity supply to roughly double if the target is to be met.

‘Baseline projections’ of future electricity production (NTUA, 2001), based on the policy position in November 1997 (see Annex 1), indicate a negligible increase in the share taken by renewable energy sources. Clearly the additional measures contained in the EU Directive, together with measures taken at Member State level, need to give a stronger stimulus to the deployment of renewable electricity technologies, for the indicative target to be attained. There are encouraging signs that this may be possible with the right mix of support measures (EEA, 2001 c). For example, the rapid expansion of wind power (38 % per year across the EU in the period 1990-1999) was driven by high growth rates in Germany, Denmark and Spain, that were the result of support measures including “feed-in” arrangements that guarantee a fixed favourable price for renewable electricity producers. Biomass/waste resources have also expanded rapidly at a rate over 9 % per year, and have the added benefit that they can be used in high efficiency combined heat and power plant.

6. Are we moving towards a pricing system that better incorporates environmental costs?

$$\boxed{\text{PRESSURE}} = \boxed{\frac{\text{PRESSURE}}{\text{ENERGY}}} \times \boxed{\frac{\text{ENERGY}}{\text{DRIVER}}} \times \boxed{\text{DRIVER}}$$

The price of energy supplies is an important factor in the interaction between energy and the environment.

Firstly price can affect the volume of demand for some energy related services (i.e. the Driver box). For example individuals may undertake less recreational travel or heat fewer rooms in their homes if fuel costs are high.

Secondly price can affect the amount of energy consumed to deliver energy related services (i.e. Energy/Driver box). This second price response itself can have three general forms:

- Adoption of alternative methods for gaining the energy related service (e.g. switching between private and public transport).
- Using more efficient devices for converting energy into energy related services (e.g. more efficient cars, trucks, boilers, lighting, etc.).
- Moving to different manufacturing and service activities that require less energy per unit of added value (i.e. structural change).

All other things being equal we are likely to demand less energy related services, adopt less energy intensive life-styles and business activities, and invest in more efficient devices when the energy price is high.

Finally price may also influence the types of energy we buy (i.e. coal, gas, oil, electricity, etc.). Once again with all other things being equal it is logical to select the lowest price source. Since some fuels are more polluting than others it follows that price can directly affect the pressures placed on the environment by energy use (i.e. Pressure/Energy box).

Nonetheless, price is not the only determinant of the demand for energy or of the choice of technologies or fuel supplies. Both businesses and citizens have a wide range of other factors that affect their decisions, including the availability and reliability of supplies, past experience, existing infra-structure, capital constraints, lack of information, fashion preferences, general affluence and, increasingly, environmental awareness.

An additional concern with energy prices is that they do not always reflect the full costs of energy to society because they do not, or not completely, take account of the impacts of production and consumption on non-traded factors such as human health and the environment. Strictly these so-called "external costs" should be included in energy prices to ensure that decisions on the choice and volume of energy consumption take account of all the costs involved. However, there are significant uncertainties in the evaluation of external costs, particularly those linked to environmental impacts, due to such factors as their diversity, geographical variations and the difficulty of setting exact values on non-traded goods. Consequently, in practice governments seek to introduce external costs associated with energy in less direct ways through regulation, taxation, tradeable emissions permits, grants and subsidies.

This section examines the evolution of energy prices over the 1985-2001 period and considers if this is consistent with the EU’s energy and environmental objectives.

☹ **Energy prices have generally remained low, or even fallen, between 1985 and 2001, offering little incentive to reduce energy consumption**

The real prices of all fuels, with the exception of diesel and unleaded gasoline for transport, fell between 1985 and 2001. The decrease was greatest in the years 1986-1987 when the crash in crude oil prices had knock on effects on natural gas, the price of which tends to be indexed to crude oil, and electricity generation. The slower decline since then was sustained by continuing low oil prices, opening up of additional natural gas supplies to the EU, and progressive liberalisation of the gas and electricity markets leading to greater price competition. The latter factor, which is continuing, was driven by the EU's Electricity and Gas Directives (European Parliament and Council, 1998b and 1996b). Oil prices increased appreciably in 1999-2000 following an agreement within the Organisation of Petroleum Exporting Countries (OPEC) to restrict production, and this contributed to an increase in prices of oil products and natural gas in 2000. However, electricity prices were not affected by the oil price rise. This is due to three factors, first growing competition in electricity markets, second only a small fraction of electricity is generated from oil and third the linkage between natural gas and oil prices is weakening within a competitive gas market.

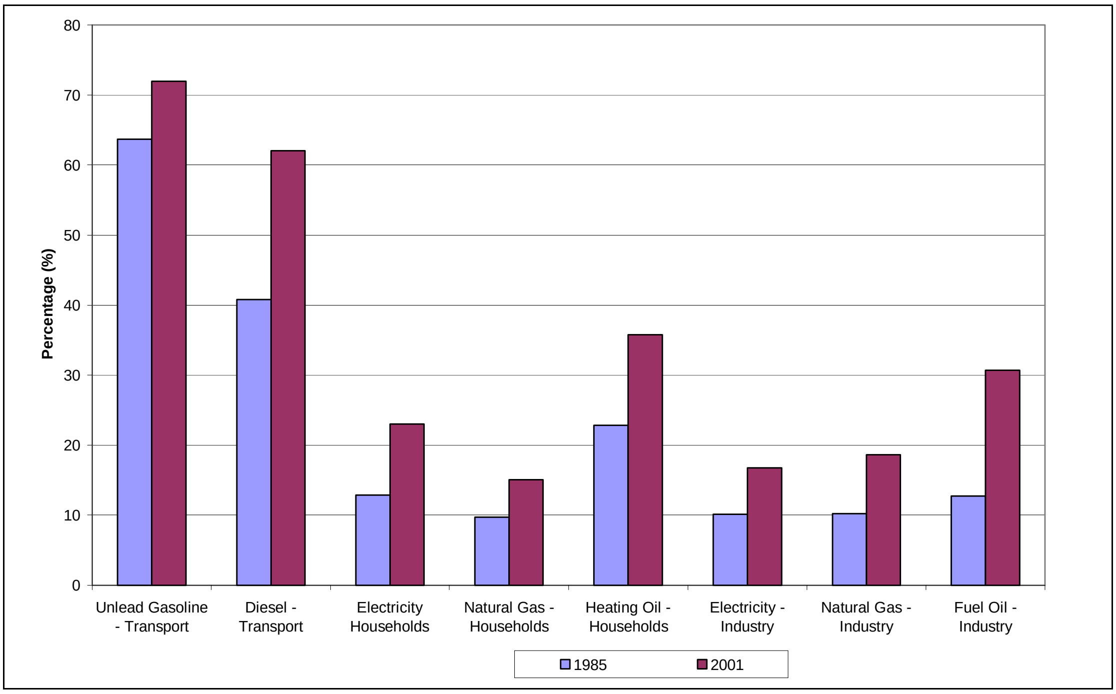
Unleaded gasoline was the only fuel to record a substantial increase in price. This was mainly due to moves by Member States to progressively increase taxation on road transport fuels such that tax on unleaded gasoline accounted for 72 % of the price in 2001; an increase from 64 % in 1991. However, it is noteworthy that much of this tax increase was absorbed by reductions in the non-tax price of unleaded gasoline, and that most of the price increase came in 2000, and was associated with the increase in crude oil prices in that year.

