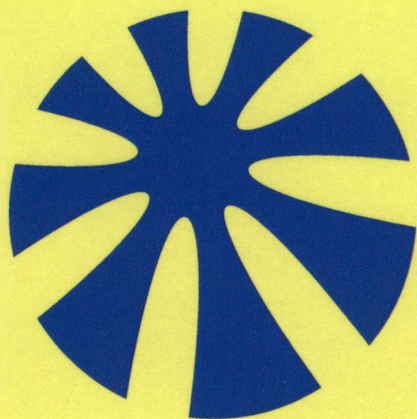


PER KÅGESON



Tools for Cutting European Transport Emissions

CO₂ Emissions Trading or Fuel Taxation?

SNS FÖRLAG

TOOLS FOR CUTTING EUROPEAN TRANSPORT EMISSIONS

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FUEL TAXATION?

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SNS – Centre for Business and Policy Studies – is an independent network of leading decision makers from the private and public sectors who share a commitment to social and economic development in Sweden. Its aim is to improve the basis for rational decisions on major social and economic issues, by promoting social science research and stimulating public debate.

TOOLS FOR CUTTING EUROPEAN TRANSPORT EMISSIONS
CO₂ EMISSIONS TRADING OR FUEL TAXATION?
Per Kågeson
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EXECUTIVE SUMMARY

This report is an analysis of the impact on efficiency and costs from including not only aviation and shipping but also the carbon dioxide emissions from road transport in the European Emissions Trading System (EU ETS). This option is compared to a case where road transport is permanently excluded from the trading scheme and where its emissions would have to be cut by other policy measures, and ultimately by allowing higher excise duties on petrol and diesel to depress the demand for fuel.

The simplest method to guarantee that the EU will be able to meet its commitment would be to gradually reduce the cap on emissions currently covered by the EU ETS and at the same time introduce a harmonised carbon tax on emissions from the non-trading sector. But with many member states strongly opposed to allowing tax rates to be set at EU level, even a challenge as crucial as mitigating climate change looks unlikely to persuade all the 27 states to support a sufficiently high common European carbon tax.

A somewhat more complicated but entirely feasible alternative would be to extend emissions trading to all sectors of society by adopting an “upstream” approach (where fuel suppliers would be liable) for the new sectors and auctioning the emission allowances allocated to them.

Even in the absence of a common carbon tax, there is a good chance – if the Council and Parliament accept the Commission’s proposal on how to split the burden between the EU ETS and member states – of achieving an overall greenhouse gas reduction of 20 per cent without having to raise fuel taxes by more than the equivalent of the forecast price in the emissions market (€30–40 per tonne of CO₂ emitted). The outcome, however, is affected by many factors, some of which are difficult to judge, and if it turns out that the target can only be reached after considerable increases in fuel taxation, there is an obvious risk of political failure.

However, the analysis of the report shows that the risk of having to raise fuel taxes substantially is a great deal larger in a case where the Community’s commitment is to reduce greenhouse gas emissions by 30 per cent between 1990 and 2030. It is likely to result in a major difference in price increases between the trading and the non-trading sectors

as well as between individual member states.

Regardless of whether the transport sector is included in the EU ETS or not, installations that are both fuel-intensive and subject to global competition will need to be compensated to protect their competitiveness. Compensation may be awarded either in advance by a free allocation of allowances or retroactively by reimbursement. Electricity-intensive industries are best compensated retroactively when the effects of emissions trading on electricity prices are known.

A conclusion from the analysis in this report is that the European Union should assess by 2012 whether the model for burden sharing and the common policy instruments (likely to be agreed in 2009) are sufficient for reaching the target for 2020. If the assessment shows that difficulties will arise in maintaining similar levels of marginal abatement cost in the EU ETS and the non-trading sector, or between member states, the trading scheme should be broadened to include emissions of carbon dioxide from all sources in the 27 member states.

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SNS'S FOREWORD

Tools for Cutting European Transport Emissions is a shortened English version of a book written in Swedish for primarily a national audience. However, the project reference group, consisting of representatives of more than 20 companies, state agencies and business associations, advised SNS to make the core-part available in English as a contribution to the ongoing European discussion on how to handle the transport sectors' large emissions of carbon dioxide.

SNS – *Centre for Business and Policy Studies* – is an independent network of leading decision makers from the private and public sectors who share a commitment to social and economic development in Sweden. Its aim is to improve the basis for rational decisions on major social and economic issues, by promoting social science research and stimulating public debate.

The book is written by Per Kågeson, a well-known European expert on externalities and market based instruments and author of numerous books and reports on cost-effective solutions to environmental problems in the transport sector. In the context of this foreword, Dr Kågeson would like to join me in extending thanks to the members of the reference group for providing background data from their respective fields of competence and for excellent feedback and constructive criticism to the various draft versions of the book.

I am particularly grateful to Lars Zetterberg of the Swedish Environmental Research Institute for contributing actively to the chapter on how the EU can protect its own energy intensive industries. Moreover, I would also like to thank Jan-Olof Edberg and Harald Edquist, CFO and Research Director of SNS for initiating this project. The rule of the game, however, is that the author of a book always has the last word. Per Kågeson, thus, is personally responsible for the conclusions and recommendations of this book.

By making Per Kågeson's analysis available to experts and policy makers in other Member States and in Brussels, SNS hopes to contribute to a process that will end in wise and well-founded decision on

instruments for making the transport sector take its part of a shared responsibility for Europe's commitment to mitigate climate change.

STAFFAN HÅKANSON

Chair of the reference group

ADVISORY GROUP

Following companies and authorities have with their knowledge, time and financial support contributed to this study.

Banverket (The Swedish Rail Administration)
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Naturvårdsverket (The Swedish Environmental Protection Agency)
Ragn-Sells
Salénia
SAS
Scania
SIKA (Institute for Transport and Communications Analysis)
Skogsindustrierna (The Swedish Forest Industries Federation)
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I. Introduction

Background

The transport sector faces a major challenge. The issue of climate change is growing in significance while the sector's greenhouse gas emissions continue to increase. The EU has introduced a system of emissions trading under a common cap which does not include the transport sector. However, high levels of fuel taxation have somewhat curtailed the growth of CO₂ emissions from road traffic. CO₂ emissions in aviation and shipping on the other hand are subject neither to quantitative restrictions nor to taxation. Rail transport's electricity consumption is affected in price terms by the fact that CO₂ emissions from power production are subject to the European emissions trading system (EU ETS).

The choice of policy instruments for reducing greenhouse gas emissions in the transport sector has been discussed in Europe for a number of years. To the extent that technical measures do not produce sufficient results, the ultimate choice lies between increasing fuel taxes on the one hand and an extension of the trading scheme to include transport emissions on the other. At their meeting in June 2007, EU environment ministers requested the Commission to present criteria for an assessment of the opportunities for an extension of the emissions trading system. However, in the Commission's proposal for a revision of the EU ETS, no extension of the trading scheme to road transport emissions is foreseen and the background documents do not include any assessment of the issue (European Commission, 2008a).

Questions that need to be answered

The simplest solution to the problem would presumably be to introduce a common CO₂ tax. However, the difficulties of reaching EU wide

agreement on tax rates helped to persuade European politicians to choose an emissions trading scheme for the power and heat generation industries together with selected energy-intensive industrial sectors. The hesitation among member states regarding the extension of the emissions trading system to include the transport sector is attributable to fear of high administrative costs and the risk of driving up the price of tradable CO₂ allowances to a level which would reduce the competitiveness of energy-intensive European industries.

An important question regarding the choice between higher fuel taxes and an extended trading scheme is whether the latter would be associated with transaction costs of a magnitude that makes the extension infeasible from a practical view. Another concern is whether or not the fuel tax alternative would actually be an efficient means of preventing the transport sector and member countries from competing with the trading sector for bioenergy and emission reduction units from the project-based flexible mechanisms, which might be in short supply.

Another central issue concerns whether or not the price of emission allowances would move in the same direction even if the transport sector was permanently excluded from the trading system. If this was the case, it would still be necessary to protect or compensate both energy-intensive and electricity-intensive companies that compete in global markets.

Presumably the choice between an extended trading scheme and higher fuel and energy taxes will ultimately depend on the level of tax increases required to allow the EU to fulfil its commitment to reduce greenhouse gas emissions by at least 20 per cent by 2020. Previous relatively modest tax increases for petrol and diesel fuel would suggest that politicians may encounter difficulties in dealing with the reactions of both the road haulage industry and motorists.

Aim

The aim of this report is to try to answer the above questions and thereby provide industry, government authorities and political decision-makers with a better basis on which to assess the policy instruments that can potentially be used to reduce CO₂ emissions in the transport sector. The objective is to identify the tools or combination of policy measures

that will enable the European transport sector to assume its share of responsibility for climate policy at the lowest possible social cost.

Limitations of the study

Since the number of actors and potential policy measures are numerous, climate policy must be based primarily on a general set of policy tools that are neutral in relation to their impact on technology. Consequently the report focuses on taxation and emissions trading. The analysis is concerned with the formulation of general policy instruments that may be applied on a broad international basis where Europe may be seen as the smallest conceivable geographical unit.

The analysis will only be concerned with CO₂ emissions since they comprise 97 per cent of the greenhouse gas emissions from the transport sector in EU27.

2. Policy tools for reducing transport CO₂ emissions

Cost and benefits of the transport sector

The transport sector generates enormous benefits. Modern societies would be unable to function without transport. The huge benefits generated by this sector are borne out by the large amounts that consumers are willing to pay for mobility and goods transport, and the sector's rapid rate of expansion.

Transport, however, gives rise to costs. The costs arising from greenhouse gas emissions are not yet fully internalised. This applies particularly to the aviation and shipping industries and to emissions from diesel rail transport.

CO₂ emissions of the transport sector

In 2005 the CO₂ emitted by the transport sector in EU27 amounted to 959 million tonnes. This figure does not include the CO₂ emissions from international shipping and aviation. The domestic transport sector accounts for 22.5 per cent of total CO₂ emissions in the European Community. These emissions have increased by 27 per cent since 1990. This growth is expected to continue unless drastic policy action is undertaken.

Road transport accounts for the vast majority of CO₂ emissions from the national transport systems of member countries. In EU27, road transport was responsible for 93.2 per cent of total emissions in 2005, while rail, domestic shipping and aviation accounted for 0.8, 2.3 and 2.7 per cent respectively.¹ Emissions from rail transport are limited since the sector is largely electrified. However electricity consumption in rail transport gives rise to emissions in the power industry.

¹ And other forms of transport 1 per cent.

TABLE 1. CO₂ emissions from the transport sector in EU27 in 2005.

<i>Type of transport</i>	<i>Mt</i>
Road	893.3
Rail	8.0
Shipping	21.8
Civil aviation	25.4
Other forms of transport	10.1
Total national transport sector	958.6

Source: UNFCCC.

TABLE 2. CO₂ emissions from international shipping and aviation in EU27 based on fuels purchased in EU member countries. Mt.

<i>Year</i>	<i>Aviation</i>	<i>Shipping</i>
1990	64	108
2000	110	131
2005	123	158

Source: UNFCCC.

The CO₂ emissions from fossil fuels purchased in EU27 for use in international aviation and shipping are presented in Table 2. Emissions from shipping are larger although the increase is more rapid in aviation.

Emissions from international transport by air or sea are not included as part of national or EU commitments under the Kyoto protocol and do not appear in their greenhouse gas emission inventories. In order to gain an impression of their overall importance and relative growth, they have been included in Table 3 along with figures for national CO₂ emissions in EU27. It is evident from this table that international transport accounts for a growing share of total transport related CO₂ emissions, having risen from 18.6 per cent in 1990 to 22.7 per cent in 2005.

The table also indicates that CO₂ emissions in the domestic transport sector increased by 27 per cent between 1990 and 2005, while emissions from international shipping and aviation grew by 46 and 92 per cent respectively. If the sale of bunker fuel for international shipping and aviation had been included in the CO₂ emission statistics of individual member states, the transport sector would in 2005 have accounted for 27.4 per cent of total CO₂ emissions in EU27.

TABLE 3. CO₂ emissions from transport fuel consumption in EU27 including the sale of fuel for international transport. Mt and percentage.

	1990	2005	Percentage change
Domestic transport #	754	959	27
International shipping	108	158	46
International aviation	64	123	92
Total	926	1240	31
Share of international transport	18.6	22.7	

Including domestic transport by air and sea.

Source: UNFCCC.

The climate policy objectives of the transport sector

The EU aims to meet its climate policy objectives at the lowest possible sacrifice. The latter comprises the direct economic costs, and the indirect effects on the economy and its international competitiveness.

Market based policy instruments

The nature of the task, the number of people and economic activities involved and the long time period during which the policy will have to be effective suggest that it will be difficult to conduct a climate policy primarily by using traditional measures such as threshold values and regulations. However, these traditional policy tools may well be required as a complement to other forms of policy action, particularly in the face of market imperfections. Nevertheless the European Community will have to rely on some form of general economic policy measures in order to ensure that CO₂ emissions are treated in an identical manner irrespective of where they take place. There is wide agreement among experts and politicians on this question.

Two types of policy instrument may be used to guarantee that the abatement of CO₂ emissions will be conducted in a cost efficient manner:

- A common CO₂ tax covering emissions in all countries and all sectors of society.
- A system of CO₂ emissions trading based on a common legal cap.

The marginal abatement costs can be expected to be the same in both cases in all countries and sectors assuming that any major market imperfections do not distort the outcome. The foremost difference between the two policy instruments is that in the tax option, the rate required to meet the objective is not known in advance with any degree of certainty. Since high levels of tax are unpopular, there is an obvious risk that the tax rate will be set at too low a level and that valuable time will be wasted. The advantage of a system of CO₂ emissions trading based on a common cap is that it ensures that the abatement target will be reached. The disadvantage is that the marginal abatement cost is not known in advance. Hence both alternatives are subject to uncertainty but of differing kinds.

Energy and CO₂ taxation

A moderately high level of international CO₂ taxation would be a powerful climate policy instrument. An advantage of this model would be that it requires less international coordination and less public and private administration than a comparable system for emissions trading (Nordhaus, 2007).

The Economist, a British business magazine, reports that the price on the largest emissions market in the United States (for sulphur) fluctuated by as much as 40 per cent during a given year and that uncertainty surrounding the market price for CO₂ emissions could create hesitation among companies, regarding the long-term profitability of investments in low carbon technologies. In the United States, Congress is considering a proposal to introduce a safety valve by allowing the administration to increase the supply of allowances when the price threatens to break through a pre-set price cap. A floor price has also been discussed. The Economist argues that with such restrictions the emissions trading system would at least in part take on the role of a CO₂ tax. It would, according to The Economist, be simpler and more straightforward to go for CO₂ taxation rather than emissions trading.²

The widespread opposition to increasing federal taxes in the United States constitutes an argument in favour of emissions trading. Common schemes of taxation are difficult to implement in Europe too as the

²The Economist, 16 June 2007.

EUTreaty requires all decisions on tax levels to be unanimous. In those few cases where the EU has succeeded in reaching agreement on tax levels, it has been a question of minimum levels of a relatively modest character. The difficulty of introducing common schemes of taxation has been a reason for choosing emissions trading in the EU. The trading scheme also allows the Community to limit the competitive pressures on companies by allocating CO₂ emission allowances free of charge.

Emissions trading

Under ideal conditions, a trading scheme for greenhouse gas emissions would be global and include all greenhouse gases. The more limited the system is in terms of geographic and sectoral coverage, the smaller benefits from trading. If the activities subject to emissions trading are similar, trade will be restricted to ironing out small differences in marginal abatement costs. In a heterogeneous system that comprises many different types of economic activity operating under widely different preconditions, marginal costs can be expected to diverge which would benefit trade and help to dampen increases in average costs. From this perspective, it would be advantageous if EU ETS could be extended to include transport emissions.

The inclusion of the European transport sector in the EU ETS would probably raise the equilibrium price in the emissions market. The fact that transport has historically grown more rapidly than GDP and that its emissions continue to increase despite relatively high taxation is an indication of a high willingness to pay and/or high marginal abatement costs.

The widespread expectation that the participation of the transport sector in EU ETS would raise the price of emission allowances confirms that current fuel taxation is probably not high enough to restrict demand to a level that would allow the EU to fulfil its climate policy objectives.

Higher prices for emission allowances resulting from the inclusion of the transport sector in the trading system may create problems for energy-intensive production that faces competition from companies in other parts of the global economy. This would apply for instance to the iron and steel industries, paper and pulp production and the manufacture of aluminium and fertilisers. Fuel-intensive production would be

affected irrespective of whether or not the emission allowances were issued free of charge as it would no longer be profitable to expand production at the margin. This could ultimately lead to a contraction of the industry and to carbon leakage when production moves abroad.

The situation is worse for companies involved in electricity-intensive production since under present rules they do not receive any compensation at all for the impact of emissions trading on electricity prices in Europe. In deregulated markets, electricity generators will have to pass the cost of emission allowances on to their customers to avoid lowering their profit margins. This is also the case when the allowances are issued free of charge. The alternative in this case would be for the power companies to sell the emission allowances rather than to engage in production. In the event of production actually exceeding the company's initial allocation of free allowances, it would, of course, have to purchase additional permits. The impact of this on the cost structure of companies that use large amounts of electricity may be substantial since marginal electricity production in Europe usually takes place in coal-fired power stations. At 40 per cent conversion efficiency and an emission price of 20 euro per tonne CO₂, the price effect would be approximately 1.6 euro cents per kWh assuming that the power companies are able to pass on the full cost to their customers.

It should be borne in mind that the price of emission allowances required to keep emissions below the cap depends on a number of factors including parallel taxation of fuels and electricity, subsidies to bioenergy, economic growth, movements in oil prices, dollar exchange rates, structural changes, technological development and technical requirements and standards. The supply of emission reduction units from the other flexible mechanisms, CDM and JI (see box) is also of major potential importance.

Parallel taxation

In the short term, parallel taxation is the most important of the above mentioned factors. In its absence, the price of emission allowances would have to be much higher in order to maintain demand for fossil fuels and CO₂ emissions at a constant level. Taxation and emissions trading operate as communicating vessels. A fall in the level of one will have to be compensated for by a rise in the other.

Emissions trading and other flexible mechanisms

The Kyoto protocol defines three flexible mechanisms that may be used for achieving national emission reduction targets: Joint Implementation (JI), Clean Development Mechanism (CDM) and International Emissions Trading (IET).

Based on the protocol, the European Union created the European Emissions Trading Scheme (EU ETS) that covers emissions of CO₂ from the energy sector (installations with a capacity exceeding 20 MWh), the production and processing of iron, mineral industries and certain industrial plants for the production of pulp, paper and board. Around 10,000 installations are currently subject to the scheme. They account for 50 per cent of the Community's emissions of CO₂, which corresponds to 41 per cent of the total emissions of greenhouse gases.

Phase 1 of operating the trading scheme was carried out as a trial during 2005–2007. In 2006 1.1 billion tonnes CO₂ worth around 19 billion euro were traded. The second phase coincides with the commitment period of the Kyoto protocol (2008–2012). The price is currently around 23 euro per tonne CO₂.