Table 6 End-user energy prices (euros[constant 1995 prices]/GJ)

Fuel	Price** 1985	Price** 2001	Percentage change in price 1985-2001
Heavy fuel oil-industry	11.2	5.1	-54 %
Natural gas – industry	8.6	5.1	-41 %
Electricity – industry	26.2	13.6	-48 %
Heating oil – households	17.0	12.2	-28 %
Natural gas – households	16.7	11.0	-34 %
Electricity – households	43.6	30.8	-29 %
Diesel – road transport****	757	772	2.6 %
Unleaded gasoline – road transport****	699*	922	32 %

*Data for 1991
**Prices are those applicable in January of each year.
*** Industry prices exclude value added tax (VAT)
**** Prices in euros/1000 litre
Source: Eurostat

☹ **Despite increases in taxation levels over the 1985-2001 period, energy prices dropped over the period for most fuels and energy demand increased in all but one sector**



Note: Unleaded gasoline tax proportion in energy prices is for 1991 instead of 1985.

Figure 25 Proportion of tax in final energy prices
Source: Eurostat

Taxation offers one method for "internalising" the external costs of energy consumption into prices. It also offers a mechanism for introducing price differentials between fuels to encourage the use of less polluting options.

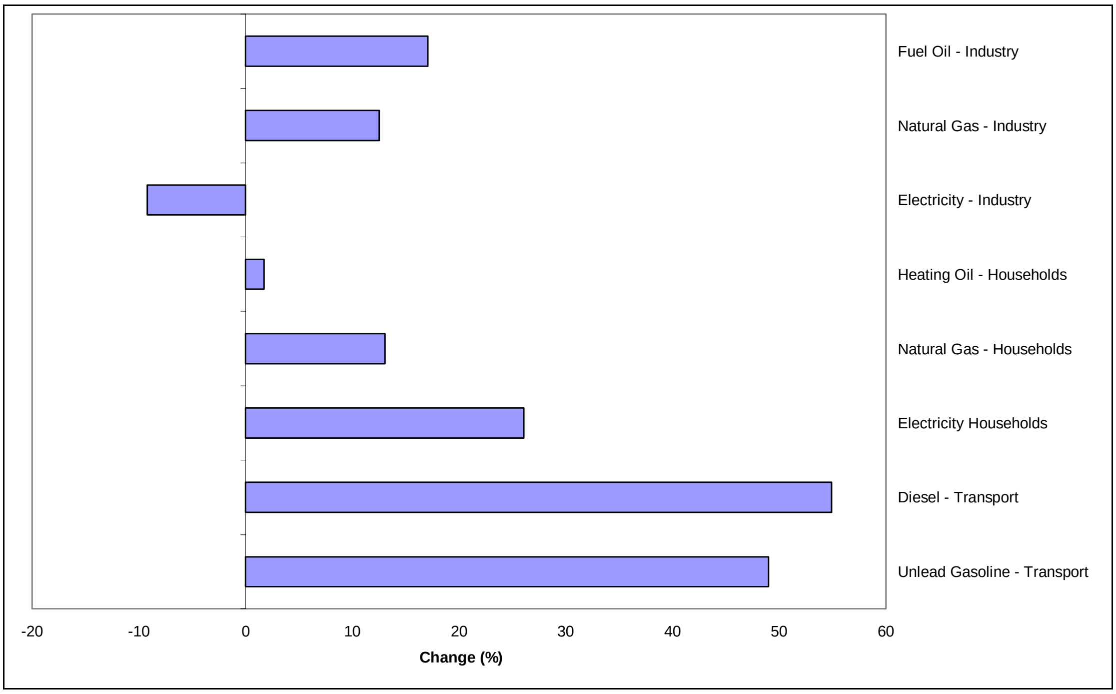
The pattern of taxation across the EU between 1985 and 2001 has been to increase the proportion of energy prices accounted for by tax. This has occurred in part through increases in the rate of tax, but it is also linked to a reduction in "before tax" energy prices. As discussed in the previous section, this has occurred through a decline in fossil fuel prices combined with greater price competition in the electricity and natural gas markets.

Energy taxation has also increased in absolute terms, but, as shown in the previous section, not sufficiently to prevent overall reductions in energy prices for all but road transport fuels. One important exception is electricity consumption in industry for which taxation has fallen in absolute terms. This is because "before tax" prices have been reduced considerably as a result of strong competition between suppliers, and this tax is generally applied as a percentage of the before tax price.

The European Commission has proposed a Directive for restructuring the Community framework for taxing energy products (European Commission, 1997c), which included suggested minimum tax levels for each fuel. This has not yet been adopted but it is noteworthy that, on average for the EU as a whole, actual taxes on transport fuels, oil based heating fuels and electricity in 2000 were higher than the proposed minimum tax levels for

2000. Actual taxation on natural gas was about equal to the proposed minimum for the year 2000 for industry and above the minimum for households.[23]

The generally modest increases in tax on industrial energy consumption reflects concerns over the impact of fuel prices on national competitiveness, with Member States looking to encourage energy efficiency through alternative schemes such as voluntary agreements, awareness campaigns, capital allowances, etc. Some Member States have adopted a "carrot and stick" approach with energy taxation combined with the option for significant rebates if energy efficiency targets are met (UK, 2000 and EEA, 2000). Also studies have suggested that a combination of increased energy taxes and reduced employment taxes could yield the "double dividends" of reduced pollution and increased employment (European Commission 2000f).



Note: Changes for unleaded gasoline are for the period 1991-2001.

Figure 26 Change in the absolute value of taxation applied to fuels, 1985-2001
Source: Eurostat

Taxation of transport fuels increased substantially between 1985 and 2001, but the impact on prices was partially offset by the effects of falling crude oil prices and market competition. Tax rates have been highest in the UK, which, from 1993 to 1999 applied a "Fuel Duty Escalator" that increased taxes by up to 6 % per year. The UK government has estimated that the tax increases between 1996 and 1999 will have cut UK transport related carbon dioxide emissions by between 1 and 2.5 MtC per year by 2010 (i.e. 2 to 5.5 %) (DETR, 2000).

There is concern that fuel taxation is not the most equitable way of taking account of transport impacts. This is because off-peak and rural travel are taxed to the same extent as urban rush hour travel, but do not cause the same damage to health or the environment. Consequently additional forms of taxation may be introduced in the future such as road pricing and differential taxation of vehicles according to their energy efficiency.

Taxes on the household consumption of electricity and natural gas have increased significantly, particularly in the last few years of the 1990's. This has had the effect of off setting price reductions resulting from energy market liberalisation and the increased price competition this causes.

☹ **With fossil fuels supplying more than half the EU's electricity, price levels would need to be increased substantially to include the estimated external costs of electricity production**

Estimation of external costs of electricity production (i.e. those associated with impacts on the environment and human health) is a complex undertaking that needs to take account of, for example:

- Location specific impacts determined by such factors as the vulnerability of the environment and the density of population.
- The exact specification of the fuel being used. For example the sulphur content of coal varies appreciably.
- How modern the generation plant is, and hence what emissions reduction devices are fitted.

The most comprehensive source of external cost assessments is the European Commission's ExternE project (European Commission, 1999a), which considered a range of electricity generation technologies located across EU Member States. This assessment examined external costs related to impacts on human health, crops, materials, forests and ecosystems, as well as giving separate consideration to climate change, and is the source of the data presented here. The evaluation of climate change was particularly uncertain because of inadequate knowledge of the timing of the impacts and their severity, the capacity of systems to adapt, the valuation of impacts in other world regions and the discount rate to apply to impacts occurring well into the future. Mid-range values are included in the data presented herein.

The external cost ranges presented in the table reflect the uncertainties (some of which were outlined above) and differences in the type of location and vintage of the technologies examined. For example the comparatively high external cost of coal generation in Belgium arises because an older plant with less pollution control was examined. Nonetheless the data show the graduation in costs that would be expected with lignite and coal having the greatest costs and renewable energy sources the least. Nuclear external costs are low reflecting the small health and environmental impacts of this technology under normal operation, however, it is noted that due to the complexity of the fuel cycle further work is needed to estimate the damages with sufficient reliability (European Commission, 1999a).

Comparison of these external costs with the current prices for electricity show that the external costs of coal and lignite generation are of the order of 20–120 % of household electricity prices and 50–240 % of industrial electricity prices. For gas fired generation external costs are 7–38 % for households and 13-73 % for industry. Clearly the external costs are greatest for coal and lignite, but are still potentially significant for gas fired electricity generation.

The external costs of energy production and consumption can be taken into account in various ways. One possibility is to tax fuels and technologies according to their damage costs. The alternative is to stimulate the development and deployment of low impact alternatives such as renewable energy technologies through grants and subsidies. This latter approach is encouraged by the Commission in its communication on "state aid for environmental protection" (European Commission, 2001i).

Table 7 Comparison of Estimates of the External Costs of Electricity Generation from different fuels with electricity prices* (euro cents[constant 1995 prices] /kWh)**

	External Costs							Prices*	
	Coal and Lignite	Oil	Gas	Nuclear	Biomass	Hydro	Wind	Price of Industrial Electricity	Price of Household Electricity
EU	-	-	-	-	-	-	-	5.6	11.1
Austria		-	1-3	-	2-3	0.1	-	7.8**	12.5
Belgium	4-15	-	1-2	0.5	-	-	-	6.3	12.4
Denmark	4-7	-	2-3	-	1	-	0.05	7.6**	16.7
Germany	3-6	5-8	1-2	0.2	3	-	0.1-0.2	6.2	13.9
Spain	5-8		1-2	-	-	-	0.2	5.7	8.1
Finland	2-4	-	-	-	1	-	-	4.3	6.7
France	7-10	8-11	2-4	0.3	1	1	-	5.5	10.6
Greece	5-8	3-5	1	-	0-1	1	0.2-0.3	4.0	5.1
Ireland	6-8	-	-	-	-	-	-	4.9	6.6
Italy	-	3-6	2-3	-	-	0.3	-	7.0	16.8
Netherlands	3-4	-	1-2	0.7	0.5	-	-	5.4**	14.6
Portugal	4-7	-	1-2	-	1-2	0.2	-	4.7	9.1
Sweden	2-4	-	-	-	0.3	0.03	-	3.3	9.0
UK	4-7	3-5	1-2	0.3	1	0-0.7	0.1-0.2	5.9	7.5

* Prices in January 2001
** Prices in January 1999
*** Prices include all taxes
Source: Eurostat

☹ **Subsidies continue to distort the energy market in favour of fossil fuels despite the pressures these fuels place on the environment**

Subsidies on energy production and/or consumption change the relative prices of different energy sources thereby affecting decisions on which sources should be used. They may also keep prices lower than they would otherwise be, and consequently may encourage increased energy consumption. Both of these factors affect the pressure placed on the environment by energy related activities.