The allocation of allowances to installations covered by the scheme is determined by National Allocation Plans (NAPs) produced by each member state and subject to final approval by the European Commission. Each allowance gives the right to emit one tonne of CO₂. The NAPs provide a cap on total emission from the installations concerned. A company emitting less than it is allowed to can sell its excess allowances to companies that would otherwise face a deficit (cap-and-trade). The allowances are initially allocated free of charge or by auction. According to the current directive, at least 90 per cent must be distributed free of charge during phase 2. “Banking” of allowances from phase 2 to phase 3 (2013–2020) is allowed.

Joint Implementation provides an opportunity for countries with reduction commitments under the Kyoto protocol to acquire Emission Reduction Units (ERUs) by investing in projects in other countries that have also undertaken to reduce their emissions (Annex I countries). The Clean Development Mechanism provides an opportunity for Annex I countries to contribute to projects in coun-

tries that have not committed themselves to reduce emissions under the Kyoto protocol. Units from such projects are called Certified Emission Reduction Units (CER). The project-based mechanisms can be used by both countries and companies. However, companies subject to the EU ETS can only use emission credits from JI and CDM projects for a small part of their emissions.

In January 2008 the European Commission presented its proposal for a revision of the current directive. The main changes are the following:

- The Commission proposes to set a single EU-wide cap and to allocate allowances on the basis of fully harmonised rules. National Allocation Plans will therefore not be needed any more. The annual cap will decrease along a linear trend line, which will continue after the end of the third trading period (2013–2020). In the case where the Community's overall reduction target is 20 per cent (below 1990), the total number of allowances should decrease by 21 per cent between 2005 and 2020.
- A few new industries (e.g. aluminium and ammonia producers) will be included and so will two further gases (nitrous oxide and perfluorocarbons).
- 60 per cent of the allowances will be auctioned in 2013 (including all those distributed to the power sector). The percentage of free allocation will gradually be reduced to zero in 2020. Harmonised rules governing free allocation will be introduced.
- Operators will be able to use credits from projects approved for the period 2008–2012 that they have not already used up. Based on a stricter emissions reduction (than -21%) in the context of a satisfactory international agreement, the limit on the use of JI/CDM credits will be automatically increased up to half of the additional reduction effort.

TABLE 4. Examples of European energy and carbon taxation in 2007. Re-estimated in terms of effective charge per tonne of CO₂. Average of the six largest member states of the EU.

<i>Type of fuel</i>	<i>Average nominal level 2007-01-01</i>	<i>Tax: € per tonne</i>
Unleaded petrol	569/1,000 litre	228
Diesel as a propellant	461/1,000 litre	177
Kerosene for use in civil aviation	0	0
Bunker oil used in maritime shipping	0	0
Gas oil for heating – non-business use	130/1,000 litre	50
Gas oil for industrial/commercial use	159/1,000 litre	61
Heavy fuel oil for heating business use	31/ton	10
Coal and coke for heating business use	0.14/GJ	1
Natural gas, industrial/commercial use	2.62/GJ	46

Table 4 illustrates the actual level of “CO₂ taxation” with regard to the combustion of fossil energy in different sectors in the six most populous countries in the EU.³ The specific designation given to the taxes by the authorities may be ignored as all energy taxes, regardless of their names, can be recalculated into effective tax on CO₂ emissions based on their content of carbon.

The impact of the taxation of fossil fuels on the growth of CO₂ emissions may be estimated by recalculating the tax rates in terms of euro per tonne CO₂. The average taxation of unleaded petrol and diesel within the six countries is 228 and 177 euro per tonne CO₂ respectively. Other forms of oil products are taxed at a lower rate, on average between 10 and 61 euro per tonne CO₂. The taxation of coal and coke is either low or non-existent in most member countries. The average taxation (highly variable) of natural gas for industrial-commercial use amounts to 46 per euro tonne CO₂ in the six countries.

A rough approximation of the average level of taxation of fossil energy in EU27 is in the range of 55–60 euro per tonne CO₂.⁴ Account should also be taken of the role played by the taxation of electricity. In most member states however, electricity tax rates are generally very low, the only exceptions being Denmark, Sweden, Germany, Finland,

³ Germany, United Kingdom, France, Italy, Spain and Poland have a combined population of 338 million (equal to 70 % of EU27).

⁴ An exact estimation is complicated and would require access to disaggregated data from all member states.

Italy and Poland. The highest rate of electricity taxation is in Denmark where it varies between 8.3 and 8.9 euro cents per kWh depending on the area of use. In terms of electricity produced in a coal-fired power station at 40 per cent conversion efficiency, this is equivalent to a carbon tax of around 100 euro per tonne.

Emissions trading in an ideal situation

In an ideal situation, economic theory suggests that energy taxation should not be used together with an emissions trading scheme. Variations in tax rates between different areas of use will disturb and distort emissions trading without any reduction in total CO₂ emissions, which are determined by the cap.

Therefore on the basis of economic rationality, the operation of a global emissions trading system would in an ideal world require the removal of all energy taxes including taxes on road fuel. The abolition of taxes on fuel would presumably have to be introduced in stages in order to avoid the risk that a change to sole reliance on emissions trading would lead to rapidly rising prices in other sectors and to serious difficulties and the destruction of capital. The abolition of fuel taxation would have to be accompanied by the introduction of some other form of tax or duty that would internalise the costs of infrastructure, traffic injuries, noise and tail pipe exhausts that are usually paid for, at least in part, by fuel taxation (Kågeson, 2001, and Proost, 2008). Traffic-related costs could be internalised by road tolls or kilometre charging. By reducing the demand for road transport services they would indirectly lower CO₂ emissions. They would not, on the other hand, provide any incentive to improve vehicle fuel efficiency.

Emissions trading under present conditions

However, the ideal conditions outlined above would not prevail if the EU unilaterally extended its emissions trading system to include the transport sector. As was pointed out above, this would most probably lead to a more rapid rise in the price of emission allowances than would have been the case if the sectors covered by the system had remained unchanged. Under these circumstances, it would be difficult to abolish fuel taxation as part of the transition to a system based on emissions

trading. The abolition of fuel taxes would further increase the demand for emission allowances in the transport sector which would lead to higher prices.

It is therefore highly likely that the EU, while waiting for the rest of the industrialised world to adopt cap-and-trade schemes similar to the EU ETS, will have to employ a hybrid solution in the road transport sector comprising fuel taxation and emissions trading. All estimates made in later chapters assume the retention of the present system of fuel taxation. This also applies in the case where road transport fuel consumption is included in the EU ETS. However the cost of reaching the common reduction target will be higher with this type of solution than would have been the case if the same rules could have been applied across all sectors.

Benefits and costs of supplementary policy measures

The compulsory requirement on suppliers to provide biofuels, equivalent to at least 10 per cent of demand, is a measure that will further dampen demand for fossil fuels in the transport sector. The same is true for legislation that forces manufacturers of energy-consuming products, such as cars, to make their products more energy-efficient. Rules of this type already exist for refrigerators and deep freezers, and the Commission has now proposed mandatory baselines for CO₂ emissions from new passenger cars (European Commission, 2007a).

Regulating the fuel efficiency of new cars and making a certain use of biofuels compulsory may however raise the costs of reaching climate targets. This would be the case if the requirements were too stringent or if the methods employed in reaching the biofuel target led to high levels of greenhouse gas emissions in a life cycle perspective.⁵ It is, however, natural that the marginal costs for meeting these supplementary requirements exceed the costs of reaching the Community's short-term goals as the objective is to prepare industry and markets for solutions that will most likely be necessary for reaching longer-term commitments. Yet there are good grounds to be aware of the risk that these policy tools may be devised in a manner that also gives rise to misallocation of resources in the long run.

⁵ Life cycle refers to emissions from production to use (well-to-wheel).

3. Greenhouse gas emissions from aviation

The aviation industry's share of travel in Europe is expanding rapidly. In 2004, it accounted for 8 per cent of passenger kilometres in EU25. Its share of freight transport, measured in tonne kilometres, is however minimal (0.1 per cent).

Domestic air travel in EU27 accounted for 2.7 per cent of the transport sector's CO₂ emissions in 2005. Between 1990 and 2005, the volume of these emissions increased by 40 per cent. Emissions from aviation fuel purchased in the EU25 for use on international routes amounted to 123 Mt (approx 5 times larger than domestic aviation). Since 1990 the volume of these emissions has almost doubled.

According to a forecast by the International Civil Aviation Organisation (ICAO), the aviation industry is expected to grow at an annual rate of just under 5 per cent over the period to 2020. The comparable figure for Europe is slightly in excess of 4 per cent per annum.

Technological development and larger aircraft have, according to ICAO, reduced average global fuel consumption per seat kilometre by 1.8 per cent per year during recent decades. Given an expected annual global increase in the number of air passengers of around 5 per cent⁶, a similar rate of decrease in aircraft fuel consumption, more direct air routes and improvements in flight control, total fuel consumption in the commercial aviation sector is expected to increase by almost 3 per cent per annum. This would be equivalent to an approximate doubling of CO₂ emissions between 2005 and 2030.

As mentioned above, the commitments made by industrial nations under the Kyoto protocol only apply to domestic flights. From an EU perspective, this means that CO₂ emissions from flights between airports in different member states and from flights to non-EU countries

⁶ And unchanged seat occupancy.

are excluded from the commitment undertaken by the Community. The Kyoto protocol (Article 2.2) recommends that Annex 1 countries should develop measures to deal with greenhouse gas emissions through ICAO which is the UN organisation responsible for aviation. However, the members of ICAO have been unable to reach agreement on the measures to be adopted which has led the EU to take unilateral action.

At a global level, aviation accounts for more than 2 per cent of CO₂ emissions as well as substantial emissions of other greenhouse gases.

The inclusion of air transport in EU ETS

In a proposed directive, the European Commission (2006a) suggests that CO₂ emissions from civil aviation should be included in the EU ETS. The directive would cover emissions from flights within the EU from 2011 and all flights to and from airports in other countries from 2012. The latter has led to a conflict with countries such as the United States, China and Australia. In their view, the EU does not have the right to include third-country airlines that operate flights to and from non-EU countries without mutual agreement.

According to the proposed directive, emissions trading would be limited to aircraft having a maximum departure weight of 5.7 tonnes or more. The flights covered by the scheme are likely to be allocated emission allowances equivalent to average sectoral emissions between 2004 and 2006 which will serve as the basis for the legal cap for emissions. At least during an introductory period, most of these permits will be allocated free of charge.

Airlines will be granted limited opportunities to make use of emission credits (CER and ERU) from the project-based flexible mechanisms (CDM and JI). In view of the expected growth of the aviation industry and the difficulties of replacing fossil fuels in air transport, the aviation industry is expected to become a net purchaser of emission allowances. Assuming an annual growth in fuel consumption of the order of 3 per cent, the industry's demand for emission allowances could be expected to be 23 per cent higher than 2005 emission levels as early as 2012.

Effects on prices and demand

As a result of higher oil prices, the cost of aviation fuel has more than doubled since 2002. By September 2007 it had reached 0.38 euro per litre. An emission price of 20 euro per tonne CO₂ is equivalent to 0.052 euro per litre fuel. This represents a price increase of 13.7 per cent. At present (September 2007), fuel accounts for approximately 17 per cent of the costs of regular flights of around 1,500 kilometres. Accordingly the price of an average medium-haul flight would at 20 euro per tonne increase by about 2.4 per cent. The doubling of emission prices to 40 euro per tonne CO₂ would increase the cost of air travel by roughly 5 per cent. Budget airlines would be subject to higher percentage increase in costs since their cost structure differs from that of traditional airlines. Fuel costs for Ryanair, EasyJet and Air Berlin account for 39, 27 and 22 per cent respectively of their total costs.

The Commission's proposal is supported by the European Parliament although it argues in favour of an allocation of emission allowances equivalent to 90 per cent of emission levels in 2004-2006 and that a quarter of these allowances should be auctioned. According to the Parliament, flights within the EU as well as all flights to and from airports in other countries should be subject to the EU ETS from 2011.

Effect on technological development, energy efficiency etc.

The limited effect of emissions trading on airline fuel costs, at least in the short run, does not mean that it lacks importance as an incentive to greater efficiency. Only part of the technological potential for raising efficiency is economically available at each level of fuel prices. The effect on fuel prices from emissions trading will increase the scope for energy efficiency. However, the effect of a moderately high price level will be limited in comparison with the unpredictable fluctuations in the price of crude oil.

4. Greenhouse gas emissions from shipping

The actual volume of fuel used in international shipping is not known. Depending on the approach adopted (bottom-up or top-down) and the assumptions made, different experts arrive at widely varying estimates. For 2001, these estimates ranged from 428 to 913 Mt. According to a new assessment carried on behalf of the International Maritime Organisation (IMO), annual global CO₂ emissions may now have reached 1,120 Mt (IMO BLG, 2007). On the basis of these estimates, emissions would appear to be in the order of 2–4 per cent of the global emissions of CO₂.

Shipping accounts for 39 per cent of freight transport within EU25 (excluding transport on lakes and canals) and just over one per cent of passenger transport.

International shipping is growing rapidly and it is usually assumed that the demand for fuel will double within 25–30 years (Corbett et al, 2007, Eyring et al, 2005). Increased operation speeds appear to offset the efficiency gains from improvements in hulls, engines and propellers.

CO₂ emissions from international shipping are not part of the greenhouse gas emissions reported by individual countries. Under the Kyoto protocol, Annex I countries are requested to cooperate with the IMO in reducing emissions. Like ICAO, the IMO has, however, been unable to reach agreement with the parties on measures to be adopted.

The EU has presented the IMO with an ultimatum, threatening unilateral action directed at the emissions of international shipping, unless the IMO decides on the introduction of a regulatory framework by 2009. Both the Council of Ministers and the European Parliament have, in principle, given their support to the inclusion of CO₂ emissions from international shipping in the EU ETS. The Commission, however, is currently investigating the feasibility of different legal measures,

among them integrating shipping in the EU ETS, a mandatory differentiation of port dues, and an obligatory use of the IMO's CO₂ index.⁷

Emissions trading

Several studies have looked into the possibility of issuing emission allowances to shipping within the framework of a global emissions trading scheme. The analyses indicate difficulties in finding an allocation model that would not give rise to substantial problems regarding administration, monitoring and the risk of distorting market competition. A number of different alternatives have been discussed such as flag state, the country where the fuel is purchased or where the vessel is owned or where the operator is located, the country from which the vessel sails or to which it is due to arrive and the country of destination for its passengers and goods. The only type of allocation that does not give rise to such problems is non-allocation, which means that the shipping sector's emission allowances are auctioned and/or the industry is required to purchase credits in existing emission markets. However, the question remains regarding who would be responsible for submitting allowances equivalent to actual emissions (CE, 2006 and CE et al, 2006).

Norwegian proposal in the IMO

In the spring of 2007, Norway proposed that the IMO should introduce a system whereby a cap would be placed on the CO₂ emissions of international shipping at the same time as a charge would be levied on vessel emissions (IMO MEPC, 2007). According to the proposal, the revenue would be used for:

- grants to measures undertaken to reduce vessel emissions of CO₂;
- purchasing emission allowances on the international market in order to balance the total CO₂ emissions from international shipping against the cap;
- contributing to climate change mitigation in developing countries.

⁷ A method for calculating emissions per tonne kilometre that could potentially be used as a legal bench-mark.

The monitoring of charges could be carried out at a number of selected ports where vessels would be requested on arrival to verify their purchase and consumption of fuel together with details of their itinerary. The Norwegian proposal may be viewed as a variant of cap-and-trade.

Maritime Emissions Trading Scheme

Commissioned by the Federal German Environment Agency (UBA), Kågeson (2007b) analysed the feasibility of linking the CO₂ emissions from international shipping to the EU ETS. He proposes that responsibility for emission allowances within a Maritime Emission Trading Scheme (METS) should rest with the ship itself despite the fact that a vessel is not a legal entity. The proposal is to tie the permission for a ship to call at a port to the vessel's participation in a scheme for emissions trading under a common cap. Non-participating ships, therefore, would not be allowed to call voluntarily and to load/unload at participating ports. The person or organisation delivering the allowances could be the owner, the operator, the charterer, the ship's master or someone else. Change of flag state or ownership would not alter the liability of the ship.

Ships would be liable for emissions from fuel bunkered since they last called at a participating port, albeit never for a period longer than a few months. This means that the return voyages of ships involved in intercontinental traffic would be covered and shipping operators would not gain anything by calling at ports in the vicinity of the European Union.

The existing system of mandatory bunkering delivery notes would be used to verify the consumption of bunker fuel. According to MARPOL Annex VI, these notes are compulsory for all vessels above 400 GT.

The report proposes that the initial allocation of emission allowances should be made by auction arranged by the EU or, if the system received global acceptance, by the IMO. If the IMO was however unable to establish the trading scheme, it could be introduced unilaterally by the EU at the same time as other countries were invited to participate. The involvement of climate-conscious American states such as California, Oregon and Washington together with British Columbia in Canada would mean in practice that the majority of intercontinental shipping would be covered by the system together with coastal shipping in Europe and along the west coast of America.

The absence of reliable information on the amount of maritime fuel consumed complicates the introduction of an emissions trading system for international shipping. According to the report, one way of circumventing the problem would be to introduce a trial year during which ships would register their fuel consumption without any obligation to submit emission allowances. The earliest possible date for the introduction of METS would be 2012 or 2013, and the cap for shipping emissions could be based, as in the case with aviation, on the approximate levels for 2005. The linking of the system to EU ETS provides vessels with the opportunity to purchase emission allowances from land-based installations as well as from the other flexible mechanisms (CDM and JI). It is in other words an open system.

The proceeds from auctioning the allowances could be recycled to the shipping sector or used for some other purpose. For instance, part of the revenues could be used to provide grants for investments in energy-saving technology in existing and new vessels or to give a fixed annual premium to all ships that make active use of the IMO's CO₂ index.⁸ To the extent that proceeds cannot be wisely spent on grants, the revenues could be returned to the participating shipowners, for instance, in relation to the number of GT kilometers sailed. When the Member States of the European Union begin to auction an increasing portion of the allowances to land-based sources, the amount of money recycled to the shipowners could gradually diminish.

The impact of the scheme on individual vessels would depend on their fuel consumption and the percentage fuel has of total costs. Fuel accounts for between 20 and 60 per cent of shipping costs (Corbett, 2006). This wide range is due to differences between ships with respect to speed, age and manning costs. Older ships that have low capital and manning costs are to be found at the upper end of the range. Assuming an emission price of 20 euro per tonne CO₂, the cost of acquiring an allowance would be equivalent to a supplement of about 19 per cent on the present market price of high sulphur bunker oil.

From a legal standpoint, there are no obstacles that would prevent the EU from demanding the participation of the shipping sector in an emissions trading scheme as a precondition for a ship being allowed to call at a port of a participating country. As port states, member countries are

⁸ The index is used to assess the impact of different policy measures on fuel consumption.

entitled to make such demands without coming into conflict with the United Nations Convention on the Law of the Sea (UNCLOS). The fact that the United States has on several occasions used this principle to impose unilateral demands on ships visiting its ports would make it difficult for the superpower to protest. However, the scheme would not apply to ships travelling through European waters on their way to ports in non-participating countries. The EU would have to respect the right of innocent passage (UNCLOS Article 24).

5. Climate change and rail transport

In Europe, rail accounts for 10 per cent of goods transport and 6 per cent of passenger transport. Approximately two thirds of rail transport is electrified. According to the UIC, energy consumption in the rail industry in 2005 amounted to around two million tonnes diesel (23TWh) and 42TWh electricity.

Climate change and electrified rail transport

Since emissions from fossil-fuel-fired power stations are covered by the EU ETS, the price of the electricity consumed by rail transport is affected by the cost to the trading sector of remaining within the cap. In a deregulated market, power generators try to pass on the marginal cost of production to all customers, and production in coal fired power stations is generally used to meet increased demand. The marginal cost also affects consumers who purchase electricity from hydro and nuclear sources.

The extent to which electricity prices during the EU ETS trial period in 2005–2007 affected rail transport is uncertain. As a result of the greater price stability expected during the Kyoto period (2008–2012), rail operators who purchase electricity in deregulated markets will feel the impact of higher marginal costs within a few years. At an emission price of 20 euro per tonne CO₂, the cost of electricity will rise by up to 1.6 euro cents per kWh. This is equivalent to 30 per cent of the cost of electricity in the Swedish rail sector (including the industry's cost of operating its own distribution network) (Banverket, 2006).

Climate change and diesel rail transport

CO₂ emissions from diesel locomotives in 2005 amounted to 8 Mt in EU27.

6. CO₂ emissions of road transport

Road transport is the principal form of transport in all European countries. Road vehicles account for 44 per cent of freight transport and 84 per cent of motorised passenger transport. Emissions of CO₂ from road transport in 2005 amounted to 893 million tonnes in EU27 which represented an increase of 29 per cent compared to 1990. Assuming a business-as-usual scenario, this figure is expected to rise by 50 per cent over the entire period 1990–2020.

Prospects for alternative transport fuels

Biodiesel and ethanol accounted for 1.6 and 0.4 per cent of the European markets for diesel and petrol in 2005 (European Commission, 2006b). The European Commission (2008e) proposes that by 2020 biofuel should make up at least 10 per cent of total motor vehicle fuel consumption. This goal indicates that a significant share of total bioenergy will be directed to the transport sector despite the fact that carbon emissions could be reduced several times more efficiently by utilising bioenergy in heat and power production (CE, 2003, Aebiom, 2007, JRC, 2007, EEA, 2008). This is attributable to the lower conversion loss when one avoids conversion from solid to liquid fuel and to the partial substitution of biomass for coal and lignite in heat and power production. Coal and lignite give rise to higher CO₂ emissions per unit of energy than petroleum products.

Bioenergy production in EU27 in 2000 was equivalent to 65 Mtoe (for all sectors). According to a *high renewable case* scenario, produced for the European Commission (2006c), bioenergy and waste may supply the equivalent of 143 Mtoe in 2010, rising to 254 Mtoe and 305 Mtoe by 2020 and 2030 respectively. By way of comparison, the consumption of petroleum products in the EU in 2005 was 666 Mtoe of which 298 Mtoe was used for other purposes than transport. The equivalent estimates in a business-as-usual scenario for 2030 are 610 Mtoe and 188

Mtoe respectively (European Commission (2006d)).

In a not yet officially published working paper, the Commission's Joint Research Centre (JRC, 2007) concludes that the limited bioenergy potential is best utilised in heat and electricity generation and that the welfare loss caused by imposing a 10 per cent biofuel target is between 33 and 65 billion euro (discounted present value) within an 80 per cent probability. The report also voices concerns over the risk of indirect negative effects on land use from enforcing the target. Environmental audit committees and governmental advisory bodies in Germany, the Netherlands and the United Kingdom have expressed similar concerns and called for a moratorium on biofuel targets until robust sustainability standards are enforced.

In addition to replacing diesel and petrol by renewable fuels, CO₂ emissions in road transport may be cut by a more optimal use of fossil fuels. Although diesel has a higher carbon content per unit of energy than petrol, the approximately 25 per cent higher fuel efficiency of diesel compared to petrol engines means that a shift to diesel results in lower carbon emissions. At the same time, a growing imbalance between the demand for petrol and for diesel would create problems. Heavy transport and machinery largely operate on diesel, while the market share of new passenger cars running on diesel is now above 50 per cent. As a result, Europe imports diesel fuel from the USA and exports petrol. A higher level of demand for diesel in Europe and/or an increased use of diesel in North America would worsen this imbalance and raise the need for investment in order to increase the production of diesel fuel in European refineries. This is technically feasible but will require higher levels of process energy.

A shift to natural gas is another area of potential expansion. Natural gas contains approximately 25 per cent less carbon per unit of energy than oil. Gas is primarily used in otto engines as a substitute for petrol although it is also possible to use a mixture of approximately three-quarters natural gas or biogas and a quarter diesel in diesel engines (as yet only in trucks and buses). This allows the combination of the more efficient diesel engine and the use of a low-carbon fuel. The potential for expansion is considerable since natural gas is distributed by pipelines in large parts of Europe while LNG provides opportunities for areas that lack a gas infrastructure.

Potential for higher levels of energy efficiency

The potential for reductions in fuel consumption in new passenger cars is generally considered to be large or even massive. By 2020, reductions of 40–45 per cent in EU27 could be possible even without making use of plug-in versions of electric-hybrids (Kågeson, 2007a).⁹ By this date, according to a preliminary assessment by the European Commission, an average CO₂ emissions figure of 95 g/km could be feasible in new cars. In the view of the European Parliament's environmental committee, an average emission of 75 g/km is a realistic target for 2025.

Current policy instruments in Europe

The taxation of diesel fuel and petrol curtails fuel consumption in road transport. The EU has agreed on the relatively low minimum tax rates of 302 and 359 euro per 1,000 litres for respectively diesel and petrol. Agreement has also been reached to raise the minimum tax rate for diesel fuel to 330 euro per 1,000 litres by 2010. In the spring of 2007, the Commission proposed that the minimum tax rate for diesel should be increased to the current minimum tax rate for petrol by 2012 and that the minimum tax rates for both fuels should subsequently be raised to 380 euro by 2014. This proposal, however, has still not been discussed in the Council. The duty on diesel fuel currently ranges from 245 to 807 euro per 100 litres in member states. The corresponding range for petrol taxation is from 300 to 760 euro.

⁹The Swedish motor industry's branch organisation, Bil Sweden, arrives at more or less the same estimate for new cars in Sweden although its figures are based on the higher initial emission value for the Swedish vehicle fleet compared to that of EU27.

7. Participation of road transport in the EU ETS

The possible participation of the road transport sector in EU ETS has been extensively analysed in a number of reports.

Road transport is a probable net purchaser

Several studies point out that road transport may be expected to become a net buyer of emission allowances in a common trading system. (Hochenstein et al, 2002¹⁰, Öko-institut, 2002, Bergmann et al, 2005, Kågeson, 2001 and 2004, Holmgren et al, 2006, Swedish Energy Agency and the Swedish Environmental Protection Agency, 2006). This conclusion is based on the relatively limited effect the trading scheme would have on prices compared to existing levels of fuel taxation for road transport. The participation of road transport in the emissions trading system therefore cannot, in itself, be expected to lead to major changes in the sector's fuel consumption and CO₂ emissions. An emission price of 30 euro per tonne CO₂ would raise the price of diesel fuel and petrol (excluding VAT) by 7.8 and 6.9 euro cents per litre respectively. If existing fuel taxes were abolished or reduced in conjunction with entry to the EU ETS, CO₂ emissions could actually increase (Kågeson, 2001 and 2004, Holmgren et al, 2006).

None of the studies have carried out detailed analyses of marginal costs and the scope for reducing emissions in the various sectors. Sijm et al (2002)¹¹ and Holmgren et al (2006), however, do present some cost estimates and generalised marginal cost curves for different sectors in support of their conclusion that marginal cost and willingness to pay is higher in the transport sector. Kågeson (2001) refers to an earlier study by Capros and Mantzos (2000) who concluded that a trading

¹⁰ See Profu (2007).

¹¹ See Profu (2007).

scheme covering all emissions in EU15 could be expected to generate an emissions price of around 33 euro per tonne during the Kyoto period, i.e. about 10 euro above the current market price. An analysis of the scope for reducing emissions in EU27, possibly in combination with a growing use of emission credits from CDM projects, could naturally produce different results.

CE Delft has recently produced an attempt to calculate the effect on carbon prices from the incorporation of the transport sector into the EU ETS. Based on conservative assumptions and a crude oil price of 35 euro per barrel, the team finds that the sector's participation would raise the price for achieving a 22 per cent reduction in 2020 from 50 to 65 euro per ton CO₂ in a case where half of the reduction effort was covered by credits from CDM projects. However, for the first reduction of 180 Mt in each sector (the current ETS and the transport sector), there is no large difference in abatement cost, and it diminishes even further when the oil price is assumed to be 60 euro per barrel. According to the report, the EU ETS carbon price would decrease if policies were put in place to promote fuel-efficient cars and market implementation of fuels with low CO₂ emissions (Blom et al, 2008).

The European Commission has not yet presented any analysis of the issue and says, in its proposal for a revision of the current emissions trading directive, that road transport should not enter the EU ETS during its third phase (2013–2020).

High transaction costs?

One potential argument for not wanting the transport sector to join the EU ETS is fear of high administrative expenses and transaction costs. For this reason, the LIFE project LETS (2006) and Wartmann et al (2006) give low priority to the inclusion of the transport sector into an enlarged trading scheme. LETS, however, admits that the adoption of an upstream approach could lower costs (see below).

Effects on industries subject to competition

Some studies underline that the transport sector's willingness to pay would exert upward pressure on the price of emission allowances which could create problems for industries subject to global competition, es-

pecially electricity-intensive production. (Kågeson, 2004, Holmgren et al, 2006, Energimyndigheten and Naturvårdsverket, 2006). Klooster et al (2006) draw attention to the risk that in an emissions trading scheme covering all sectors, fear of hurting industries under competitive pressures may cause political decision-makers to set a higher cap than they would otherwise have done and thereby adopt a less ambitious stance for climate policy.

The actual transfer of resources between different sectors is not just related to the cost structures of individual companies but is also dependent on the volume of emission allowances allocated to energy-intensive installations that are subject to global competition. Bergmann et al (2005) emphasise that emission allowances could be distributed by auction to the transport sector while retaining a free allocation for stationary sources. If decision-makers wish to protect industry, they can choose to be generous in their allocation of free emission allowances. However, they will not be able to prevent the marginal price effect on energy-intensive production, and under the current scheme, companies using large amounts of electricity do not receive any form of compensation.

The allocation of liability

There appears to be almost complete unanimity in the existing literature in favour of auctioning as the most suitable method for the initial distribution of emission allowances in the transport sector and to use the so called “upstream” approach for allocating responsibility.¹² These two issues are inter-related. An upstream approach means that fuel suppliers are compelled to take responsibility for the procurement of emission allowances equivalent to the emissions arising from the combustion of the fuel that they sell.

However, the current emissions trading scheme uses a “downstream” approach. Here final users are responsible for emissions. However, this approach would be administratively difficult to apply to road transport since it would mean that 156 million owners of 221 million vehicles

¹² The McCain-Lieberman proposal presented in the American Congress regarding a federal trading system that would include the transport sector, recommended free allocation of allowances (at emission levels prevailing in 2000) despite the adoption of an upstream distribution of responsibility.

would each be required to hold emission allowances corresponding to their fuel purchases (Energimyndigheten and Naturvårdsverket, 2006). It is notable in this context that the Commission in its proposal for the revision of the trading directive suggests that small installations should be given a chance to depart from the scheme because of high transaction costs (per tonne CO₂).

In order to minimise administrative costs and facilitate monitoring, the liability for transport fuels may be placed either with the firms importing or refining fuel for each individual member state's market or with the owners of depots from which the fuel is delivered to end-users. In the former case, it interfaces with the businesses from which national energy statistics are collected while in the latter, it coincides with the point of taxation of natural gas, heating oil and fuel.

Information is available in Sweden on the number of companies that would be covered by the upstream approach. In 2004, according to the Swedish Petroleum Institute, seven companies supplied fuel to Swedish depots for petrol, diesel, heating oil and liquefied petroleum gas. These companies were responsible for all petrol supplies to the Swedish market and 97–98 per cent of the deliveries of heating oil and diesel. A further two companies would be involved if domestic consumption of aviation fuel were to be included in the emissions trading scheme. According to the Swedish Gas Association, one company accounts for all natural gas imported into Sweden. Hence a total of ten companies would be involved at present if responsibility was located at the importing and refining stages for natural gas, petrol, LPG and oil (Kågeson 2004).

A potentially much larger number of companies and organisations would be covered if the liability was placed at the interface with energy taxation. According to the Swedish Tax Board, there were 34 authorised companies that had petrol depots in Sweden in 2004 and a further 235 that were authorised to store oil, mineral oil and LPG. Only one company in the former group is liable for emissions from an installation under the current trading scheme. However in the latter group, 138 companies (59 per cent) are already subject to the EU ETS (Kågeson 2004).

In 2004, according to the Swedish Gas Association, there were seven companies that supplied natural gas to small-scale users in Sweden. With one exception, all of these companies have plants covered by the current EU ETS.

Uncertainty surrounds the number of energy companies and fuel depots in other EU countries. However, according to Department for Transport (2007), 20 firms account for more than 90 per cent of all deliveries in the UK. Thus it is unlikely that the number of energy companies involved would increase to any great extent in relation to the size of the population of the member state. However, the number of fuel depots is much more likely to reflect population size.

If an upstream approach is adopted, it would seem essential to extend the EU ETS to include all fossil energy use rather than just the transport sector's emissions alone as the very same energy companies also provide heating fuel and energy to small industrial plants.

The use of an upstream method would almost certainly rule out granting fuel suppliers free emission allowances since that would provide them with windfall profits at the expense of taxpayers and consumers. Auctioning allowances appears to be the natural choice.

Department for Transport (2007) rejects a downstream allocation on the grounds that transactions costs would increase and that the difference to an upstream allocation would be small anyway as oil companies could be expected to offer to purchase and submit allowances that match the quantities of fuel bought by their customers.

Avoiding double-counting

The trading sector includes energy consumed in industrial boilers and combustion processes using heating oil and natural gas. A widening of the trading sector to cover fuel supplied to other sectors runs the risk of double-counting energy consumed in installations that are already part of the trading sector. The problem arises because the liability in the current trading sector is located downstream while the Community for practical reasons is bound to adopt an upstream approach for all other sectors. This problem arises irrespective of whether or not the liability is imposed at the import stage or at the interface with energy taxation.

The problem of double-counting may be solved by requiring energy suppliers to report to the relevant authority, the actual amounts of fuel sold to installations covered by upstream and downstream liability. Alternatively, the supplier may present documentation for total energy deliveries as a basis for reimbursement from the registering authority

for emissions that would otherwise have been covered twice. In this context, transport fuels do not present any difficulties since they are never part of the liability for emissions under the present EU ETS. Reimbursement already occurs in the context of energy taxation, for instance in relation to transport fuel used in agriculture and forestry (Kågeson 2004).

Effects on technological development in the road transport sector

The possible effects of the choice between emissions trading and higher road fuel taxation on technological development in the road transport sector are examined in a number of studies. According to Holmgren et al (2006) and Klooster et al (2006), a general emissions trading scheme would lead to a lower price for road fuel than would be the case in a system where road transport had its own cap and was forbidden to trade with companies in other sectors. They worry that the lower price will provide limited incentive for the technological improvement that will be needed in the longer term. Kågeson (2007c) recommends that the participation of the road transport sector in the EU ETS should be supplemented by policy tools designed to make the motor vehicle industry reduce the specific fuel consumption of new cars. This will be necessary as part of the preparations for more long-term climate commitments when the transport sector may be expected to make a greater contribution than is currently the case.

Koch et al (2005) and Pädam and Johansson (2006) discuss the option of linking a system of certificated targets (baseline and credits) for CO₂ emissions from new cars with the ETS by recalculating emissions per kilometre in terms of emissions arising over the entire life of the car, given certain assumptions on annual mileage and emissions in actual traffic. However, the authors conclude that the disadvantages of these arrangements are greater than the potential benefits. Ellerman et al (2006), however, argue that this type of system would be more cost efficient than a combination of emission trading based on actual emissions and specific emission limits for new vehicles. Kågeson (2007c) objects to their proposal on the grounds that it provides a poor relationship with actual emissions that vary according to driving pattern and traffic conditions. Moreover the average price of emission allowances during

the expected maximum 20-year life of the vehicle may be expected to be higher than in the year when the car was first registered.

Advantages of a common emissions trading scheme

As has been seen above, the extension of the EU ETS to take account of road transport emissions would necessitate the parallel inclusion of CO₂ emissions from other external sectors. In addition to achieving a cost efficient reduction of carbon emissions, the use of a common cap would guarantee that the EU is able to attain its reduction target for 2020.

A common emissions trading scheme would offer the opportunity to harmonise the allocation principles at the Community level. The EU would thereby be able to avoid complicated decisions regarding future discussion of appropriate distributions of the burden to be shared between member states. Under such a scheme the revenues from auctioning emission allowances could be distributed between countries on the basis of their share of Community population or in any other way that is deemed as fair and able to receive wide acceptance and support.

8. If road transport is not subject to emissions trading

The carbon emissions of road transport will have to be dealt with in other ways if the sector remains outside the ETS. The policy instruments to be considered are those that would stimulate energy efficiency, a shift to fuels with a lower fossilised carbon content, and a reduction in the demand for transport services (possibly combined with measures to promote a shift from road transport to other modes). Ultimately, European governments will have to rely on higher fuel taxes to keep demand at a sufficiently low level.

The difficulty of the task will above all depend on the level of future commitments undertaken by Europe and the scope given to emissions trading. The European Commission (2008a) proposes a European cap for the trading sectors in EU27 and a linear reduction after 2010 leading to a maximum permissible emission of 1,720 Mt CO₂ in 2020. This is equivalent to a 17.4 per cent cut compared with the annual allocation during phase 2 (2,083 Mt) and a reduction of 21 per cent between 2005 and 2020.

The Commission limits its proposal for an extension of the EU ETS to a few additional industrial processes and greenhouse gases other than CO₂.¹³ According to the proposal, the responsibility for greenhouse gases emitted from road transport, non-energy-intensive industries, agriculture and forestry, public and private services, and small-scale heating of buildings will remain with the individual member states. The Commission (2008b) has presented a proposal for how to allocate among member states the burden of reducing emissions from the non-trading sectors. The average commitment is set at a 10 per cent reduction and the proposed limits for individual countries fall in the range of

¹³The greenhouse gases from these additional types of installation will be given an extra emission volume in addition to the 1,720 Mt cap.

-20 to +20 per cent compared to 2005 levels.

It is conceivable that the CO₂ emissions from domestic aviation and shipping may be added to the EU ETS if the Community decides to include emissions from international aviation and shipping.

Acting together?