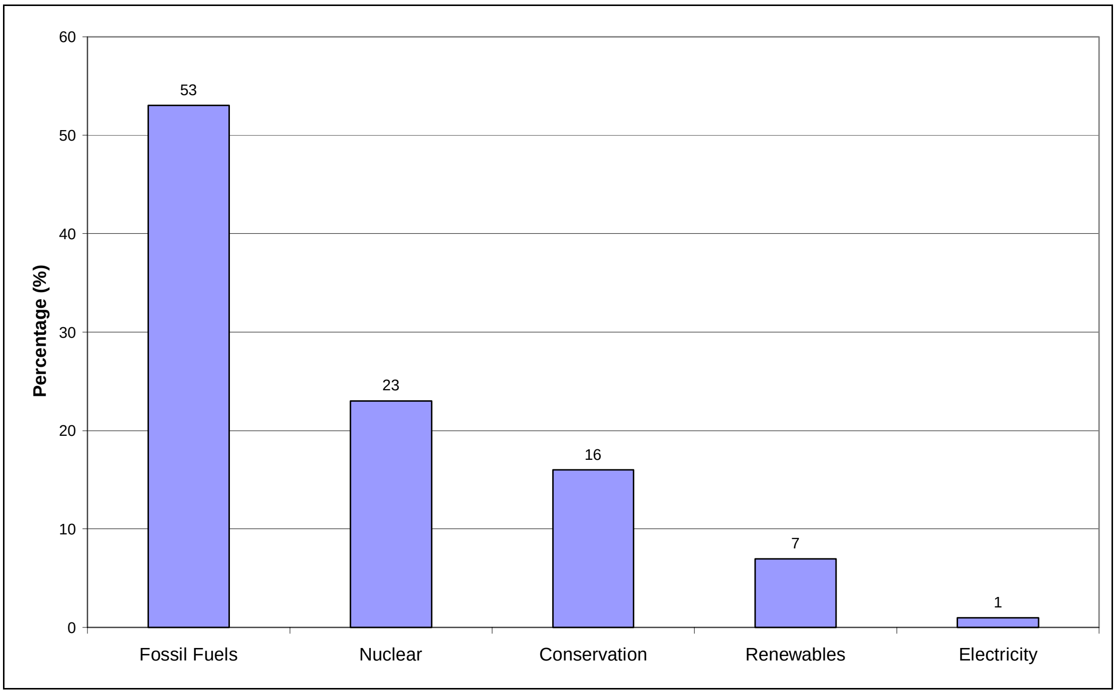
Governments use a broad range of methods to give subsidies including:

- Direct financial support to particular energy supply industries
- State supply quotas or state obligations to purchase
- Low cost or under-written loans
- Limits on the liabilities of particular energy industries
- Price support
- Preferential tax treatment
- Failure to "internalise" external damage costs
- Support for Research and Development

Consequently it is difficult to develop reliable estimates of the total value of subsidies to particular energy industries, let alone to monitor how these are changing over time. The data in the figure show the results of one estimate covering the 1990 to 1995 period, which has included only direct subsidies[24]. This shows that most subsidies across the EU are directed at supporting fossil fuels, with much less support for renewable energy sources or energy conservation. Clearly this distribution of subsidies will not favour the reduction of the environmental pressures caused by energy production and consumption. It is important to determine if this distribution has changed in more recent years.

Subsidies are used as a tool to achieve policy objectives, which in the case of energy may include security of supply, industrial competitiveness and social/employment concerns as well as environmental factors. It is challenging to get an optimal balance between these policy drivers. Moreover, the removal or reduction of subsidies may not yield environmental benefits in the short-term if the subsidies have encouraged investment in durable infrastructure and plant that are only replaced over long periods (e.g. 20 to 40 years).

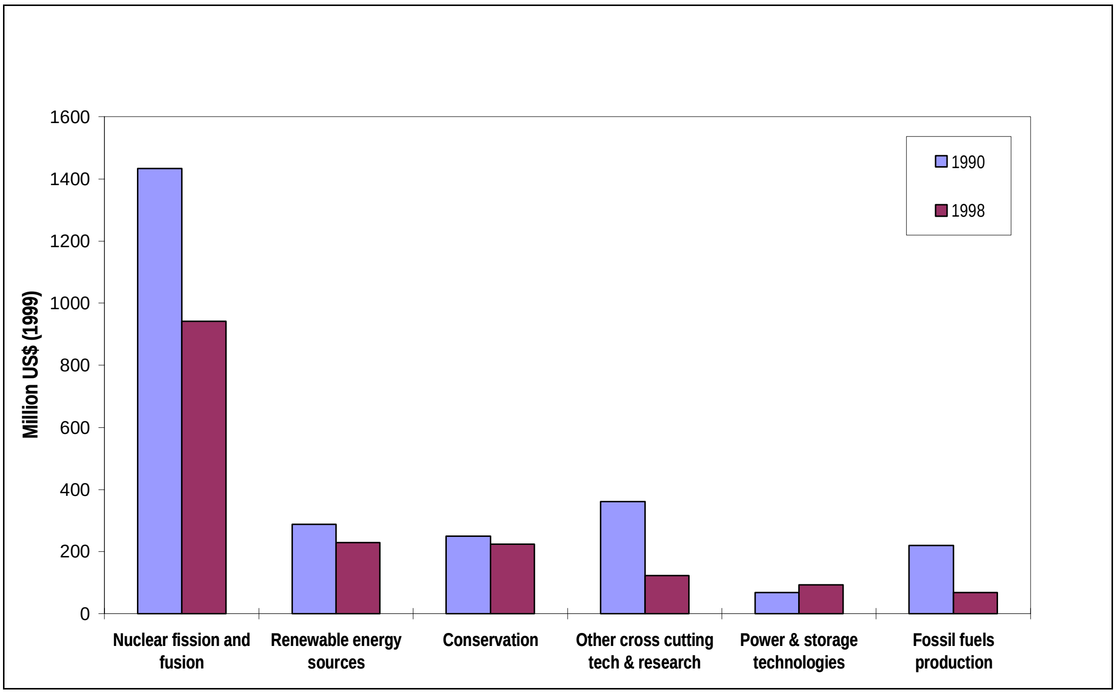
[24] Direct subsidies include direct payments from public budgets, tax receipts forgone due to tax reductions, government funded R&D, and payments that reduce the cost of energy production, consumption or conservation.