The EU could contemplate the introduction of a common cap for the emissions of the non-trading sectors instead of enforcing a separate limit on each member state. However, a fair distribution of the costs would be dependent on the parallel harmonisation of energy taxes and that the Community rather than member states would purchase reduction credits from the project-based mechanisms to the extent needed. This type of solution is not particularly realistic since the Treaty requires unanimity on all decisions on tax levels, and several countries are unable to accept such decisions on the ground that decision-making in this area should as a matter of principle not be done at Community Level.

Continuing responsibility of individual member states

In the absence of joint action, the Community will have to continue to negotiate on a fair distribution of costs. Since emissions from electricity production and district heating are covered by the trading scheme, the responsibility of member states will be limited to fossil fuel used for small-scale heating, certain industrial processes that do not require large amounts of energy and to fuel for vehicles and machinery. They will also have to take on emissions of greenhouse gases other than CO₂ to the extent that these are not covered by the EU ETS.

An obvious risk associated with continuing to delegate responsibility for the emissions of the non-trading sector to individual member states is that the burden-sharing process will result in decisions that lead to marked variations among countries with respect to the marginal abatement cost. Klepper and Peterson (2006) show that the implicit tax required to meet the Kyoto objective in the absence of purchases of CER and ERU varies between 5 and 60 euro per ton CO₂ in EU15. The Community has undoubtedly learned a lot from its first round of

burden-sharing decisions, and the Commission has done its best to achieve a fair allocation of responsibility in its proposals for the post-2012 regime. Nevertheless, substantial variations in the energy and fuel taxes that member states must adopt to meet their commitments cannot be ruled out. Tax rates for transport fuels may increasingly tend to diverge which may be considered unjust and is likely to lead to a growth in “petrol tourism”.

The extent to which fuel taxes will have to be raised depends not just on the distribution of costs between trading and non-trading sectors but on a range of factors of which the following are the most important:

- rate of economic growth;
- movements in oil prices and dollar exchange rate;
- changes in the housing stock and vehicle fleet;
- rate of improvement in energy efficiency in the non-trading sectors;
- use of biomass and solar energy in the non-trading sectors;
- distribution of transport services between different modes of transport;
- role of physical and urban planning;
- volume of other greenhouse gas emissions (not covered by the EU ETS);
- opportunities available to national governments to compensate for excess emissions by purchase of reduction credits from the project-based mechanisms.

Use of biomass

The use of biomass will give rise to competition. From a climate perspective, heat and power production make the most efficient use of Europe’s limited bioenergy resources. This applies to both large scale plants that are covered by the emissions trading scheme and small scale incinerators that are able to convert from coke and oil to wood chips or pellets. If the road transport sector’s compulsory quota for biofuel is set at a level where distribution companies are unable to meet their commitments by importing from other continents (e.g. sugar cane ethanol), they will have to compete with the heating sector for European resources. As a result of the conversion losses that arise in the production of liquid and gaseous biofuel, biomass will be unable to replace the same volume of oil and coal as it could have done in the heating sector.

When less biofuel is available for use in small-scale heating, the burden increases on road transport and other parts of the non-trading sector. Accordingly the tax on transport sector fuel will as last resort have to be raised by a higher amount than would have been the case if the EU had set the compulsory biofuel quota at a lower level.

In view of the likelihood of increased demand for biofuel in Japan, China, India and the USA produced from crops cultivated in tropical countries, there is a substantial risk that problems will arise in trying to meet the EU's proposed 10 per cent share for biofuels in the road transport market (SRU, 2007). European production of biofuel may, as has already been noted, also give rise to increased emissions of different greenhouse gases in the agriculture sector, which will add to the burden of the non-trading sector and increase the risk of having to raise fuel taxes compared to a situation where road transport does not require ethanol and biodiesel produced from European raw materials.

Increased fuel taxation

To the extent that other measures will not be sufficient, the only remaining solution would be to raise both fuel taxes and the taxation of fossil fuel used in other areas of the non-trading sector. The expected rise in the price of emission allowances that would arise from the inclusion of the transport sector in the EU ETS confirms that present levels of transport fuel taxation are too low to allow the EU to meet its climate objectives.

Two scenarios

The approximate effect on fuel taxes and prices of the permanent exclusion of road transport from the EU ETS may be estimated on the basis of assumptions on growth and burden sharing during the period 2010–2020. The European Commission (2008c) says the requirement on member states to reduce emissions by 10 per cent can be expected to result in a 7 per cent reduction in road transport,¹⁴ while larger cuts are assumed to take place in the heating sector and, in particular, for non-CO₂ gases (-21 %).

¹⁴ However, in a background document the necessary cut is, under partly differing assumptions, set at 5.5 % (European Commission, 2008d).

To be able to assess the impact on road transport from a requirement to reduce emissions by 7 per cent it is necessary to depart from a reference scenario based on business-as-usual assumptions. Between 1990 and 2005 the average annual increase in emissions was slightly in excess of 1.6 per cent, however not evenly distributed across the period. Annual growth exceeded 2 per cent between 1995 and 2000 and shrank thereafter to little more than 1 per cent per year. Between 2004 and 2005 domestic transport emissions in EU15 fell by 0.4 per cent, mainly due to rising demand for biofuel and changing tax conditions in Germany (EEA, 2007b). Under business-as-usual, the average annual increase in emissions would presumably have been higher.

In a base-scenario for the development of the energy and transport sectors until 2030, produced for the European Commission (2006d), end use of energy in transport is assumed to grow by 14 per cent between 2005 and 2020. It is, however, unclear whether this is a clean-cut business-as-usual scenario or whether some assumptions have been made about a growing share for biofuel and declining specific fuel consumption. Some guidance is provided by the fact that it is assumed passenger and freight transport will grow by 26.8 and 33.4 per cent respectively, while fuel use per tonne and passenger kilometre is predicted to fall by 17.7 and 1.5 per cent respectively. The distribution of bioenergy across sectors is not shown, but presumably the calculations depart from the assumption that the road sector's 10 per cent biofuel target will be achieved by 2020.

In order to avoid double-counting when assessing the effect on road transport from reducing emissions by 7 per cent, it is essential to depart from a reference scenario where the use of biofuel is not increasing and where the improvement in fuel economy of passenger cars stays at the annual level that existed prior to the agreement between the automotive industry and the European Commission on the reduction of specific fuel consumption. Therefore the business-as-usual scenario is based on the assumption that the annual reduction of specific fuel consumption is around 0.5 per cent and that, therefore, transport energy consumption and emissions will rise by 1.5 per cent in a case where traffic grows by 2 per cent per annum.

The estimates presented in Table 5 illustrate a possible abatement scenario in a situation where road transport is excluded from the EU ETS until at least 2020. Under business-as-usual (BAU), CO₂ emis-

TABLE 5. CO₂ emissions in road transport in EU27 in 2020 assuming a 7 per cent reduction target compared to 2005 and a 100 per cent utilisation of the technical potential for emissions reduction.

	<i>Mt CO₂ in 2020</i>
Emissions in 2005	893
Emissions according to a business-as-usual scenario (BAU)	1,117
Lower emissions from new passenger cars	-104
Lower fuel consumption for other types of vehicle	-35
Net emissions after measures to reduce vehicle fuel consumption	978
Other measures (eco-driving, tyres etc)	-49
Net emissions after all measures to reduce vehicle fuel consumption	929
Increased use of renewable fuel	-84
Net emissions after all measures to reduce BAU emissions	845
Target for road transport emissions in 2020	831
Deficit	-14
Effect of increase in European excise duties	-14
Final emission in 2020	831

sions in the road transport sector will reach 1,117 Mt in 2020.¹⁵ Passenger cars, light trucks and heavy vehicles are assumed to account for 55, 5 and 40 per cent of emissions respectively.

Table 5 is based on the assumption that road transport emissions will decline in comparison with a business-as-usual scenario as a result of measures such as stricter specific emission levels for new vehicles and a commitment to a 10 per cent biofuel target by 2020. The detailed basis for the calculation is presented in the box below and allows the reader to make alternative estimates using different assumptions.

When the target is a 7 per cent reduction compared to the 2005 level, road transport in EU27 may not emit more than 831 Mt in 2020. The result of the calculation, shown in Table 5, is that this could under ideal circumstances be achieved without any substantial increase in fuel taxation.

Table 5 features the best possible outcome for road traffic. Technical measures reduce emissions by 5.4 per cent compared to 2005, i.e. not far from the 7 per cent assumed by the European Commission. To depress demand to the extent needed to avoid a deficit of 14 Mt in 2020, fuel taxes would only have to increase by around 10 per cent. Alternatively member states can raise the cap by the same amount by buying

¹⁵ Note that account of an increased use of biofuel will be taken at a later stage of the calculation.

Detailed calculations for Table 5

1. As a result of stricter emission requirements for new cars (130g 2012, 100g 2020), it is assumed that the existing fleet of passenger cars in 2020 will emit on average 140 g/km compared to approximately 174 g/km in 2010. The average car is 10 years old in 2020. This will reduce emissions from passenger cars by 20 per cent – equivalent to 123 Mt – in 2020 compared to BAU ($0.2 \times 0.55 \times 1117$). Making allowance for a rebound effect of 15 per cent, the net reduction will be 104 Mt in 2020.
2. An equivalent but less strict requirement to reduce specific fuel consumption in other vehicles is expected to lower the average fuel consumption of the existing commercial vehicle fleet in 2020 by 7 per cent. This is equivalent to 35 Mt in 2020 ($0.07 \times 0.45 \times 1117$). No rebound effect is assumed to take place.
3. Other measures (eco-driving, tyres, road improvements etc) are assumed to reduce remaining consumption by 5 per cent. Feedback of brake energy limits the potential reduction. Increased use of air conditioning will offset part of the savings.
4. Ten per cent of fuel (CO₂ equivalent) consists of biofuel, compared to 1 per cent in 2005. This will reduce emissions by 84 Mt in 2020 (0.09×929) compared with the BAU scenario.

emission credits from CDM projects.

The calculations are based on a number of uncertain assumptions. The available room for emissions in the road sector would be smaller in a case where member states and the European Parliament decide on allocating a larger part to the EU ETS. In addition the Commission might be wrong in assuming that other greenhouse gases can be reduced to such an extent that road transport can be allowed a target of only 7 per cent. For an assessment of the potential range in outcome it is relevant to supplement Table 5 with a calculation based on more pessimistic assumptions.

The next scenario therefore is built on the postulation that the burden of reducing emissions in 2020 is evenly split between the EU ETS and the non-trading sectors (in both cases a reduction by 14 % com-

pared to 2005 levels). As presumably it will be difficult to cut emissions of non-CO₂ gases by more than the 21 per cent assumed in the first case, one should expect road transport to have to take on a greater part of the burden in this scenario. The assumption therefore is that road traffic must cut emissions by 12 per cent and that it will only be able to make use of 85 per cent of the technical reduction potential identified in Table 5. The results of a calculation based on these pessimistic estimates are shown in Table 6.

In this scenario taxes on fuels must be raised to reduce fuel demand to a level that is in line with the target. It is unclear which choice of fuel price elasticity is most relevant for a situation of this kind. In Europe the long-term fuel elasticity for petrol used in private cars is usually assumed to fall in the range of -0.6 and -0.8. Around one half of the consumers' adjustment to higher prices is through choosing cars with lower specific fuel consumption than they would normally have preferred. The other half is made up by reduced car ownership and shorter annual mileages.

Some recent scientific papers suggest that the price sensitivity may have declined substantially compared to a few decades ago, at least in the United States (Hughes et al, 2008, and Small and van Dender, 2007). This can partially be a result of growing real income. However, it is not known whether a similar decline is more modest in Europe where households depend less on the private car. In the absence of any recent estimates for Europe, it is here assumed that the long-term fuel price elasticity in EU27 is -0.6 (i.e. the lower part of the -0.6 to -0.8 range).

When carrying out the calculation for private cars, it is important to

TABLE 6. CO₂ emissions in road transport in EU27 in 2020 assuming a 12 per cent reduction target compared to 2005 and 85 per cent utilisation of the technical potential for emissions reduction.

	<i>Mt CO₂ 2020</i>
Emissions in 2005	893
Emissions according to a business-as-usual scenario (BAU)	1 117
Net emissions after all measures to reduce BAU emissions	886
Target for road transport emissions in 2020	786
Deficit	-100
Effect of increase in European excise duties	100
Final emission in 2020	786

consider the fact that the proposed EU regulation on the fuel efficiency of new passenger cars will make use of most of the potential for cutting specific emissions. Raising fuel taxes will therefore change consumer preferences to a smaller extent than under the historic conditions on which the estimates of fuel elasticity are based. To avoid double-counting, one should assume that under such conditions the remaining part of the long-term fuel price elasticity is probably no higher than -0.35. Professional drivers and their employers are much less sensitive to increases in fuel cost. In their case the long-term price elasticity could be expected to be around -0.15. The average long-term elasticity could thus be assumed to be -0.25 during the 2010s.

Under these circumstances the taxation of diesel and petrol in EU27 would have to increase on average by 86 per cent to reduce emissions by the additional 100 Mt needed for meeting the target. The detailed calculation is shown in the next box.

Calculating the required increase in fuel taxation

The deficit of 100 Mt is equivalent to 11.3 per cent of expected net emissions (100/886). The price at the pump will therefore have to increase by 45 per cent assuming an average price elasticity of -0.25 ($0.25 \times 0.45 = 0.113$). Assuming the relationship between price (0.49/l),¹⁶ excise duty (€0.55/l)¹⁷ and VAT (€0.22/l)¹⁸ that applied to petrol in EU27 in the autumn of 2007, the excise duty on petrol would have to increase by 86 per cent from 0.55 to 1.02 euro in order to ensure a 45 per cent increase in the price at the pump. In practice, the rate of tax increase on diesel should be somewhat larger than on petrol since diesel is subject to a lower rate of tax than petrol in most member states.

16 Cost of production + gross profit margin (with regard to the Swedish market in November 2007).

17 Average excise duty in EU27, weighted by population.

18 21 per cent VAT which is an approximate average figure for VAT on fuel in member states.

Based on the more pessimistic assumptions the average duty per litre of petrol and diesel would have to rise by 0.47 euro to keep road transport emissions in line with the target. This amounts to an increase in price at the pump of 45 per cent. This is considerably more than the price increase at the pump if road transport is included in the EU ETS. The latter option would probably give rise to an equilibrium price of between 30 and 40 euro per tonne CO₂, which would be equivalent to a price increase of 0.09 and 0.11 euro per litre (including 21 per cent VAT) and raise the cost of filling up by about 8 per cent.

Net increase in fuel taxes when emissions credits are used

Member states have another option if they want to avoid or to minimise the increase in fuel taxation. According to the Commission's proposal, they will be allowed to buy an amount of CERs in the international market for emission credits that is equivalent to 3 per cent of their emissions from the non-trading sectors in 2005. The issue of supply is discussed in chapter 10. Assuming that member states can use this opportunity to its full extent, it would allow EU27 to raise the cap for non-trading sectors by 90 Mt in 2020. Using one third of the potential for increasing the permissible emissions in road transport is thus equivalent to 30 Mt, which is 30 per cent of what is lacking in Table 6.

When the objective is minus 30 per cent

Conditional on other major industrialised countries and regions taking similar steps, the European Union has declared its willingness to raise the 2020 target to a 30 per cent reduction. The Commission (2008b) proposes that the additional burden of meeting the more ambitious target should be distributed between the EU ETS and member states along the same lines as the reduction by 20 per cent. In practice this means that the trading sector would be liable for 63 per cent of the incremental reduction and member states for the remaining 37 per cent. However, according to the proposal, the limits for the use of credits generated through projects in third countries would be raised to equal half of the additional reduction effort due to the international agreement.

The additional reduction for achieving minus 30 per cent can hardly

be split on the various sub-sectors of the non-trading sector in the same way as the contribution to a target equal to minus 20 per cent. A plausible assumption is that the additional reduction in road transport would have to be similar percentage-wise to that in the other sectors.

In a case where road transport must cut emissions by more than 7 or 12 per cent (as assumed in Tables 5 and 6), it is not reasonable to expect that technical measures can contribute more than a minor improvement compared to the assumptions on which Table 5 is based. The sector's additional contribution must therefore come primarily from a combination of tax increases that depress fuel demand and purchases of CERs.

Based on the above assumptions, the deficit after having made use of the identified potential for technical improvement would be 104 Mt in the *most favourable scenario*. To reach the target, taxes on petrol and diesel would on average have to be raised by 0.49 euro per litre in a situation where no credits from projects in third countries were used. If, on the other hand, member states make maximum use of such credits, the taxes would only have to increase by 0.14 euro per litre.

In *the worst case* (in line with Table 6) road traffic emissions must be cut by additional 89 Mt, based on the assumption that a total reduction of 22 per cent from the 2005 level would be required. Maximum use of emission credits would bring down the deficit to 114 Mt and require taxation to increase by "only" 0.54 euro per litre.

Range and most likely outcome

Table 7 shows that the range of the possible effect on road transport fuel prices is large. The assumptions behind the worst case could be regarded as more extreme than those on which the most favourable scenario is based. Thus the most likely deficit might be in the order of 40 Mt when overall greenhouse gas emissions in EU27 must be cut by 20 per cent and about 130 Mt when the Community's commitment is minus 30 per cent. With a maximum use of emission credits, bought from third countries, the deficits would shrink to 10 and 55 Mt respectively.

TABLE 7. Required increase in taxation in 2020 with and without making use of emission credits according to rules proposed by the Commission.

	Most favourable case		Worst case	
	<i>Deficit/ surplus in 2020, Mt CO₂</i>	<i>Need for tax increase, €/litre</i>	<i>Deficit/ surplus in 2020, Mt CO₂</i>	<i>Need for tax increase, €/litre</i>
When the EU's 2020 commitment is -20%				
With maximum use of CO ₂ emission credits	+16	0.00	-70	0.33
Without any use of CO ₂ emission credits	-14	0.07	-100	0.47
When the EU's 2020 commitment is -30%				
With maximum use of CO ₂ emission credits	-29	0.14	-114	0.54
Without any use of CO ₂ emission credits	-104	0.49	-189	0.89

As large purchases of emission credits will burden state budgets, member states may try to strike a balance between incremental expenditure and revenue from raising fuel taxes. As a result of such exercises, the average country may not wish to use more than, say, three quarters of the permissible volume of credits, if such quantities can be found in the first place. If so, the deficits would amount to 18 and 74 Mt when the overall objective is to reduce greenhouse gas emissions by -20 and -30 per cent respectively. Based on an average long-term fuel price elasticity of -0.25 (as explained above), the taxes on road fuels would have to be raised by 0.09 euro per litre in the first case and by 0.35 in the latter.

Raising taxes by these amounts is equivalent to 36 and 139 euro per tonne CO₂. In a case where overall greenhouse gas emissions must be reduced by 20 per cent, one can thus conclude that the effect on fuel prices from cutting road transport emissions by 7 per cent would probably be of the same magnitude as the result on prices from allowing the sector's emissions to be included in the EU ETS. However, when the ambition is to cut overall emissions by 30 per cent in 2020, the effect on fuel prices is likely to be much more pronounced when road traffic remains outside the trading scheme than when the emissions are covered by the scheme. The exact difference, however, is difficult to predict.

Extending the sensitivity analysis

A calculation of this type is based on numerous uncertain assumptions. Several of them are particularly sensitive in terms of their influence on the results. The rate of growth in the BAU scenario is obviously of decisive importance as is the Commission's assumption that road transport would not have to cut emissions by more than 7 per cent as a contribution to the 20 per cent reduction target. Movement in crude oil and natural gas prices is another uncertain factor. The calculations are based on constant real prices and an unchanged dollar exchange rate.

A third area of uncertainty concerns price sensitivity in relation to major changes that occur over relatively short periods of time. The sensitivity may be either larger or smaller than one would expect from historical experience of the effects of limited or moderate price fluctuations.

A rapid electrification of the new vehicle fleet (plug-in) and increased use of natural gas, especially in heavy urban transport, might potentially affect the estimates. Radical changes in the pattern of distribution and logistics may also exert a positive influence. A modest change in the assumptions regarding efficiency improvements in the vehicle fleet is not of major importance for the results. In the total absence of higher fuel efficiency requirements for passenger cars and different types of duty vehicles, excise duties would, however, have to be raised by a further 0.65 euro per litre.¹⁹ Improvements in the fuel efficiency of road vehicles are accordingly of special long-term interest to consumers.

In the truly long term, increased signs of saturation will take on growing importance. Car ownership and annual average mileage per vehicle will tend to stabilise at high levels. At the same time, it will become increasingly difficult to achieve further improvements in the energy efficiency of the vehicle fleet. It is therefore difficult to assess what will be required of road transport to meet the EU climate objectives for 2030 that have still to be agreed.

Impact on individual member states

The analysis above was based on average figures for EU27. However,

¹⁹ Based on a price elasticity of -0.7 for passenger cars and -0.15 for commercial transport and an average elasticity of -0.45 . It is also assumed that new passenger cars will continue to emit 160 g/km on average

TABLE 8. The Commission's proposal for burden sharing in the non-trading sectors and the percentage of CO₂ emissions emanating from the transport sector in member states that are expected to make the largest cuts between 2005 and 2020 when the overall EU commitment is minus 20 per cent.

	<i>Proposed reduction target, %</i>	<i>Transport CO₂ emissions in 2005, Mt</i>	<i>Transport share of non-trading CO₂, %</i>	<i>Transport CO₂ emissions per capita, tonne</i>	<i>Cars per 1,000 inhabitants in 2005</i>
Austria	-16	24.0	52	2.9	503
Belgium	-15	25.5	37	2.4	468
Denmark	-20	13.1	51	2.4	362
Finland	-16	13.5	60	2.6	462
Ireland	-20	12.9	52	3.1	395
Netherlands	-16	34.7	36	2.1	434
Sweden	-17	20.0	60	2.2	459
United Kingdom	-16	129.3	41	2.1	469

in order to function well, the proposal for how the burden of reducing emissions in the non-trading sector should be shared among member states must produce similar levels of marginal abatement cost in all countries. One way of looking into this is to study the share of CO₂ emissions in the non-trading sector that are produced in transport. Table 8 shows the relevant figures for the eight member states that, according to the Commission's proposal, would have to make the largest cuts (percentage-wise). As can be seen from the table, Finland and Sweden appear to face a difficult task in the transport sector, while, in particular, Belgium, the Netherlands and the United Kingdom may enjoy an easier ride.

Table 8 also provides information on the amount of transport emission per capita and the number of cars per 1,000 inhabitants, two parameters of importance for judging a country's relative position where domestic transport is concerned.

The real burden of achieving the national reduction target depends, of course, on multiple factors. One of them is the relative size of non-CO₂ gases in the non-trading sector and the reduction options left with the individual member states in that context. Table 9 shows how the emissions of CO₂e in the non-trading sector were divided on three main sub-sectors in 2005. According to the Commission (2008c) larger cuts are on average assumed to take place in the heating sector and, in particular, for non-CO₂ gases (-21%).

TABLE 9. Non-trading sector emissions in 2005, divided on sub-sectors. Per cent.

	<i>Non-CO₂</i>	<i>CO₂, transport</i>	<i>CO₂, other sectors</i>
Austria	22.8	40.2	37.0
Belgium	23.0	28.6	48.4
Denmark	31.8	34.8	33.4
Finland	34.2	37.5	28.3
Ireland	47.6	27.2	25.3
Netherlands	27.5	26.4	46.1
Sweden	30.3	42.0	27.7
United Kingdom	24.1	31.2	44.7

From Tables 8 and 9 it is evident that Sweden is the country (among the eight) having the highest share of transport emissions both in terms of the entire non-trading sector (42 %) and in relation to the CO₂ part of the non-trading sector (60 %). Now let us suppose that transport emissions in Sweden are cut by exactly 7 per cent as suggested by the European Commission as a likely average for EU27. For Sweden this is equal to a reduction of 1.4 Mt by 2020. The Swedish Environmental Protection Agency believes that the country's non-CO₂ emissions can at best be cut by 3.7 Mt (-26 %) between 2005 and 2020. To achieve minus 17 per cent in the entire non-trading sector, this would leave 3.0 Mt of CO₂ to be cut in the remaining non-trading sectors of the Swedish economy. This would mean a reduction of 23 per cent. Nothing of this appears impossible. The conclusion should be that the Commission has done a fair job in preparing for the 20 per cent overall reduction target, but that nevertheless some member states appear to have been given a somewhat easier task than others.

However, going for a 30 per cent reduction in 2020 based on the same burden-sharing recipe may turn out to put a great deal more stress on the transport sector of member states that are obliged to make large overall cuts. In the case of Sweden, it will be very difficult indeed to cut non-CO₂ gases much further than in the minus 20 per cent case. That leaves most of the task to be achieved in the transport sector and with little hope that fuel efficiency improvement can deliver more by 2020 than it will in the case where the Community's commitment is minus 20 per cent. There is, thus, an evident risk that the marginal cost of achieving the national targets will differ a great deal between member states under the more ambitious regime.

9. Separate trading system for transport sector emissions?

Making all emissions subject to a common cap irrespective of the sector from which they emerge would make it possible for the EU to meet its future climate commitments with high degree of certainty. However, in order to avoid putting Swedish industry at a competitive disadvantage, as a result of the higher prices that would arise from the inclusion of the transport sector in the emissions trading system, the Swedish Energy Agency and the Swedish Environmental Protection Agency have proposed that the possibilities for creating a separate trading system for transport emissions ought to be examined (Energimyndigheten and Naturvårdsverket, 2006).

It should be possible to use a downstream method for the liability and allocation of emission allowances in the existing scheme (EU ETS) while adopting an upstream approach for the second system. An upstream method is appropriate for the transport sector where there are millions of small consumers. The same would appear to apply to private and public services, agriculture and forestry as well as to private housing. Regarding manufacturing industry, it might be possible to allow companies, over a certain emission level, the opportunity to choose whether they wish to belong to an upstream or downstream system.

Another important issue concerns the parts of the transport sector that should be included in the new trading system. With respect to domestic shipping and aviation, a problem will arise if aviation fuel used in international flights is allocated a separate cap linked to EU ETS. In the proposal by the European Commission, domestic and international aviation are included in the same system. To differentiate between them is difficult but not impossible. Since some aircraft continually switch between domestic and foreign routes, airlines would be required to distinguish between fuel used in international and domestic flights. As regards shipping and fishing vessels, this would be difficult to imple-

ment and monitor. The emissions of the aviation and shipping sectors will clearly require an integrated approach which would allow their respective emission caps and emissions to be either linked to the EU ETS or to the complementary trading system.

The rapid growth of international aviation and shipping suggests that these industries should be given the opportunity to participate in an open trading system such as the EU ETS rather than a possible complementary European trading scheme. A possible disadvantage of this arrangement is that the emissions of the various transport sectors would be dealt with in different trading systems that might potentially give rise to differing prices. Shipping, aviation and the electrified rail net (and trams) would be covered by or linked to EU ETS while road transport and diesel trains would be included in the new trading system. In the long term, a growing share of road transport would also most likely be covered by the EU ETS once plug-in hybrid electric and/or fuel cell²⁰ cars become common. The transition from individual oil-fired heating to electric heat pumps is another example of energy consumption that may over time be transferred from the complementary trading system to EU ETS.

Open, half-open or closed?

A complementary emissions trading arrangement will have to be a closed system if the objective is to prevent road users' willingness to pay from exerting upward pressure on the emission price in the EU ETS. It cannot be linked either directly or indirectly to the EU ETS or be allowed to purchase emission allowances from the JI or CDM projects. However, in one respect it will be difficult to prevent actors in the two trading systems from competing with each other. Both groups may have an interest in using biomass as long as it is cheaper than purchasing emission allowances on their own market. In this respect, there is little difference in dealing with CO₂ emissions within one trading system or two.

The opportunities to use bioenergy that are available to companies in the EU ETS are also affected by the demands that the EU may place on the transport sector regarding the use of biofuel.

²⁰When electrolysis is used for producing the hydrogen.

Effects of a separate trading system

If the trading systems can be kept separate, the equilibrium price for CO₂ in both parallel systems will largely be determined by the level of their respective emissions caps. Decisions regarding the latter will be made by European politicians who will be forced to make a difficult trade-off between the risk of a higher price in the EU ETS and a substantial impact on household costs for fuel and heating. If the reason for introducing a second trading system is to avoid placing energy-intensive industries at a severe competitive disadvantage, politicians are likely to favour the installations currently covered by the EU ETS. On the other hand, they may find themselves in difficulties with voters who dislike having to pay higher fuel taxes.

In order to keep overall emissions in line with the commitments made by the EU, the price of allowances in the complementary trading scheme must be allowed to reach the level of the fuel excise duties and energy taxation on residential heating that would have been required in the absence of an emissions trading system. The only difference would be that the cost in the former would appear to be determined by trade per se and impossible to predict, while the level of energy taxes in the latter would have to be gradually adjusted by politicians in order to reach the level required to meet the target. It may be assumed that voters will subsequently understand that there is actually no difference at all. They will have to pay approximately the same price irrespective of the model adopted by the politicians.

Trading system II

The inclusion of other sectors than just the transport sector in the new trading system increases the potential for cost-reducing trade compared to a situation that only deals with road transport. Initially, road transport will account for almost half of the emissions. Manufacturing companies, public and private services, agriculture and forestry together with residential heating are responsible for slightly more than half of total CO₂ emissions. This may appear to provide a reassuring breadth although two particular types of energy use are likely to predominate: transport fuel and energy for residential heating.

The consumption of electricity by companies, households and the public sector is naturally included in the EU ETS. In the long run, a

high price for emission allowances in the transport sector would contribute to and accelerate a shift towards plug-in hybrid and/or fuel cell vehicles. As a result, part of the demand from the road transport sector will be transferred from trading system II to EU ETS where cars will compete with other forms of electricity consumption and influence costs in electricity-intensive industries. Consequently, the division of the emissions trading system into two separate schemes in order to protect the competitiveness of industry from difficulties caused by high electricity and energy prices, may in the long term become increasingly less efficient.

A decisive issue is the pace at which the price differential between the two separate markets can be expected to decline. If the change occurs at a rapid rate, the energy-intensive industry will not have much time to experience any positive effects from the separate systems. The same will also apply if competition for bio raw materials intensifies between the two trading sectors.

Alternative measures

Trying to reduce the transport sector's probable demand for emission allowances in a common trading system could be an alternative to dividing the emissions market into two separate systems. Emissions trading could be complemented by measures that would encourage road transport to make use of low price measures including those that have a negative cost.²¹ In this context, it would be essential to overcome market imperfections and different types of market rigidity.

Another possible solution would be to offer energy-intensive industry some form of protection. This alternative will be discussed in Chapter 14.

²¹ Meaning that the benefits to the consumer would outweigh his/her costs.

10. The use of CER and links to other trading schemes

The European Commission (2008a) proposes that after 2012, operators covered by the trading scheme should be able to make use of emission credits up to the remainder of the level which they were allowed to use in the period of 2008 to 2012, from project types which were accepted by all member states during that period. The Commission estimates that these credits may account for at least a third of the proposed emission reductions in the EU ETS between 2013 and 2020. This would be equivalent to approximately 85 Mt CO₂ in 2020.

As regards the scope for member states to raise their respective caps (excluding emissions covered by the EU ETS), the Commission (2008b) wants the purchases of credits from non-member to be limited to 3 per cent of each member state's emissions in 2005. This is equivalent to 90 Mt for the entire EU27.

Credits to be used in aviation and shipping

The Commission proposes that both domestic and international aviation (including routes between the EU and other countries) should be included in the EU ETS from 2011–2012 and that the trading system's cap should be raised by an amount equivalent to average aviation emissions between 2004 and 2006. CO₂ emissions from aviation fuel sold within the EU amounted to 148 Mt in 2005 and could in a business-as-usual (BAU) scenario be assumed to reach 268 Mt in 2020 (at a 4 per cent annual rate of increase). The emissions would be even higher in a case where in-bound flights were also liable.

Emissions trading will provide airlines with an incentive to reduce part of their emissions by internal measures. If assuming that such measures will account for one third of the required reduction, the remaining two thirds would have to be covered by net purchases of emis-

sion credits from the project-based mechanisms and/or by net purchases of allowances within the EU ETS. This would be equivalent to 80 Mt in 2020. It is still (March 2008) unclear to what extent aircraft operators will be allowed to raise their cap by making use of CER post 2012. However, they will not be allowed to become net sellers of emission allowances and credits in the EU ETS. Nor has the Commission suggested any reduction in the aviation industry's cap after 2012. It may therefore be assumed that its post-Kyoto cap will continue to be based on average emissions for the period 2004–2006.

If the IMO is able to create an emissions trading scheme for international shipping, it will further increase the demand for emission credits. If the IMO fails to act, the EU says it will introduce unilateral measures. In 2005, CO₂ emissions from marine bunker fuel sold in EU27 amounted to 180 Mt. Assuming an annual growth of 3.5 per cent on a business-as-usual basis, CO₂ emissions would increase to 302 Mt in 2020. If assumed that the shipping industry's cap will also be based on its level of emissions in 2005 and that no further reductions will be required until phase 4 (post 2020), CO₂ emissions will have to be reduced by 122 Mt in 2020 compared to the BAU scenario. If fuel used for journeys to Europe were included, the figure would be substantially higher.

Emissions trading will provide companies with an incentive to use internal measures to reduce part of their emissions. If such measures, again, are assumed to take care of one third of the required reduction, the remaining two thirds would have to be covered by net purchases of emission credits. This would be equivalent to 81 Mt in 2020.

Overall European demand for emission credits

The assumptions CO₂ for the period to 2020 presented above are summarised in Table 10. Assuming a European commitment to reduce overall greenhouse gas emissions by 20 per cent by 2020, the maximum demand for emission credits by the EU (including bunker fuel sold within EU27) would be equivalent to 336 Mt. Please note that emissions from journeys by ships and aviation to Europe are not included.

TABLE 10. Maximum need to acquire emission credits (CER) in EU27 in 2020 (including international shipping and aviation), assuming a commitment to reducing European emissions of greenhouse gases by 20 per cent.

	<i>Potential needs, Mt CO₂e</i>
EU ETS	85
Member states	90
National and international aviation	80
National and international shipping	81
Total	336

When the objective is minus 30 per cent

If an international climate agreement is reached with other major industrial countries, the EU is committed to raising its emission reduction target to 30 per cent by 2020, which would increase the need to acquire emission credits from projects in other countries. According to the Commission’s proposal, member states would be allowed to cover half of this additional reduction by means of credits. In 2020, this would correspond to a reduction in CO₂ emissions of around 91 Mt, in addition to the permissible volume of 90 Mt when the target was minus 20 per cent, i.e. a total reduction of 191 Mt CO₂e.

Setting the overall reduction target at 30 per cent by 2020 would, according to the proposal, also raise the scope for purchasing credits from non-member countries by an amount equivalent to half of the additional reduction required by the installations covered by the trading scheme. Consequently, the additional reduction of the EU ETS cap by 310 Mt would increase the potential demand for emission credits on the international market by a further 155 Mt.

A commitment to reduce carbon emissions by 30 per cent in the EU would presumably mean that emissions reduction in the aviation and shipping industries could no longer remain at 2005 levels while other sectors were required to lower their emissions by on average 24 per cent compared to that year. If for example the shipping and aviation sectors were obliged to reduce their emissions by 12 per cent in relation to 2005 levels, this would be equivalent to 22 and 18 Mt respectively. It is unlikely that either mode of transport would manage to introduce internal technical changes by 2020 on a scale very different from the assumptions on which Table 10 is based. This would indicate that their

need for emission credits in 2020 in the more ambitious alternative can be expected to be of the order of 103 Mt for shipping and 98 Mt for aviation.

The estimated CO₂ emissions in EU27 for the period to 2020 presented above are summarised in Table 11. Assuming a commitment to a 30 per cent reduction, the maximum demand for emission credits by the EU (including bunker fuel sold in EU27) in 2020 would be equivalent to 622 Mt. Please note that emissions from journeys by ships and aviation to Europe are not included.

Supply and demand of CER and ERU

During the Kyoto period (2008–2012), the global supply of CER and ERU is expected to be in the range of 1,700 to 2,600 Mt (World Bank, 2007, and UNFCCC, respectively). According to the IETA (2007b), output is expected to reach at least 2,200 Mt.

In the spring of 2007, emission credits totalling 917 Mt were under contract, more than half for use in the EU ETS (55 %) and the remainder in Japan (29 %) and the member states of EU15 (16 %). The World Bank (2007) estimates that there is need for a further 1,083 Mt, mostly for use in the EU ETS (59 %) and EU15 (28 %). There is considerable uncertainty surrounding demand from Canada, United States and the voluntary sector. According to IETA (2007a), demand from the voluntary sector may grow rapidly and reach a level of 120 Mt per annum in 2012. Towards the end of the period, following the enlargement of the EU ETS, the aviation industry will start to demand emission credits. The World Bank estimates that the latter will be in the range 30–80

TABLE 11. Maximum need to acquire emission credits (CER) in the EU27 in 2020 (including international shipping and aviation), assuming a commitment to reduce European emissions of greenhouse gases by 30 per cent (partly based on own assumptions regarding emission targets and permitted use of CER).

	<i>Potential needs, Mt CO₂e</i>
EU ETS	240
Member states	181
National and international aviation	98
National and international shipping	103
Total	622

Mt in 2012. At the present moment, the extent to which the aviation industry will be able to use project credits within the EU ETS remains unclear.

The annual supply of CER and ERU is expected to be in excess of 500 Mt at the end of the Kyoto period. The future rate of growth will above all depend on demand and long-term price expectations. At a 10 per cent annual rate of growth post Kyoto, the volume will double by 2020. At the same time, demand from the United States, Canada, Australia and Japan may accelerate if all these countries accept reduction targets. Under these conditions, it would seem unlikely that Europe will be able to buy more than one third of the credits available in the international market. This would be equivalent to approximately 330 Mt, which may be compared with the estimated total European demand requirement of 622 Mt in Table 11.