Note Electricity subsidies include support for R&D on storage methods, combined heat and power and crosscutting factors such as power conditioning and load management.

Figure 27 Estimated distribution of direct energy subsidies (1990-1995 average)
Source: Ruijgrok, E and Oosterhuis, F (1997).

☹ **Energy research and development expenditure has been reduced at a time when innovation is needed to develop less polluting technologies**



Note: Approximately 25 % of the expenditure for nuclear fission and fusion research was spent on fusion.

Figure 28 Change in R&D expenditure between 1990 and 1998
Source: IEA

It is generally acknowledged that the environmental problems associated with energy production and consumption will not be solved by fiscal and market based measures alone. Innovative technologies will also be needed to capture less polluting energy sources such as renewable energy, and to use energy with maximum efficiency. This is particularly so in the longer term when substantial reductions in greenhouse gas emissions will be needed to limit climate change to tolerable levels. The longer term research and development (R&D) needed to produce such innovative technologies is not always attractive to businesses that are required by their shareholders to deliver short term profitability, and therefore needs to be partially supported by public funds.

Total energy R&D expenditure by Member State governments has been reduced by 36 % between 1990 and 1998 (IEA, 1999). Within this overall budget the expenditure on individual technology areas has changed less dramatically with nuclear fission (39 %) and fusion (18 %) R&D still taking more than half the total. The share of R&D targeted on renewable energy sources and energy conservation has increased, but in absolute terms the budgets have fallen.

The decline in the budgets for fossil fuel R&D may seem reasonable since these are mature technologies whose future development should be left to industry. However, the major reductions in greenhouse gas emissions needed in the long term, may require advanced fossil plant with carbon dioxide sequestration. Therefore there is also a need for additional research into the potential environmental pressures associated with options for carbon dioxide disposal, to gain assurance that they do offer an acceptable approach for reducing greenhouse gas emissions.

Appendix 1

Background to the "baseline" energy and greenhouse gas emissions projections

The "baseline" projections of energy consumption and greenhouse gas emissions used in this report were derived from work carried out for the European Commission in producing the report "Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change" (Ecofys, 2001).

The energy projections were made with the PRIMES model, and were an up-date of an earlier baseline projection developed in the "Shared Analysis Programme" (European Commission, 1999b). This earlier set of projections was based on 1995 data and assumed a continuation of the policies adopted by November 1997 over the full modelling period. In the update an additional assumption was made that the EU's voluntary agreement with the European, Japanese and Korean car makers (the so-called ACEA Agreement), for a reduction in the average carbon dioxide emissions for all new cars to 140 g/km by 2008-2009, is met. Other key assumptions in the "baseline" projections are:

- In the period 1995 to 2010 economic growth in the EU was expected to be in line with historic trends at around 2.3 % per year.
- The long established trend of restructuring EU economies towards services and high value-added products continues.
- Liberalisation and integration of the electricity and gas markets to be developed fully in the second half of the 2000 to 2010 period.
- Technological improvements continue with both energy supply and demand technologies.
- Continuation of support for renewable energy and combined heat and power.
- Continued extension of the natural gas infrastructure across Member States.
- Nuclear plant lifetimes are extended to 40 years, but no new plant are commissioned before 2010.

The results from the PRIMES model were also used to project the carbon dioxide emissions attributable to energy use. Projections of non-energy related carbon dioxide emissions, and the emissions of the other five greenhouse gases covered by the Kyoto Protocol[25], to 2010 were made by a "bottom-up" modelling approach (Ecofys, 2001). These latter projections were based on emission inventories for either 1990 or 1995, and assumed a "Frozen technology reference level" to 2010. That is no change in the emission level per unit of production compared to the base year, with the following exceptions:

- Industrial emissions of adipic acid take account of reduction measures taken between the base year and 2000.
- Waste sector emissions take account of the effect of abatement measures taken as a result of the Landfill Directive after the base year.

[25] The Kyoto "basket" of greenhouse gases consists of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride.

Acronyms and abbreviations

ACEA	European Automobile Manufacturers Assciation
BAT	Best available technology
CHP	Combined Heat and Power
CO_2	Carbon dioxide
DG	Directorate General of the European Commission
DG ENV	Directorate General Environment (of the European Commission)
DG TREN	Directorate General Energy and transport (of the European Commission)
DPSIR	Driving forces, Pressures, State, Impact and Responses
EEA	European Environment Agency
EIONET	European Information and Observation Network
ETC	European Topic Centre
ETC–ACC	European Topic Centre on Air and Climate Change
EU	European Union
Eurostat	Statistical Office of the European Union
ExternE	Externalities of Fuel Cycles Project
FCCC	Framework Convention on Climatic Change (UN)
FGD	Flue Gas Desulphurisation
GDP	Gross Domestic Product
GIEC	Gross Inland Energy Consumption
HFCs	Hydrofluorocarbons
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
JAMA	Japan Automobile Manufacturers Association
KAMA	Korean Automobile Manufacturers Association
ktonnes	Thousand tonnes
kWh	Kilowatt hour
MS	Member State (of the European Union)
Mt	Millions of tonnes
N_2O	Nitrous Oxide
NMVOC	Non-methane volatile organic compounds
NECD	National Emission Ceiling Directive
NOx	Nitrogen oxides, including nitric oxide (NO) and nitrogen dioxide (NO_2)
NTUA	National Technical University of Athens
OECD	Organisation for Economic Cooperation and Development
OPEC	Organisation of Petroleum Exporting Countries
OSPAR	Joint Oslo and Paris Commissions
PFCs	Perfluorocarbons
PM	Particulate Matter
SO_2	Sulphur dioxide
TERM	Transport and Environment Reporting Mechanism for the EU
toe	Tonne of Oil Equivalent
UNFCCC	United Nations Framework Convention on Climatic Change
WHO	World Health Organisation

Glossary and definitions

References

ADEME, 1999. Energy Efficiency Indicators – The European Experience, Ademe, Paris, 1999.