The supply of emission credits will have to increase at a substantially more rapid rate than 10 per cent per annum after 2012 in order to restrain the upward pressure on prices generated by the demand from the industrialised countries.

The opportunities for member states and installations subject to the EU ETS to purchase additional emission credits after 2012, following a decision to reduce emissions by 30 per cent, will be limited to purchases from countries that have ratified the new international agreement. This may restrict supply to the extent that a shortage creates a situation of scarcity pricing.

Links to other trading systems

The extent to which links will be allowed between the EU ETS and the trading systems that can be expected to emerge in North America, Australia and possibly Japan will influence the price in the European emissions market. If the emissions trading schemes are linked together, price differences will tend to be eliminated, which would benefit European companies subject to global competition. At the same time competition for CER and global bioenergy resources will be intensified.

The EU supports the establishment of links to other trading systems. Under article 25 of the ETS directive, an agreement on linking should be reached with third countries that have ratified emission reduction targets under the Kyoto protocol. However, it is also possible to es-

establish links with other systems, e.g. in the United States, assuming that they fulfil certain conditions. The European Commission (2008f) states in an explanatory memorandum that it should be possible to link all cap-and-trade systems without undermining the environmental integrity of the EU ETS. The establishment of new trading systems and mutual links between them increases the likelihood that global climate policy will succeed.

It would become more complicated to link different trading systems in a situation where the systems varied with respect to target periods, the opportunity to bank emission allowances between periods, the extent of relative emission targets etc. The existence of a price cap in one of the systems would create substantial difficulties since linking it to other schemes would indirectly create the same price cap in the latter. The Bingaman proposal in the American Congress contains a price cap of seven dollars per tonne CO₂ in 2010, which is far below the expected price in the European market. Another problem is that foreign trading systems may approve trade units that are not accepted by the EU ETS. Linking the systems would allow these units to influence total supply and thereby affect the emission price.

Different levels of ambition are not a problem per se in relation to linking. A more generous trading system would undoubtedly strengthen company capital assets compared to a less generous scheme. The link would, however, remove any difference in marginal abatement cost, which would be to the advantage of businesses in countries and regions that operate ambitious climate policies. In practice, linking will mean that the least ambitious country will import a higher emission reduction price than it would have encountered in the case where the trading systems were not linked.²²

²² However, competition for CER may also eliminate or reduce price differences.

II. Participating in EU ETS versus raising fuel taxes

As was pointed out in the introduction, three questions need to be answered in order to reach a conclusion as to whether or not greenhouse gas emissions from the transport sector²³ should be included in the EU ETS or as last resort be curtailed in some other way such as by higher levels of fuel taxation. The three questions are:

1. Will the inclusion of the transport sector in the EU ETS give rise to unacceptably high levels of transaction costs?
2. Will the participation of the transport sector in the trading scheme severely affect the competitive position of European industry?
3. Are there alternative policy instruments and measures that would be more suitable than the extension of the EU ETS to road transport?

Unacceptably high levels of transaction costs?

It was shown in Chapter 7 that the inclusion of the transport sector and other small-scale users of fossil energy in the emissions trading system need not be technically complex. This assumes however that responsibility for the verification of emission allowances is placed upstream i.e. with the fuel distributors. If this liability is allocated to the importers and refiners of natural gas, petrol, LPG and oil, in Sweden a total of ten companies would be involved. This suggests that in EU27, the number of companies may fall in the range of 300 to 500, compared to the 10,000 companies already covered by the EU ETS.²⁴

23 This applies first and foremost to emissions from road transport and diesel trains. Emissions from the aviation industry will presumably be included along the lines of the Commission's proposal, and in the long run emissions from international shipping industry may as well will be included or linked to the ETS.

24 Compared to Sweden, this figure may be higher in member states that use coal or coke on a small scale.

The answer to the first question is that if the EU ETS is extended to cover all small scale CO₂ emissions and responsibility for verification of emission allowances is placed at the importing and refining stages, there are no reasons to believe that administrative and other transaction costs would be any higher than the average for the installations that are currently under the cap of the trading scheme.

What will be the impact on the competitiveness of European industry?

According to the European Commission (2008c), the proposed burden sharing between the EU ETS and the non-trading sector should result in more or less the same level of marginal abatement costs in both sectors. There is naturally substantial uncertainty. It cannot be ruled out that the extension of the EU ETS to include all CO₂ emissions would raise the price of allowances. However, it is unlikely that this rise would exceed ten euro per tonne. It should also be noted that some non-trading areas have relatively low marginal abatement costs. The property sector is a case in point.

If consideration for the situation of energy-intensive companies is the decisive factor for excluding the transport sector from participation in the EU ETS, it will be essential to prevent companies in the non-trading sector from exerting any influence on prices in the trading sector. This may be easier said than done since there will be competition for emission credits and bioenergy.

The decisive factor in being able to answer this second question is whether the price of emission allowances in the EU ETS, even in the absence of the transport sector, will rise to a level that will necessitate some form of protection or compensation for energy-intensive companies. With the help of various models, the European Commission has tried to estimate the effect on the price of allowances of a 20 per cent reduction in total emissions by 2020. According to this assessment, the marginal cost would be 39 euro per tonne, assuming that no CER are purchased and there is a cost-efficient sharing of the burden between the trading and non-trading sectors. These estimates are based on a crude oil price of 61 dollar per barrel. The rules governing the use of CER proposed by the Commission are expected to lower the price of emission allowances in the EU ETS to around 30 euro per tonne in 2020. Using other

models and different sets of assumptions, the price of allowances varies between 21 and 35 euro per tonne (European Commission, 2008c). In a scenario where the emissions reduction target is -30 per cent and there is a commitment to fulfil half of this additional reduction by domestic abatement measures, the price of emission allowances in the EU ETS would be expected to rise.

Hence it appears likely that by 2020, the price of emission allowances will have reached a level of between 30 and 40 euro per tonne even in the case where road transport is permanently excluded from the trading scheme. The European Commission (2008a) accepts that some energy-intensive industries will be subject to severe competitive pressures and will require protection as long as their non-European competitors do not have to contend with the same demands. The Commission proposes that companies whose energy expenditures exceed a given proportion of total costs should be allocated allowances free of charge. This will continue to apply even after the introduction of auctioning of allowances to all other installations. Decisions on these procedures will be taken after 2011. Once again the problems confronting the electricity-intensive industry have not received the attention of the Commission.

Hence the answer to the second question is that the transport sector's inclusion in the trading scheme would not substantially change the competitiveness of energy-intensive industries. The question regarding how to best protect or compensate these companies will be dealt with in greater detail in Chapter 14.

Are there better policy instruments than the EU ETS?

A whole range of policy instruments designed to influence the emissions of the non-trading sector are either already in force or are about to be introduced in the EU. In road transport, there are for instance regulations relating to minimum levels of taxation for petrol and diesel fuel (that the Commission wishes to raise), proposals for emission limits for new passenger cars and a requirement to increase the use of biofuels to 10 per cent of transport fuel consumption by 2020.

As discussed in Chapter 8, these policy instruments could under ideal conditions be sufficient to reduce road transport emissions by more

than 5 per cent compared to 2005. To reach a reduction of 7 per cent, as suggested by the Commission, would only require a modest increase in fuel taxation. Using alternative assumptions on burden sharing between sectors and more conservative estimates regarding the opportunities to use the technical reduction potential for energy efficiency, the tax on petrol and diesel may have to be raised by as much as 0.33 euro per litre in EU27, assuming a target for total greenhouse gas reduction of 20 per cent and the maximum use of emission credits. If the Community raises its climate policy objective to a reduction target of -30 per cent, fuel taxation would have to be increased even further.

In order to be on a par with the expected emission price level in the EU ETS in 2020 (€30–40 per tonne), the real tax increase should not exceed 0.08–0.10 euro per litre. If the burden can be distributed between trading and non-trading sectors along the lines proposed by the Commission, there is little risk that fuel taxes will have to be raised by more than this amount in the average member state. However this would require that member states make use of most of the reduction potential for energy efficiency and purchase the maximum permissible amount of emission credits from countries outside the EU. If the Council and Parliament decide to place a greater share of the burden of emissions reduction on the road transport sector, there is a growing likelihood that the necessary tax increases will be more costly for motorists than the effect of buying emission allowances would have been in the case where the sector had participated in the EU ETS.

If the EU commits itself to a 30 per cent reduction of greenhouse gases by 2020, it is highly probable that the taxation of diesel fuel and petrol will have to increase by more than the corresponding increase in the price of emission allowances in the EU ETS. This would apply even when most of the technical reduction potential was utilised and member states made full use of the permissible volume of project-based emission credits. There is also an evident risk that substantial differences will emerge between the marginal abatement costs of different member countries.

If the EU decides to permanently exclude the road sector from EU ETS, there will be a growing need to coordinate the taxation of petrol and diesel fuel. In this perspective, it is alarming to note that the Council has still not begun to deal with the Commission's proposal for higher and harmonised minimum levels of fuel taxation. According to

the Commission (2007b), the minimum level of taxation for petrol and diesel fuel in 2014 should be 380 euro per thousand litres.

Common energy taxation policy?

If the Community wants to ensure reaching its climate policy objective for 2020 and does not wish to include road transport in the trading scheme, the introduction of a common energy tax policy might offer a solution. Without this type of policy coordination, there is an obvious risk that certain member states will find themselves in political difficulties when they try to implement the required tax reform. Moreover the EU does not have a system for dealing with free riders. The problem of border trade (“petrol tourism”) also supports the case for policy coordination.

A possibility would be to introduce a common CO₂ tax on all emissions that are not covered by the trading sector. If the EU commits itself to reducing emissions by 30 per cent by 2020 compared to 1990, the level of carbon taxation would have to exceed the expected price of emission allowances in order for the Community to set an emission trend that would meet the target. Such a carbon tax would be levied on top of the current excise duties on road fuel. Member states would continue to set their own levels for the pre-existing fuel taxes (subject to minimum levels established within the EU) and would also collect and retain the carbon tax revenues.

In a case where reduction targets are guaranteed by a combination of emissions trading for installations already covered by the EU ETS and a common CO₂ tax on emissions from other sectors, the EU could act as the party responsible to the UNFCCC for the European climate policy commitment. In this way, the Community would avoid having to negotiate a burden-sharing agreement between member states.

Since the level of petrol and diesel fuel taxation (excluding the CO₂ tax) will continue to be set by member states, these excise duties can take account of the costs of road vehicles such as wear and tear on the roads, accidents, noise and other forms of pollution than carbon dioxide. Heavy trucks that are subject to road tolls or kilometre taxation could be offered relief through lower diesel tax e.g. by providing a refund.

It is evident from Chapter 8 that the level required for a common

carbon tax would be difficult to establish in advance. The need to raise the tax level would be affected by, for instance, the rate of economic growth, the price of crude oil and the dollar exchange rate (assuming that oil is still traded in dollars). In order to deal with these problems, it would be advantageous if the European Commission was allowed to vary the tax rate within limits set by the Council. It would also be beneficial if the Commission could be permitted to buy and sell emission credits from the flexible project-based mechanisms in order to balance the outcome. Surplus revenue from allowances auctioned under the EU ETS could be used to finance net purchases. If responsibility for the European reduction target is transferred from member states to the Community, individual countries would no longer need to purchase any allowances.

It would be reasonable to exempt bioenergy from the new common CO₂ tax. As a result, renewable transport fuel and biofuel for heating would be able to compete with petrol and heating oil provided that they could be produced at an incremental cost lower than the new tax.

Other advantages and disadvantages

There are substantial advantages from an extension of the EU ETS. It would place all CO₂ emissions under a common cap and would result in a cost-efficient climate policy. However, it would not cover all greenhouse gases.

Together with supplementary purchases of CER and ERU, the common carbon tax would allow the EU to meet its climate policy commitments for 2020. Having said that, the choice of this option would require that the Commission's authority is extended into an area where member states have been sovereign. However, the motive for increasing the legal competence of the Commission would be the same as in the case of the Commission's proposal regarding taking over responsibility for the EU ETS. If the Council and Parliament support the proposal, they have confirmed that the climate issue is of such importance that it is reasonable to extend the competence of the Community in this area.

An important aspect of the choice between the two alternatives is the extent to which the scope for an efficient climate policy would be curtailed by the division of European CO₂ emissions into two segments. The underlying motive for emissions trading is that it allows abatement

measures to be concentrated in sectors where marginal costs are low. Some of the potential benefits would be lost as a result of a division into two segments. The extent of this loss will depend on how well the Commission succeeds in estimating the effect on marginal abatement costs of the proposed burden sharing between the trading and non-trading sectors. The more ambitious 30 per cent reduction target increases the likelihood that these estimates will be incorrect.

A factor that may possibly argue against an extension of the emissions trading scheme is that individual member states do have a greater opportunity to influence outcomes through their transport, housing and energy policies compared to their chances of influencing the companies presently covered by the EU ETS. Could an extension of the trading system actually reduce incentives for government to actively contribute to climate policy?

Wait until after 2012

One option might be to postpone until after 2012 a decision on the possible extension of the trading scheme to include CO₂ emissions from road transport and other small-scale users of fossil energy until after 2012. By that time, we will have data on the price of emission allowances during the Kyoto period and will know whether or not the emissions reduction target for 2020 has set at 20 or 30 per cent. A clearer picture should also have emerged regarding the development of the international market for emission credits. If an assessment carried out in 2011 or 2012 indicates that there is a risk of substantial variations in marginal costs between trading and non-trading sectors or between member states, the emissions trading system should be enlarged. In such an event, the extension of the trading system should be able to come into force by 2015 or 2016.

I2. Effects on the competitiveness of different modes of transport

Many factors influence the market distribution between different modes of transport. The four main modes are more often complementary than competitive. However, technological development and new infrastructure may influence the area of competition between different types of transport, even if such changes tend to come about slowly. Economic growth and structural change may also exert an influence in this context. Although the cost of transport fuel is not unimportant, it often accounts for a modest proportion of total transport expenditure. Table 12 illustrates the approximate cost of fuel and electricity – including current excise duties – in various types of transport. The large variations within some modes are the result of differences in capacity utilisation, costs of manning and capital, and choice of design speed. A passenger ferry, for example, has much higher capital and crew costs than a container ship of equal size, and in addition higher port dues.

TABLE 12. The approximate share of fuel and electricity costs in various types of transport including current excise duties (excluding VAT).

<i>Type of transport</i>	<i>Share of fuel and electricity costs (%)</i>
40-ton long-distance truck (2007)	31
Delivery truck (2007)	12
Freight train (2007)	10
General cargo vessel, 3,000 dwt (2007)	7
Container ship, 9,300 dwt (2007)	25
Taxi (diesel) 2005	6
Bus (2005)	15
Passenger train (2007)	5
Car ferry, 3,000 dwt (2007)	6
Traditional airline (medium-haul)	17
Budget airline (medium-haul)	20–30

Sources: The Swedish Association of Road Haulage Companies, the Swedish Taxi Association, the Swedish Bus and Coach Federation, SJ, Green Cargo, SAS, Ryanair, EasyJet, Air Berlin and Lloyd's Register Fairplay.

These figures may differ somewhat between member states due to variations in factor prices and taxation.

The effect on the competitive position of different types of transport following the introduction of emissions trading may be best assessed by a comparison between the expected emission price and the present level of company fuel costs including tax. Table 13 presents the results using two different price levels. Note that the emission price represents the upper limit of the trading system's impact on business costs. Many companies have the opportunity to reduce at least part of their emissions at a cost lower than the equilibrium price on the emissions market. It should also be borne in mind that changes in oil prices may substantially affect company fuel costs.

In Table 13, it is assumed that rail transport purchases electricity on a deregulated market where producers, at least in the long run, may shift the marginal costs of emission allowances on to their customers. It is also assumed that marginal electricity production takes place in coal condensation power stations at a 40 per cent conversion rate. The fact that road fuels are heavily taxed explains the limited additional effect from participating in the EU ETS.

Note that electrified rail transport has already partially internalised the costs of the energy sector's participation in the EU ETS. This means that the inclusion of other types of transport in the trading system would improve the competitiveness of rail transport. However, the effects are likely to be modest since the cost of fuel in many cases only accounts for a moderate proportion of total costs. Table 14 shows the approximate effects of the EU ETS on average total costs in the various transport sectors.

TABLE 13. Approximate effect on fuel and electricity prices of the transport sector's participation in EU ETS

<i>Type of transport</i>	<i>Percentage increase in fuel cost</i>	
	<i>At €20/tonne CO₂</i>	<i>At €30/tonne CO₂</i>
Diesel-powered road vehicles*	5.0	7.5
Electrified rail transport #	30.0	45.0
Container ship	14.9	22.3
Ferry	14.2	21.3
Aviation (traditional airline)	13.7	20.5

*Major customers, September 2007.

"Current cost" for rail transport estimated prior to the establishment of the ETS.

TABLE 14. The approximate marginal effect of CO₂ emissions trading at 30 euro per tonne on the total costs of different types of freight and passenger transport.

<i>Type of transport</i>	<i>Percentage increase in total cost (%)</i>
40-tonne long-distance truck (2007)	2.3
Delivery truck (2007)	0.9
Freight train (2007)	4.5
Container ship, 9,300 dwt (2007)	5.6
Taxi (diesel) 2005	0.5
Bus (2005)	1.1
Passenger train (2007)	2.3
Car ferry, 3,000 dwt (2007)	1.3
Aviation (traditional airline, medium-haul)	3.5

Rail transport has still only been partially affected by emissions trading during the trial period. A further increase in the price of emission allowances may strengthen the competitive position of the shipping industry, in relation to road and rail transport, since ships travelling at a modest speed are the most energy-efficient form of freight transport. However, in the long term, competition between the various modes of transport may also be affected by the following factors:

- Changes in labour costs and/or changes in staffing levels.
- Changes in tax regulations affecting the salaries (payroll charges) of on-board employees.
- Introduction of road tolls or kilometre taxation for road vehicles in order to internalise the cost of road maintenance, accident risks, and emissions of pollutants and noise.
- Stricter requirements for shipping emissions of NO_x, SO₂ and particles.
- Stricter requirements for the aviation sector's emissions of greenhouse gases other than CO₂.
- Stricter surveillance of road transport working hours, rest periods and loading regulations.
- Changes in the taxation of fuel, motor vehicles or transport services.
- Changes in the regulations regarding the length and total weight of trucks.
- Possible introduction of VAT on intra-European air fares.
- Creation of a new infrastructure including combi-terminals.
- New technology that contributes to more rapid and/or cheaper transport services.

- Changes in punctuality and the frequency of damage.
- Availability of related services (complete logistical and transport packages).

If CO₂ emissions from road transports are not included in the EUETS, the sector's emissions must be limited by other means. Competing forms of transport derive an advantage from the exclusion of road transport from the emissions trading system as long as politicians manage to tax petrol and diesel at the level required to reach climate objectives. In view of the popular demonstrations in a number of EU member states against perceived high levels of petrol and diesel taxation, it cannot be taken for granted that politicians will manage to keep such taxation at the required level.

13. Effects on industry and consumers

The transport sector will not be able to avoid responsibility for its emissions of greenhouse gases. Irrespective of the policy instruments chosen by politicians, the costs of travel and freight transport for households and businesses will be affected.

The increases in fuel taxes that would be required if road transport continues to remain outside the EU ETS were discussed in chapter 8. On the other hand, the inclusion of emissions from road transport in the trading scheme would also have an impact on the price of fuel. This was illustrated in chapter 7. The difference in effect on prices was estimated to be close to zero in 2020 when the Community's commitment is to reduce greenhouse gas emissions by 20 per cent and member states make use of most of the permissible volume of emission credits bought from countries outside the EU. Regardless of which of the two alternatives becomes the choice of EU decision-makers, the effect on fuel prices would be around 0.10 euro (VAT included). However, when the overall target is a reduction by 30 per cent, motorists are likely to have to pay about 0.25 euro more per litre if road transport is not subject to emissions trading than if it were part of the EU ETS.

Effect on industry's transport costs

Since fuel accounts for a low or moderate proportion of the total costs of commercial transport services, the effect on customer prices will be limited. The cost structures of most industries will be largely unaffected by higher transport costs, especially if they occur gradually over many years. Transport costs account for 2–4 per cent of turnover in the majority of industries. Assuming that fuel initially accounts for 25 per cent of transport costs and that the latter represent 3 per cent of total customer expenditure, a 30 per cent increase in the price of fuel would consequently raise transport costs by 7.5 per cent and the customer's total expenditure by 0.23 per cent. In other words, this type of change

is likely to be relatively limited in scope for most industries and companies compared to the outcome of wage negotiations over the same time period or potential changes in raw material costs.

Share of transport costs

In 2004, the expenditure for purchasing domestic transport services by engineering industries in Sweden amounted to 1.6 per cent of total costs. In some industries, however, the share of transport costs was appreciably higher. According to Swedish industrial statistics, transport accounted for 12.3 per cent for mining (of which 90 per cent was by rail), 8.3 per cent for pulp and paper, 3.3 per cent for timber and wooden products and 3.4 per cent for foodstuffs. Higher fuel prices would also have a negative impact on the cost structures of suppliers of sand, gravel and macadam. However, these industries are not normally subject to international competition.

In addition to expenditure on transport services, companies also have to finance their in-house transport expenditure. Industrial statistics do not provide any details on the extent of these costs. On the basis of national income accounts, Johnsson (2003) carried out a satellite assessment of the distribution of diesel fuel purchases for heavy transport in 1995 between the Swedish road haulage industry and companies operating their own transport services. He found that the latter group accounted for 47 per cent of fuel purchases. The percentage is likely to vary considerably between different member states.

Local distribution is not subject to international competition. However customers face higher prices for transport services as a result of emissions trading or higher fuel taxes.

Share of energy costs

It should be noted that several industries, especially in the forestry sectors, emit high levels of greenhouse gases and are also major consumers of transport services. Irrespective of the mitigation measures adopted by the European Parliament and Council, these sectors will be vulnerable to higher costs. Electricity-intensive sectors such as the mechanical wood pulp industry and aluminium and fertiliser production have potentially more to gain from the exclusion of the transport sector from

the EU ETS than saw mills and producers of chemical pulp.²⁵

There are good grounds to pay particular attention to the share of electricity costs in the most vulnerable companies since electricity-intensive industry still does not receive any compensation for its additional emission reduction costs in relation to non-European competitors. According to the Swedish Energy Agency, paper manufacture has the highest proportion of electricity costs. They comprise on average 7.4 per cent of total variable costs. The corresponding figures for other Swedish industries are cement and limestone (6.2 %), wood pulp (6 %), limestone quarrying (5.5 %), mining (5.3 %), basic chemicals (3.4 %) and refinery products (3.1 %).

On the basis of a study of Nord Pool spot prices, Honkatukia et al (2006)²⁶ estimated that the electricity industry managed to pass on between 75 and 95 per cent of their price increases to their Finnish customers during the first 16 months of the ETS trial period (phase 1). According to the Swedish Energy Agency, an increase in the price of electricity by 0.025 per kWh²⁷ would lead to an average increase in total variable costs of 6.8 per cent for the paper industry. The following industries were also affected by substantial increases in costs: wood pulp (5 %), mining (4.8 %), cement and limestone (4.4 %), limestone quarrying (3.6 %), other metals (2.8 %), basic chemicals (2.7 %) and refinery products (2.3 %). It must be emphasised in this context that conditions may vary both within and between industries in member states. In the latter case, the structure of the electricity market may have a decisive impact on the actual outcome.

Effects on households

In 2004, 23.8 per cent of Swedish household expenditure was allocated to transport services, motor vehicles and vehicle maintenance (excluding charter tourism). Travel services accounted for almost half of this expenditure, with the remainder spent on vehicles and fuel.²⁸ Fuel costs comprise a larger proportion of the total expenditure of low-income

25 Assuming that they do not receive any form of financial compensation.

26 Cited by the Swedish Energy Agency (Energimyndigheten, 2007).

27 Corresponds to a marginal cost of €31/tonne CO₂ for electricity production in coal condensation power plants at 40% fuel conversion and a complete shift of the price effect on to consumers.

28 National income accounts.

households compared to high-income earners. Fuel tax increases are consequently regressive in nature.

The use of higher taxes to curb the CO₂ emissions of the transport sector, as opposed to participation in the EU ETS, will consequently have a greater impact on low-income groups, especially those who live in rural areas. A large increase in petrol and diesel fuel taxation would, however, generate substantial revenue that could be used to reduce other taxes. This type of tax reform could be focused on low-income groups, providing them with the largest “refund”.

Unlike high-income households, low-income groups do not have the opportunity to reduce their variable costs for car transport by choosing modern, energy-efficient vehicles. They will instead purchase their cars on the second-hand market. Therefore, measures that provide incentives to high-income earners and companies to make increasing use of energy-efficient vehicles from the smaller model range could, within a couple of years, have a major impact on the make-up of the second-hand car market, and thus on the future fuel costs of low income households. That in turn should make it easier for politicians to use fuel taxes as a policy instrument.

14. Measures for protecting energy-intensive industry

If a fear of raising the price of emission allowances and thereby damaging the competitiveness of energy-intensive production is the main reason for hesitation regarding the inclusion of road transport in the emissions trading system, two questions need to be answered:

1. How great is the problem?
2. Is there a better method of protecting companies subject to global competition than the free distribution of emission allowances that is currently used in the EU ETS?

How great is the problem?

A decisive question affecting the likelihood of survival for energy-intensive companies is the extent to which they would be able to pass on increased costs to their customers. Electricity producers operating in deregulated markets stand a good chance of doing just that. In the absence of non-European competition, they are able to raise the price of electricity without running the risk of losing market share. Power and heating utilities account for more than 70 per cent of volume within EU ETS and the Commission is proposing not to grant them any free allowances after 2012. Sectors such as the steel industry are more vulnerable to global competition and may find it more difficult to pass on costs to their customers.

One method of assessing the scale of the problem is to compare the cost structures of installations in the EU ETS that face international competition with those of non-trading sectors that also operate on global markets. The latter include the engineering industry and many service companies. Such businesses often have energy bills that only account for a single per cent of total costs. Therefore taxation of their

electricity and fuel consumption does not appreciably affect their overall competitiveness. The same situation may also apply to certain companies that are subject to both the EU ETS and global competition.

Demaiily et al (2007) have quantified the impact of the EU ETS on sectoral costs and compared the cost increases with the sectors' value added. Starting from the assumption that emission allowances are not distributed free of charge, the authors find that there are substantial increases in costs. The study also examines the indirect effect on the price of electricity. In terms of value added, the study indicates that costs rose by 66 per cent in the limestone industry, 21 per cent in the iron and steel industry, 14 per cent in the cement industry, and 7 per cent in oil refineries when the price of emission allowances was 15 euro. As regards, electricity-intensive production, the authors identify five sectors where the increase in costs was equivalent to at least 3.5 per cent of added value, namely production of precious metals, industrial gas, inorganic chemicals, ceramic products and household products. Somewhat surprisingly, wood pulp and paper are not among these industries. Aluminium smelters and fertiliser production are also absent from this list. However this may be due to the small scale or non-existence of these sectors in the British economy.

In order to assess the potential effects on competitiveness of a higher price for emission allowances, one can examine the factor cost structures of specific companies operating in competitive markets. If for example, an oil-consuming company has an energy cost share of 5 per cent at the current dollar exchange rate (1.45)²⁹ and crude oil price (\$90/barrel), an emission allowance price of 25 per tonne CO₂ would mean that the company's total costs would increase by 0.9 per cent. Assuming a 50 per cent wage share in relation to total costs, the effect on the company's competitiveness would be equivalent to a 10 per cent increase in real wages over a number of years while the labour costs of foreign competitors only increased by 8 per cent over the same period. This example illustrates that the higher energy costs brought about by the EU ETS are not necessarily the most important factor price change in terms of the scheme's impact on profitability. On the other hand, it represents an additional cost that competitors avoid and may be relatively large in relation to the company's profit margins.

29 Against the euro

The effect of emissions trading on electricity-intensive production depends on the extent to which electricity producers are able to pass on their marginal costs to their customers. If the entire cost of an emissions allowance costing 20 euro per tonne CO₂ is shifted to consumers, this would be equivalent to an increase in electricity prices of 0.016 euro per kWh.

Another important aspect of the potential need to provide compensation is the extent to which energy-intensive companies are actually subject to international competition. Energy-intensive materials are sometimes produced for local or regional markets because transport costs are high or proximity to the customer is considered important. In other words, there may be natural barriers to imports. On the other hand, this may already be reflected in current market shares. Increased costs for European producers thereby provide opportunities for their competitors to gain a foothold in the market. For European exporters, on the other hand, the cost of emissions trading may strengthen the barrier to foreign markets.

It will thus be important to examine whether there are other energy-intensive installations than power and heat production plants that will not require protection. Equally essential is to identify the approximate level of energy-intensity when an increase in CO₂ prices of, say, 10 euro per tonne following the transport sector's inclusion in the EU ETS would seriously undermine a company's competitive position. In the proposal for a revision of the trading directive, the Commission (2008a) states its intention to present an analysis of these issues by 2011. In a back-ground document, the Commission (2008c) defines energy-intensive industries as those using more than 3 per cent of their expenditure on fuels and electricity.

Different methods of protecting companies facing international competition

In principle, there are five different ways of protecting or compensating industries that risk being placed at a competitive disadvantage due to the additional costs that may arise from their participation in the EU ETS.

- Free allocation – compensation in advance.
- Retroactive compensation.
- Border tax adjustments.
- Exempting energy-intensive industries from ETS.
- Placing a cap on the price of emission allowances.

Compensation in advance

Providing compensation in advance is the method currently used in the EU ETS. Emissions allowances are allocated to installations free of charge based on historical emissions. The owners thus escape the cost of purchasing allowances equivalent to an unchanged level of emissions. Electricity-intensive plants, however, are not compensated for higher electricity prices resulting from emissions trading.

A disadvantage associated with free allocation based on historical emissions is that the market becomes less transparent than would have been the case if emission allowances had been initially allocated by auction. Another disadvantage is that new entrants do not compete with existing installations on equal basis.

Of course the system can be reformed to minimise these negative effects. In order to prevent distorting competition within Europe, compensation should be the same in all member states as proposed by the Commission (2008a). Ideally the level of compensation should correspond to, say, 95 per cent of the emissions arising from the use of best available technology (BAT). This would prevent overcompensating companies or weakening their incentives to improve energy efficiency and adopt low carbon fuels. The Commission would consequently have to monitor technological development and continually update baselines for energy-intensive raw materials, semi-manufacturers and finished goods. However, companies wishing to increase emissions above the level determined by their free allocation would have to purchase additional allowances at the same auction as non-energy-intensive companies.

Electricity-intensive installations could also be compensated in advance by means of a free allocation of allowances equivalent to the emissions from marginal electricity production. (Egenhofer et al, 2006, High Level Group, 2006). This compensation may be justified on the grounds that electricity generators operating on deregulated markets

are able to pass on the entire marginal production costs to their customers. Once again, allocation of allowances should be based on BAT. The free allocation of emission allowances to industrial installations that purchase electricity on regulated markets will have to be adjusted to take account of the actual increases in costs that have taken place. Electricity-intensive companies would have the opportunity to sell their free allocations on the emissions market or use them as part payment for purchases of electricity from their suppliers.

Retroactive compensation

Retroactive compensation offers an opportunity to protect both fuel- and electricity-intensive industries. In this type of system, all emission allowances would be subject to public auction. Part of the auction revenues would then be used to provide monthly or quarterly compensation to energy-intensive installations (exceeding a certain energy cost share) for the costs of purchasing allowances, equivalent to the emissions for which they are either directly or indirectly responsible. As in the case with advance compensation, the allocation would cover up to 95 per cent of the emissions based on BAT and be identical for all installations of the same type.

The advantages of this type of arrangement, compared with compensation in advance, are that new entrants and existing installations are treated equally and that the emission market becomes more liquid and transparent. This means in effect that European companies will be able to expand under more or less the same conditions as equivalent companies in other parts of the world. This would, however, mean that within the EU ETS the European Commission would have to reserve some room for emissions originating from the expansion of such industries.

In a retroactive system, electricity-intensive installations are compensated for the costs of emission allowances, corresponding to the emissions from marginal electricity production attributable to their demand for electricity. Once again compensation would cover up to 95 per cent of electricity consumption using best available production technology. Van Asselt and Biermann (2006) propose that compensation to the electricity-intensive industries should be financed out of the proceeds from the sale of emission allowances to the electricity gener-

ating sector. The benefit of retroactive compensation for electricity-intensive companies compared to advance compensation is that allowance can more easily be made for the additional costs that arise due to differences in deregulation between markets.

Border tax adjustments

Border tax adjustments (BTA) in the form of equalising tax adjustments/tariffs represent a third possible form of compensation for companies facing international competition. The underlying principle is that countries that produce in regions with high CO₂ cost, e.g. the European Union, should be compensated when they export to other regions. Conversely, a symmetrical import duty could be levied on imported products from regions without comparable CO₂ restrictions (Grubb and Neuhoff, 2006).

Although it is probably a relatively simple matter in technical terms to apply BTA to raw materials, it may be much more difficult to adjust for differences in the costs of CO₂ between all of the semi-manufactures and finished products manufactured in different countries and regions that have carbon-intensive components (Azar, 2004). The European car industry would for example, following the introduction of BTA, pay for the CO₂ costs of aluminium irrespective of whether the metal was produced in Europe or in some other part of the world. On the other hand, car manufacturers in Japan and the United States could continue to buy aluminium from non-European suppliers without having to pay for the costs of CO₂ emissions.

The European Parliament has proposed that the Commission should seek to introduce CO₂ related import tariffs on goods from countries that have not ratified the Kyoto protocol. The former French president Chirac supported the introduction of BTA and his successor Sarkozy holds the same view. However, free trade is a delicate balancing act and a step in one direction may lead to counter measures from other countries that could result in a net loss for the EU. In preparing its proposal for a revision of the emissions trading directive, the Commission assessed the possibility of making importers submit CO₂ allowances corresponding to emissions caused in the production of energy-intensive materials but decided to wait until 2011 before making any proposal on this matter.

De Cendra (2006), who analysed the legal complications of BTA, concluded that GATT and the WTO SCM agreement³⁰ do not present a barrier provided that emission allowances are auctioned and that the entire system is designed in a non-discriminatory manner. He points out, however, that this issue has still not been examined by any WTO panel.

The United States may encounter difficulties in protesting against a possible introduction of border tax adjustments in Europe since such measures are already under discussion in the United States. America's Climate Security Act (ACSA), put forward by senators from both political parties, contains proposals that would impose tariffs on goods imported from countries that have failed to place a cap on their emissions. The tariff duties would reflect differences in CO₂ costs.

In order to avoid acting in a discriminatory manner, the European BTA system would have to provide relief or make exceptions for producers in other parts of the world that are subject to similar demands in their domestic markets. This type of adjustment may be difficult to implement due to differences in requirements and abatement costs in different countries and systems. The practical and administrative problems associated with the introduction of BTA are substantial.

Exempting energy-intensive industries from EU ETS

Exemptions from trading scheme may provide a fourth possible solution to the problems confronting energy-intensive industries. It may appear somewhat paradoxical solution as the EU decided to construct the ETS around these sectors. However, it may be a better solution to exempt the relatively small number of installations requiring protection than to leave housing, offices, motor vehicles and non-energy-intensive industry outside the trading scheme.

Emissions of carbon dioxide from the industrial installations concerned would have to be controlled by other means in order to prevent exemptions from the EU ETS acting as a barrier to the implementation of cost-efficient climate measures. Regulation may be introduced at EU level through the establishment of compulsory baselines or by

30 The WTO Agreement on Subsidies and Countervailing Measures (the SCM Agreement).

allowing member states to issue licences covering the emissions of specific installations. A variant would be to permit trade in emission credits between companies subject to a given baseline. Relative commitments, however, have the disadvantage of being unable to impose an absolute cap on the total emissions of the specific installations. Increases in production will raise the levels of emissions.

The advantages of exempting certain energy-intensive installations from the trading scheme are that it liberates the owners from the financial burden of buying allowances without jeopardising the target and, at the same time, allows a cap to be placed on all other CO₂ emissions from the 27 members of the EU. These installations will be able to expand operations on the same basis as non-European competitors, provided that they adopt the best available technologies of production.

It is, however, unlikely with this type of solution that energy producers would be exempted from the EU ETS. Their emissions are substantial and most of customers are engaged in production that is not particularly energy-intensive. This method cannot thereby be used to compensate electricity-intensive industrial installations.

Placing a cap on the price of emission allowances

As mentioned previously, the effects of an emissions trading system on the competitiveness of energy-intensive industry could be limited by placing a politically determined cap on the price of emission allowances. This solution has been discussed in the United States and means that the state would guarantee a price ceiling by increasing the supply of emission allowances. This means in practice raising the emission cap and replacing the allowance market with a carbon tax.

Other types of measures

Another method that could be used to protect European industry would be to try to establish sectoral trading systems for energy-intensive industries at a global level. The European cement industry's organisation, Cembureau, has begun discussions with corresponding organisations in the United States, Japan and China in order to examine the possibilities of establishing a common trading system. The Center for Clean Air Policy (2006) has analysed these possibilities in relation to electricity

generation, iron and steel, aluminium, cement and limestone, chemicals and petrochemicals and paper and pulp industries.

If this method is to succeed in protecting electricity-intensive industries, power generation would have to be subject to a more or less worldwide cap. Moreover all local and regional electricity markets would have to be deregulated in order that marginal costs could be passed on to their customers. It is highly unlikely that this would occur in the foreseeable future.

Conclusions on compensation

The first four methods discussed above would all require some form of direct or indirect government support being given to energy-intensive industries. The economic benefits received by the companies involved would be similar in kind. They differ mainly in terms of form. On the other hand, the outside world and international trade organisations are likely to find these alternatives more or less acceptable. Licensing emissions using some form of threshold value is probably the method that would encounter least opposition while border tax adjustments and financial aid may be considered potentially more distorting. A detailed legal evaluation of the various alternatives will have to be carried out before the EU can reach a decision on this issue. A preliminary conclusion, however, is that it would appear feasible to compensate both energy- and electricity-intensive producers for most of their costs arising from emissions trading.