The Council of the European Union, 1998.Council resolution (98/C 394/01) on energy efficiency in the European Community.

The Council of the European Union, 2001. Common Position (EC) No 22/2001 – with a view to adopting the regulation of the European Parliament and of the Council on a Community energy-efficiency labelling programme for office equipment.

UK 2000. Department for the Environment, Food and Rural Affairs, http://www.defra.gov.uk/environment/ccl/. UK

DIW, 2001. DIW – Wochenbericht 45/01, CO_2 Emissions: *Trende noch nicht in Sicht*, German Institute for Economic Research. November 2001.

ECOFYS, 2001. Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change – Summary Report for Policy Makers. A report for the European Commission Directorate General for Environment from ECOFYS Energy and Environment, AEA Technology and the National Technical University of Athens. (http://europa.eu.int/comm/environment/enveco)

EEA, 2002. European Community and Member State atmospheric pollutant trends. To be published. European Environment Agency, Copenhagen.

EEA, 2001a. European Community and Member State greenhouse gas emission trends 1990-1999. Topic Report 10/2001. European Environment Agency, Copenhagen.

EEA, 2001b. TERM 2001 – Indicators tracking transport and environment integration in the European Union. European Environment Agency, Copenhagen.

EEA, 2001c. Renewable energies: success stories. Environmental issue report No. 27. European Environment Agency, Copenhagen.

EEA, 2001d. Annual European Community Greenhouse Gas Inventory 1990-1999. Submission to the Secretariat of the UNFCCC. Technical report No. 60. European Environment Agency, Copenhagen.

EEA, 2000. Environmental taxes: recent developments in tools for integration. Environmental issues series No. 18. European Environment Agency, Copenhagen.

European Commission, 2001a. Environment 2010: Our Future, Our Choice, Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions. COM(2001) 31 final. Brussels. Commission of the European Communities.

European Commission, 2001b. A sustainable Europe for a Better World: A European Union Strategy for Sustainable Development. Communication from the Commission to the Council and the European Parliament. (COM(2001) 264 final. Brussels. European Commission.

European Commission, 2001c. Draft second report under Council Decision 99/296/EC amending Decision 93/389/EEC for a monitoring mechanism of Community greenhouse gas emissions. Brussels. Commission of the European Communities.

European Commission, 2001d. Proposal for a Council Decision concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate

Change and the joint fulfilment of commitments there under, COM(2001) final, Brussels. Commission of the European Communities.

European Commission, 2001e. Proposal for a Directive on the energy performance of buildings. Brussels, Commission of the European Communities.

European Commission, 2001f. Alternative fuels for road transportation and a set of measures to promote the use of biofuels. COM(2001) 547 provisional. Brussels, Commission of the European Communities.

European Commission, 2001g. Integrating environment and sustainable development into energy and transport policies: review report 2001 and implementation of the strategies. Commission staff working paper. SEC(2001) 502. Brussels, Commission of the European Communities.

European Commission, 2001h. Memorandum to the Commission on the policy guidelines of the White Paper on a common transport policy. Brussels, Commission of the European Communities.

European Commission, 2001i. Information from the Commission – Community guidelines on State aid for environmental protection. Official Journal (2001/C 37/03)

European Commission, 2000a. Council conclusions of June 2000, Common Position on the proposed Directive on a national emission ceiling for certain atmospheric pollutants. Brussels, Commission of the European Communities.

European Commission, 2000b. Review of the Auto Oil II Programme. COM(2000) 626 final. Brussels, Commission of the European Communities.

European Commission, 2000c. EU policies and measures to reduce greenhouse gas emissions: Towards a European Climate Change Programme. COM(2000) 88 final. Brussels, Commission of the European Communities.

European Commission, 2000d. Action plan to improve energy efficiency in the European Community. COM(2000) 247 final. Brussels, Commission of the European Communities.

European Commission, 2000e. Green Paper on greenhouse gas emissions trading within the European Union. COM(2000) 87 final. Brussels, Commission of the European Communities.

European Commission, 2000f. Report to the European Commission Directorate General for Environment from University of Bath and AEA Technology. Study of the relationship between environment/energy and taxation and employment creation, April 2000. (www.europa.eu.int/comm/environment)

European Commission, 1999a. Externalities of Fuel Cycles “ExternE” Project. Directorate General for Science, Research and Development, JOULE. Brussels.

European Commission 1999b. Energy in Europe – European Union Energy Outlook to 2020 – The Shared analysis Programme, Brussels. Commission of the European Communities.

European Commission, 1998a. Communication and Fourth report for the Commission on: The present situation and prospects for radioactive waste management in the European Union COM(98) 799 final. Brussels, Commission of the European Communities.

European Community, 1998b. Results of the Atlas Project (www.europa.eu.int/comm/energy_transport/atlas) Brussels, Commission of the European Communities.

European Commission, 1997a. A community strategy to promote combined heat and power (CHP) and to dismantle barriers to its development. COM(1997) 514 final. Brussels, Commision of the European Communities.

European Commission, 1997b. Energy for the Future: Renewable Sources of Energy, White Paper for a Community Strategy and Action Plan. COM(97) 599 final. Brussels, Commission of the European Communities.

European Commission, 1997c. Proposal for a Council Directive restructuring the Community framework for the taxation of energy products. COM(97)30 Final. Brussels, Commission of the European Communities.

European Parliament and Council, 2001. Directive on the promotion of electricity produced from renewable energy sources in the internal electricity market. Directive 2001/77/EC. Luxembourg, September 2001.

European Parliament and Council, 2000. Large Combustion Plant Directive on the limitation of certain pollutants into the air from large combustion plants. Directive 2001/80/EC. November, 2001.