15. Summary

The European Union will soon have to reach agreement on how to deal with greenhouse gas emissions from the transport sector. Without strong general policy instruments that gradually reduce the emissions in a cost-efficient manner, it is difficult to believe that Europe and the world will be able to meet the objective of limiting increases in average global temperatures to a maximum of two degrees centigrade compared to pre-industrial conditions. This is a difficult, long term task that will affect several hundred million households and companies.

When meeting in June 2007, EU environment ministers asked the European Commission to present criteria for an assessment of the opportunities to extend the European trading system for emission allowances, the EU ETS. In January 2008, the Commission presented its proposal for a revision of the directive, but without suggesting the inclusion of the transport sector or providing any guidance on the matter.

Two principal approaches

There are two general forms of policy instrument that can be used to guarantee a cost efficient reduction of greenhouse gases: The same carbon tax in all countries and all economic sectors or emissions trading under a common cap.

A moderately high level of common CO₂ taxation would be a powerful general instrument of climate policy. Among the advantages of this model are that it requires less coordination and administration than a comparable system of tradable emission allowances.

There are however three reasons in favour of emissions trading. Firstly a common level of European taxation is difficult to implement, due to a lack of popular support and the stipulation in the EU Treaty that requires all decisions concerning tax levels to be unanimous. Secondly it is possible within a trading system to limit the economic burden on companies operating in competitive markets by allocating emission

allowances free of charge or by offering the companies retroactive compensation. The third and most powerful reason is that a comprehensive cap covering all sectors will ensure that the climate objective is reached.

The most common arguments against the inclusion of the transport sector are:

- That administrative and other transaction costs could be high;
- that the transport sector's participation could potentially raise the price of emission allowances in the EU ETS;
- that there are other policy instruments more suitable for the purpose of reducing road traffic emissions.

The transport sector's participation in the EU ETS

The inclusion of the transport sector along with emissions from other small scale areas, including buildings, need not be technically or administratively complex. The adoption of an upstream approach would place responsibility on distributors for verification of emission allowances. If this liability is placed with companies that extract, refine or import fuel, the number of affected businesses would be small and the transaction cost per ton CO₂ would probably fall below the average of the installations currently under the cap of the EU ETS.

In its proposal for a revision of the emissions trading directive, the European Commission has striven to attain a similar marginal abatement cost in the EU ETS as in the non-trading sector. According to the assessment, the marginal cost of achieving a reduction of 20 per cent by 2020 is expected to be 39 euro per tonne in a situation where no emission credits are bought from third countries. The marginal price is believed to drop to 30 euro in a case when member states and the installations covered by the trading scheme make maximum permissible use of the scope for purchasing emission credits.

The calculations are based on a number of difficult assumptions concerning the developments under phase 3 (2012–2020), and the uncertainty about some of them must be considered as substantial. However, even if the Commission may have misjudged some of them, it is rather unlikely that the price of allowances will end up being higher than 40 euro, assuming the proposed revision is confirmed by the Council and the European Parliament.

The Commission wants to gradually phase out the allocation of free allowances to installations that do not operate on global markets. However, energy-intensive industries will be allocated allowances free of charge as long as major competitors in other parts of the world are not subject to a cap similar to that of the EU ETS. As road transport's prospective inclusion in the trading scheme would not reduce the amount of free allowances given to the industry, it would not make the situation for these companies any worse.

However, where electricity-intensive industries are concerned, the picture is less clear. The Commission does not provide any assessment of how companies belonging to this category should be handled in a likely situation of rising prices on the emissions allowance market. Electricity-intensive companies could potentially be protected by free allocation of allowances corresponding to their purchases of electric power, through retrospective compensation (based on actual consumption) or through a system whereby importers to Europe of goods covered by the regulation would have to submit allowances equal to the emissions from the marginal power production in the country of origin.

The case when road transport is permanently excluded from EU ETS

As long as the EU ETS only covers half of total CO₂ emissions, energy taxes will have to continue to be used to reduce emissions in the other sectors. As was made evident in Chapter 8, the implementation of the European Commission's proposal for emission limits for new passenger cars (max 130 gram CO₂ per km in 2012) would by 2020 reduce road transport emissions by more than 100 Mt compared to a business-as-usual scenario. However, this is far from sufficient, and in view of the limitations on global bioenergy supplies, the EU can hardly expect to replace more than about 10 per cent of its consumption of petrol and diesel fuel with biofuel. According to the estimates presented in Chapter 8, this would be equivalent to 85 Mt in 2020.

However, together with additional measures aimed also at reducing emissions from heavy duty vehicles, the package should under favourable conditions be able to reduce road transport emissions by 5.4 per cent, which comes pretty close to the 7 per cent below the level in 2005 anticipated in the Commission's assessment of how the burden should

best be split between sectors. There would in this case be no need to raise fuel excise duties, if member states make use of the legal opportunity to buy emission credits in the international market.

In a scenario based on less favourable assumptions, where the Council and the European Parliament decide to demand the same percentage reduction from the trading and the non-trading sectors and where road transport is not able to make use of more than 85 per cent of the identified technical reduction potential, fuel taxation would as a last resort have to be raised on average by 86 per cent by 2020 to achieve the target. However, in a case where member states use the entire permissible volume of emission credits from CMD projects, taxes would only have to be raised by 60 per cent.

Depending on the assumptions made about the development under business-as-usual, type of burden sharing, use of project-based emission credits and the long-term price elasticity of road fuels, the result can obviously fall anywhere within a broad range.

If other major parties in the coming climate negotiations commit themselves to reductions similar to those of Europe, the Community has declared its willingness to reduce emissions by 30 per cent by 2020 (compared to 1990). According to the calculations presented in chapter 8, the EU would in this situation have to raise fuel taxes by 0.14 euro per litre in the most favourable scenario and by as much as 0.54 euro in the worst set of circumstances. In both cases a maximum use of emission credits from third countries was assumed.

A conclusion in chapter 8 is that the most likely outcome for the road transport sector is a gross deficit of around 30 Mt in a case where the overall commitment is to reduce greenhouse gases by 20 per cent, and about 130 Mt when the target is -30 per cent. After maximum use of emission credits, the deficits would shrink to 10 and 55 Mt respectively.

Purchasing large amounts of emission credits from abroad would burden the state budgets of member states and one can envisage a situation in which governments might like to strike a balance between the cost of buying credits and the revenues from raising fuel taxes. If so, they may not want to make use of more than, say, three quarters of the permissible volume of credits, if indeed such quantities are available in the international market. In this scenario, the deficits would be 18 Mt if the target is -20 per cent, and 74 Mt if it is -30 per cent. Based on the average long-term price elasticity of road fuels assumed in chapter 8,

fuel taxation in the average member state would not have to be raised by more than 0.09 euro per litre when the commitment is -20 per cent. However, when the objective is a 30 per cent reduction, the increase in fuel tax would on average have to be 0.35 euro per litre.

These increases in taxation correspond to respectively 36 and 139 euro per tonne CO₂. This means that the effect on fuel prices would, if the commitment is -20 per cent, probably be similar to a case where emissions from road transport are covered by the EU ETS. However, in a situation when the target is -30 per cent, climate change mitigation will cost motorists three to four times more when road transport is not admitted into the EU ETS than if the emissions are covered by the trading scheme.

Supply and demand for emission credits

A concern in the context of supplementing domestic measures with purchases of emission credits from projects in non-EU countries is the extent to which such credits will be available post 2012. The Commission has not made any assessment of the likely effect on global supply of the European rules and limitations proposed in the revision of the current trading scheme and the system for burden sharing.

Linking with other trading systems

The establishment of a link between the EU ETS and new trading systems in other countries and continents may become a reality after 2012. The link may be open in one direction (semi-open) or may take the form of a link that mutually accepts the emission allowances from both systems. Differences in the price of emissions allowances will disappear as the systems become linked to each other. The system with a low level of ambition (high allocation of emission allowances) will “import” a higher price while the system with a lower cap will by becoming a net purchaser enjoy a lower equilibrium price than would have been the case without the link. The establishment of several trading systems covering most of the world’s production of energy-intensive goods would reduce the need to protect European industry. However, problems may continue to affect those sectors of industry that are large consumers of electricity.

Different methods of protecting industry subject to global competition

At present, energy-intensive installations in the EU receive advance compensation in the form of free allowances based on historical levels of emissions (grandfathering). The European Commission (2008a) thinks this practice should continue so long as competing industrialised countries in other parts of the world do not enforce cap-and-trade systems similar to the EU ETS. It is the Commission's intention to present a proposal in 2011 that makes clear which European installations will be exempt from the gradual phase-out of free allowances and on what grounds.

However, under the present regime, the electricity-intensive sector does not receive any compensation at all. During the trial period, the power generating industry received emission allowances free of charge. They were able to pass on all or the greatest proportion of the incremental marginal cost of electricity to their customers, especially in deregulated markets. This produced substantial effects on electricity prices in these countries.

The extension of compensation to cover electricity-intensive installations is quite feasible. They could be allocated emission allowances equivalent to the level of emissions in the type of power production that is affected by their demand and either sell them or use them in part-payment for their electricity purchases. However, differences with respect to the degree of deregulation and the supply of hydro-electric power will lead to substantial variations in the conditions affecting electricity markets over the year and across Europe. It may consequently be better to compensate these large consumers of electricity retroactively once the effect of emissions trading on the price of electricity is known.

Retroactive compensation is also an option in relation to fuel intensive installations operating in global markets. They could be allocated emission allowances equivalent to the emissions produced by the best available technology in their sector. The advantage of such an arrangement (compared to compensation in advance) is that existing and new installations would be treated equally. Moreover the emissions market would be more fluid and transparent. As result companies in Europe would be able to expand on more or less the same basis as comparable enterprises in other parts of the world. Using this type of policy design,

all the emission allowances in the trading system could be allocated by means of an auction.

An alternative option would be to require firms that import energy-intensive materials from outside the EU to submit CO₂ allowances matching the emissions of the factories in the exporting countries. European producers of such materials would in this case be exempt from the liability of submitting emission allowances for the share of their production which is exported. This arrangement would protect European manufacturers and prevent carbon leakage which could otherwise occur as a result of production capacity shifting to other continents. However, in order to provide the same protection to electricity-intensive installations, it would be necessary to make European importers also submit allowances equal to the associated emissions in the country of origin, based on the marginal electricity production.

Within the framework of the negotiations in the UNFCCC, the EU could demand that important producer countries such as the United States, India, China, South Korea and Brazil introduce legally binding caps or require their companies to participate in industry-based global emissions trading schemes. Alternatively, producer countries that did not set a cap on emissions from energy-intensive installations could be obliged to introduce a CO₂ tax on the emissions from these installations. For levelling the playing field, this tax would have to be charged at the level of the emission price in the EU ETS and other linked emissions trading schemes. The United States will presumably understand the importance of an international solution to the problem since several American proposals related to emissions trading assume either border protection or a price cap.

Complementary policy mechanisms and the withdrawal of subsidies

Complementary policy instruments may be required in order to prepare for future climate commitments and to minimise market failures and other barriers that complicate or prevent the adoption of cost-effective measures. Limit values and technical standards such as the European Commission's proposed limits on CO₂ emissions from passenger cars are examples of this.

It is also essential to abolish harmful subsidies. According to the EEA

(2007a), fossil fuel subsidies accounted for 73 per cent of total subsidies to the energy sector in 2001, amounting to 29 billion euro. An analysis by Kutas et al (2007) estimates that biofuel subsidies in the EU in 2006 were of the order of 3.7 billion euro. The most cost-efficient ethanol subsidy was almost a hundred times larger than the emission price in the EU ETS (€23/tonne CO₂).

The large scale subsidies given to biofuel have generated a higher level of bioenergy consumption in the transport sector than would be justified on grounds of economic efficiency. These subsidies will indirectly lead to higher prices in the emissions market. In practice, the energy-intensive sector will pay part of the bill for biofuel.

Is, after all, a general CO₂ tax feasible?

The partial harmonisation of energy tax policy is presumably the only realistic alternative for the EU if it wants to be certain of reaching its most ambitious climate objective for 2020 while continuing to exclude the road transport sector from the emissions trading scheme. In the absence of such coordination, there is an obvious risk that some member states will not be able to gain sufficient political support to implement the necessary tax increases. Moreover the EU does not have a system for dealing with such “free riders”. The problem with border trade in relation to petrol and diesel fuel would also be an argument in favour of joint action.

The possibility of introducing a common CO₂ tax for all emissions in the EU not covered by the trading sector was presented in Chapter 10. In order to establish an emission trend in line with the Community’s 30 per cent reduction target, the level of this tax would have to be higher than the expected price of emission allowances. The tax on CO₂ would be added to the present excise duties on fossil fuels used in the non-trading sectors. Member states would continue to determine the levels of these duties but would have to observe the minimum levels that already apply in the EU. The CO₂ tax revenues would however be retained by member countries.

It is difficult to predict the appropriate level for the tax on CO₂ emissions. The need for tax increases will be determined for instance by the rate of economic growth, the price of crude oil and the dollar exchange rate. In order to deal with this problem, it would be advantageous if

the European Commission were allowed to vary the rate of tax within a range determined by the Council of Ministers and purchase or sell emission allowances from the project-based flexible mechanisms to achieve a balanced outcome. The surplus derived from auctioning part of the allowances could be used to finance net purchases. If responsibility for European commitments was transferred from member states to the Community, individual countries would no longer need to purchase emission credits from the project-based flexible mechanisms.

It would be appropriate to exempt bioenergy from the new tax. This would mean that renewable transport fuel and bioenergy for heating would be able to compete successfully with petrol and heating oil if they can be produced at an incremental cost that is lower than the general CO₂ tax.

The EU's climate target for 2020 would in this case be guaranteed by a combination of emission trading among installations already covered by the EU ETS and a general tax on CO₂ emissions for the remaining sectors. The Commission could then be the body responsible for Europe's entire commitment vis-à-vis the UNFCCC. The Community would thereby avoid repeated negotiations on how the burden should be shared between the member states.

When is the time right?

An important aspect of the choice between the taxation and emissions trading alternatives is the extent to which the scope for an efficient climate policy would be reduced by splitting European CO₂ emissions into two segments. Even if the Commission in its proposal for burden-sharing may have made a skilful estimate of marginal abatement costs in the various sectors of society, there is cause to believe that over time significant differences may arise. However, if the differences prove to be small, this may be judged as a bearable price for not having to enforce both fuel taxation and emissions trading in the transport sector. Broadening the EU ETS could potentially also come at a price, if it results in member states taking less responsibility for all those domestic measures aimed at small-scale emissions that should also be part of climate policy.

One option could be to postpone a decision on the possible inclusion of road transport in the EU ETS until after 2012. By that time policy makers will know how the market for emissions allowances developed

during the Kyoto period and the Community will in all probability have made up its mind on whether the target for 2020 is -20 or -30 per cent. If assessment of future prices in 2012 points at a growing risk for substantial sectoral differences in marginal abatement cost, the time will be ripe for enlargement of the EU ETS. In such a case road transport and other non-trading sectors could probably enter the trading scheme in 2015 or 2016.

The indefinite postponement of the extension of the EU ETS may create uncertainty surrounding the Community's long-term intentions and could lead to serious delay if member states prove unable to raise fuel taxes to the level required for meeting the Union's commitment. EU decisions to limit the enlargement of the EU ETS to one transport sector at a time may cause substantial deceleration in the pace of climate policy reform. If the Community commits itself to -30 per cent and decides not to widen the emissions trading scheme to include road transport, it will have to decide on stringent complementary measures to meet its overall climate objective. A failure to make these decisions would seriously delay the Community's work on climate policy.

16. Conclusions

The following conclusions may be drawn from the analyses presented in previous chapters:

1. The simplest method to guarantee that the EU will be able to meet its commitment would be to gradually reduce the cap on emissions within the EU ETS and at the same time introduce a harmonised CO₂ tax on emissions from the non-trading sector. This assumes, however, that the climate issue is given sufficient priority by member states to allow them to make an exception, in the case of carbon dioxide, to their right to decide on matters of tax rates.
2. A somewhat more complicated but entirely feasible alternative would be to extend the emissions trading to all sectors of society by adopting an upstream approach for the new sectors and auctioning the emission allowances allocated to them.
3. In both cases, installations that are both fuel-intensive and subject to global competition could be either compensated in advance by a free allocation of allowances or retroactively by reimbursement. This assumes that regulations would be harmonised and that the free distribution of allowances would never exceed the level of emissions produced by the best available technology in each type of production.
4. Companies consuming large amounts of electricity are best compensated retroactively when the effects of emissions trading on electricity prices are known. This compensation will also be needed if the scope of the EU ETS remains unaltered.
5. It is difficult to prevent price competition between companies covered by the existing trading scheme and the non-trading sector. They will compete, for instance, for biofuel. Assuming that the non-trad-

ing sector continues to be the responsibility of individual member states, their purchases of emission credits from CDM and JI projects would raise the price at the expense of trading sector companies.

6. If the Council and Parliament accept the Commission's proposal for how to split the burden between the EU ETS and member states, there is a good chance of achieving a greenhouse gas reduction of 20 per cent without having to raise fuel taxes by more than the equivalent of the forecast price in the emissions market (€30–40/tonne). The outcome, however, will be affected by many factors, some of which are difficult to judge, and if it turns out that the target can only be reached after a considerable increase in fuel taxation, there is an obvious risk of political failure.
7. The risk of having to raise fuel taxes substantially is a great deal larger in a case where the Community's commitment is a 30 per cent reduction. It is likely to result in a major difference in price increase between the trading and the non-trading sectors as well as between individual member states.
8. A conclusion from the analysis of this report is that the European Union should assess by 2012 whether the model for burden sharing and the common policy instruments (likely to be agreed in 2009) are sufficient for reaching the target for 2020. If the assessment shows that difficulties will arise in maintaining similar levels of marginal abatement cost in the EU ETS and the non-trading sector or between member states, the trading scheme should be broadened to include all emissions of carbon dioxide from sources in EU27.

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The European Union has introduced a cap-and-trade system for emissions of carbon dioxide (CO₂) from power production and energy-intensive industries. The fast-growing transport emissions, however, are not yet subject to any cap.

This report is an analysis of the impact on efficiency and costs from including not only aviation and shipping but also the CO₂ emissions from road transport in the European Emissions Trading System (EU ETS). This option is compared to a case where road transport is permanently excluded from the trading scheme and where its emissions would have to be cut by other policy measures and ultimately by allowing higher excise duties on petrol and diesel to depress the demand for fuel.

The analysis shows that the chance of reaching similar marginal abatement costs in the transport sector and the EU ETS is a great deal higher when the Community's commitment is to cut overall greenhouse gases by 20 per cent than in a case where the objective is a reduction by 30 per cent between 1990 and 2020. The more ambitious target is likely to result in a major difference in price increases between the trading and the non-trading sectors as well as between individual member states.

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