European Parliament and Council, 1999. Directive 99/96/EC of the European Parliament and of the Council on the approximation of the laws of the Member States relating to measures to be taken against the emission of gaseous and particulate pollutants from compression ignition engines for use in vehicles, and the emission of gaseous pollutants from positive ignition engines fuelled with natural gas or liquefied petroleum gas for use in vehicles and amending Council Directive 88/77/EEC. December 1999.

European Parliament and Council, 1998a. CORRIGENDUM TO: Directive 98/69/EC of the European Parliament and of the Council relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directive 70/220/EEC. October 1998.

European Parliament and Council, 1998b. Directive 98/30/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas. June 1998.

European Parliament and Council, 1996a. Directive 96/61/EC of the European Parliament and of the Council concerning integrated pollution prevention and control. September 1996.

European Parliament and Council, 1996b. Directive 96/92/EC of the European Parliament and of the Council concerning common rules for the internal market in electricity. December 1996.

European Parliament and Council, 1994. European Parliament and Council Directive 94/63/EC on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations. December 1994.

European Parliament and Council, 1993a. Council Directive 93/12/EEC relating to the sulphur content of certain liquid fuels. March 1993.

European Parliament and Council, 1993b. Council Directive 93/59/EEC amending Directive 70/220/EEC on the approximation of the laws of the Member States relating to measures to be taken against air pollution by emissions from motor vehicle. June 1993.

European Parliament and Council, 1991. Council Directive 91/542/EEC amending Directive 88/77/EEC on the approximation of the laws of the Member States relating to the measures to be taken against the emission of gaseous pollutants from diesel engines for use in vehicles. October 1991.

European Parliament and Council, 1974. CORRIGENDUM TO: 76/464/EEC: Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community. May 1976.

Eurostat, 2001. Integration – indicators for energy. Data 1985-98.

Fraunhofer, 2001. Greenhouse gas reductions in Germany and the UK – Coincidence or policy induced? An analysis for international climate policy. Report prepared for the Conference of the Parties, Bonn, Germany, 2001.

IPCC, 2001. Intergovernmental Panel on Climate Change – Working Group I, Third Assessment Report, Summary for Policy Makers. IPCC.

NTUA, 2000a. Top-down analysis of emission reduction possibilities in the power sector, 'Economic evaluation of sector targets for climate change', DG Environment, prepared by prof P. Capros and Dr. L. Mantzos, 27 March 2000

NTUA, 2000b. Top-down analysis of emission reduction possibilities in the energy demand sectors, 'Economic evaluation of sector targets for climate change', DG Environment, prepared by prof P. Capros and Dr. L. Mantzos, 27 March 2000

OECD, 1999. Environmental Data Compendium 1999. Organisation for Economic Cooperation and Development (OECD), Paris 1999.

OECD, 1993. Indicators for the integration of environmental concerns into energy policies. Organisation for Economic Cooperation and Development (OECD), Paris 1993.

Ruijgrok, E and Oosterhuis, F (1997). Energy subsidies in Western Europe, Institute for environmental studies, Vrije University, Amsterdam.

UNFCCC, *Report of the Conference of the Parties on its Seventh Session, held at Marrakesh from 29 October to 10 November 2001, Part 2 "Action taken by the Conference of the Parties at its Seventh Session, "The Marrakesh Accords", FCCC/CP/2001/13, Addendum 1,2 and 3*, 21 January 2002.

WHO-UNECE, 2001. Overview of instruments relevant to transport, environment and health, and recommendations for further steps. Synthesis report, World Health Organisation and United Nations Economic Committee for Europe, Geneva.

Open call for tender EEA/EAS/001/02

Technical specifications

"Framework contract for expert assistance in the area of energy and environment"

1. Background

Integration of environmental concerns into all policy areas has been rising up the political agenda recently with the Cardiff summit of the European Council (June 1998) inviting *"all relevant formations of the Council to establish their own strategies for giving effect to environmental integration and sustainable development within their respective policy areas. They should monitor progress taking account of the Commission's suggested guidelines and identifying indicators. The Transport, Energy and Agriculture Councils are invited to start this process."*

Increasing attention is therefore given by the European Environment Agency to producing information that permits the assessment of the effectiveness of the progress with the integration of environmental considerations into sectoral policies. The EEA's work on the energy sector[1] has so far included two main sets of activities.

- Energy and environment reporting mechanism. Its outputs include an energy and environment indicator based report (see Annex VI), energy and environment indicator factsheets, indicator-based energy and environment chapters in EEA publications.
- Best practices, starting with a report on "Renewable energies: success stories" (web link: http://reports.eea.eu.int/environmental_issue_report_2001_27/en).

Other energy and environment activities are envisaged to support the Commission and to provide the necessary energy and environment information and assessments for the EEA's main state of the environment and outlooks reports.

Taking into account the priorities in the current and coming EEA work programmes, and the expertise currently available in the EEA and in its EIONET network (in particular European Topic Centres) and the co-operation with Eurostat, expertise is being sought to support the development of the Agency's energy and environment related activities and the preparation of the Agency's 2002-2004 activities and projects on energy and the environment.

2. Purpose and contents of the contract

To establish a framework agreement with a contractor that can provide broad support to the EEA's various energy and environment related tasks and projects.

[1] The energy sector is defined to include all energy related activities, both energy supply activities (coal, oil and gas exploration and extraction, public electricity and heat production, refineries and other industries engaged in transforming primary energy into other energy products) and energy consumption activities (from the transport, industry, household, services and agriculture sectors).

3. Activities

Tasks can, among others, include:

- contributing to the further development of the energy and environment reporting mechanism, including support to energy and environment indicator-based reports as well as focus reports and technical papers, and covering all the EEA member countries and the accession countries. This also includes the extension of energy and environment activities to address wider sustainability concerns;
- developing further criteria and methods for monitoring and assessing progress with the integration of environmental considerations into the energy sector and consequently environmental progress;
- conducting specific studies (and reporting) on the impacts and effectiveness of environmental, energy and other policy instruments and measures;
- providing data, methodological and assessment support to the Agency on energy and environment, including scenario development, policy effectiveness analyses, hotspot analyses;
- supporting the EEA in its scenario and outlooks activities on energy, specifically with respect to the EEA state of the environment and outlooks report (to be published in 2004), the energy and environment reports and energy and environment chapters in EEA publications;
- carrying out of analysis of energy-related environmental hot spots;
- supporting the networking with energy related experts, organisations and authorities throughout Europe, including among others the development of web-based networking tools and the organising and participating in expert meetings and workshops;
- contributing to the assessment, writing and review of energy and environment relevant chapters in EEA main reports, in particular the Environmental Signals series, and the 2004 state of the environment and outlooks report;
- contributing to EEA activities regarding energy and the environment, including e.g. stocktaking of good practices and follow-up of relevant international and national RTD.

To support the above activities, the contractor is expected to provide a wide range of expertise, in particular on the integrated assessment of pressures/impacts engendered by the sector, energy - environment policy integration, energy economy, pricing, taxation, energy scenarios, energy demand management, energy efficiency, renewable energies, abatement pollution technologies, links with other socio-economic sectors etc. In addition, expertise will also be required regarding the wider sustainability concerns, including energy related socio-economic and health impacts and benefits.

Networking and building on country expertise is an essential part of the task. Therefore, the formation of a consortium reflecting the wide geographical European scope of the EEA's member countries - including east, south, north, west - is encouraged. The consortium's size should however be limited to keep the work easily manageable (e.g. 2-4 firms, groups, services providers or contractors).

For some projects the geographic scope of the work can also be pan-European (i.e. including non EEA member countries).

4. Organisation and location of work

The contractor will have to work closely with the EEA staff and the European Topic Centres (ETCs).

The main part of work can be executed from the Contractor's offices, with very regular contacts with the relevant EEA Project Manager for Energy and Environment. Periods of intra-muros work (long term and short term) at the EEA have to be foreseen.

5. Time schedule

The framework contract will run over a period of three years (36 months) following its signature, with the possibility to renew it twice for a period of one year, its maximum duration being limited to 5 years. The start of work is to be specified on specific agreements (a model is attached in Annex III) and the timing will be agreed in discussion with the respective EEA Project Manager.

6. Reports and documents to be submitted

The reports and other products to be provided by the contractor, and their timing, will be detailed under the specific agreements.

The following gives an indication of expected products:

- energy and environment reports;
- energy and environment indicator fact sheets for a set of countries (e.g. accession countries, EU countries) or for specific countries;
- chapter contributions to EEA reports;
- focus reports devoted to specific energy / environment issues;
- technical reports dealing with analytical issues, scenario, method and data development;
- background papers for and minutes of certain expert meetings and workshops
- web products.

The reporting language is English. The word processor used in this project is Word. Data are exchanged as Excel spreadsheets and/or as databases compatible with the EEA data warehouse system. All materials are to be delivered in a format compatible with the EEA's computer system.

7. Payment

Payment schemes will be agreed in the specific agreements that will be concluded under the framework contract.

8. In drawing up the bid, the tenderer should bear in mind the provisions of the standard framework contract (Annex I), of the General Terms and Conditions applicable to contracts awarded by the EEA (Annex II), and of the specific agreements (Annex III).

9. The tender must include

- all the information and documents required by the authorising department for the appraisal of tender on the basis of the award criteria set out at point 12:
- the price in accordance with point 10.

10. Prices

The contractor will be expected to offer the services at daily rates (in EURO per day) according to the expertise offered and levels of experience (i.e. senior and junior contractor). Travel and subsistence expenses likely to be incurred in the course of execution of the contract (for short term missions to EEA and elsewhere) are to be excluded from these daily rates and indicated separately.

Travel and subsistence costs for *short term* missions to EEA or elsewhere shall be agreed under the specific agreements, and shall be reimbursed in accordance with the rules and conditions relating to the payment of missions expenses in force at the Agency (Annex III).

In addition, daily rates have to be given for *longer term* periods of intra-muros work at the EEA’s premises in Copenhagen (more than 14 consecutive days). These need to specify the daily fees and travel/subsistence costs (as calculated by the contractor) separately.

The terms of payment will be specified in the specific agreements and are those, which are in force at the European Environment Agency for Service contracts.

11. Selection criteria

Tenderers must provide evidence of their identity, financial and economic standing and professional and technical qualifications by means of the following documents:

- an identification sheet (name or business name, legal status, contact person etc.), attached in Annex IV
- a list of comparable services and projects performed over recent years
- where applicable, references of the inscription on the VAT-register
- where applicable, references of the inscription on the trade register
- evidence of tenderer’s financial standing shall be furnished by (extracts from) financial statements for the past 3 years
- detailed curriculum vitae of the candidate or, where applicable, of the personnel involved in the tender when it concerns a legal person
- information on the candidate’s working languages and those in which the candidate is able to submit reports.

Tenders will lapse: 12 months after the final date for receipt of tenders.

12. Contract awarding criteria

The contract will be awarded to the tenderer whose offer is the most advantageous in the working area or areas of interest, taking into account the following criteria:

- good knowledge of policies, data, information sources, and RTD in the energy and environment sector at the European level;

- proven track record of similar activities at the European level, i.e. competence of the working team and capacities to offer expertise on a broad range of energy/environment issues, such as experience in energy and environment policies, in assessing the environmental pressures and impacts from the energy sector, in the evaluation of the effectiveness of related policy measures and instruments, in the development of scenario/outlooks, in energy and environment statistics etc. Expertise should cover all energy related activities;
- composition of the team or consortium, which should reflect the wide geographical area of all EEA member countries (north-south-east-west);
- good writing skills and experience in reporting for policy supporting purposes;
- good networking capacities throughout Europe;
- competitiveness - financial considerations and guarantees offered.

Tenders from consortiums of firms or groups of service providers or contractors shall specify the role, qualifications and experience of each member or group.

ANNEXES

Annex I: Model for standard framework contract
Annex II: General terms and conditions applicable to contracts awarded by the EEA
Annex III: Model for specific agreement
Annex IV: EEA rules for reimbursement of expenses
Annex V: Identification sheet
Annex VI: Energy and Environment in the European Union, draft for external review (Februar 2002)