Emissions trading for transport and the built environment

Analysis of the options to include transport and the built environment in the EU ETS

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Preface

This report has been written for the European Commission within the project 'Economic Instruments for Transport and the Built Environment: Analysis of Policy Options'. The information and views set out in this publication are those of the authors and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

The authors

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Summary

Introduction

In terms of the amount of emissions covered the EU ETS is the largest emissions trading system in the world. Having starting in 2005, the EU ETS presently covers direct emissions from large industrial installations, power plants and aviation. Sectors such as agriculture, transport and the built environment are not included, though individual large combustion installations (boilers, CHP) located in these sectors are. Within the transport sector, electric rail is indirectly included since power plants are included.

The EU ETS faces a growing imbalance between supply and demand of allowances. The Commission has identified a number of measures that might be taken to address the imbalance, one of them being the inclusion of new sectors. The transport sector and the built environment come to mind, since they account for 22% and 16% of CO_2 emissions in the EU and could create a strong and relatively stable demand for allowances.

This study analyses whether and, if so, how the transport sector or the built environment can be included in the EU ETS, what the benefits and disadvantages would be, and what this would imply for existing EU legislation addressing emissions from these sectors. Note that the study does not analyse the potential design of an optimal set of policy instruments to address GHG emissions from these sectors.

Inclusion variants

In order to include transport and/or the built environment in the EU ETS, a large number of choices have to be made on key design issues. This study has developed coherent sets of design choices, called inclusion variants.

The most important design choice is the regulated entity, i.e. the entity that is responsible for monitoring and reporting emissions and for surrendering allowances. These entities need to satisfy a number of criteria, of which two are the most important. First, whether or not a sector can be addressed with sufficient precision (in terms of system boundaries, MRV accuracy, leakage, fraud). Second, what the number of regulated entities and the associated administrative costs are. Note that the first criterion requires an entity in the sector, or as close to it as possible, whereas the second criterion requires an entity as far upstream as possible.

The regulated entity that satisfies both criteria best is the tax warehouse keeper for liquid fuels, and the fuel supplier for solid and gaseous fuels. Tax warehouse keepers are required to monitor quantities of fuels delivered to the market, and are able to distinguish between use in different sectors or subsectors when different tax rates apply. There are about 5,000-10,000 tax warehouse keepers for energy products in the EU, and the amount of fuels they sell on average results in somewhat lower emissions than the average installation in the current EU ETS. There are about 1,500 suppliers of gas and 4,000–8,000 suppliers of coal in the EU. Fuel suppliers do not always have to monitor the amount of fuel as accurately, since gas and coal are often exempt from energy taxes. Nevertheless, most gas suppliers will accurately monitor fuel for financial purposes. Suppliers of coal to the built environment face the greatest challenge in developing accurate monitoring systems because of lack of an additional control mechanism (such as the tax warehouse system) or physical limitations (natural gas distribution).

An equally important design choice is the method of allocation. The current ETS directive establishes auctioning as the basic principle of allocation, because it is the simplest and most economically efficient system.
Free allocation is possible for certain sectors for a limited amount of time, and only indefinitely for sectors where there is a risk of carbon leakage.
Neither transport nor the built environment meet the criteria set for carbon leakage. Hence, we propose to auction the allowances, because it is administratively less complex than free allocation and eliminates the risk of windfall profits.

Other design choices, such as the data to be monitored, the institutional set-up of the MRV system and the geographical scope, depend directly on the regulated entity and are not discussed separately in this summary.

The study also analyses an inclusion variant which would have profound consequences for the EU ETS, viz. an complete upstream coverage of all fuels in the EU ETS. In this case, the regulated entity is chosen further upstream, thereby decreasing the number of entities to about 2,000. In addition, about 1,000 installations that emit greenhouse gases which do not result from combustion would need to be included in the system. In this case, allowances would also be auctioned and carbon leakage could be addressed by giving free allowances to non-regulated entities in exposed sectors. Even though these entities would not need to surrender allowances, they could sell the allowances to regulated entities, thus decreasing their average costs.

Table 6 presents an overview of the inclusion variants.

Table 1 Overview of inclusion variants

Variant	Regulated entity	Allowance allocation method	Sectors and subsectors covered
Variant 1a	Tax warehouse keeper	Auctioning	All transport sectors (the possibility of exempting subsectors has been analysed)
Variant 1b		Fuel benchmark	
Variant 2a	Tax warehouse keeper (liquid fuels) Fuel supplier (gaseous and solid fuels)	Auctioning	Built environment
Variant 2b		Fuel benchmark	
Variant 3	Importer or extractor of liquid or solid fossil fuel TSO for gas Point sources for non-energy related GHGs	Auctioning (compensation for exposed downstream entities has been analysed)	All sectors using fossil fuels, including transport and the built environment.

The inclusion of the transport sector in the EU ETS

In order to include the transport sector in the EU ETS, tax warehouse keepers would need to surrender allowances for fuels sold to the transport sector. They could buy the allowances at auctions or on the secondary market.

Technical feasibility of inclusion

All transport fuels pass through tax warehouses with the exception of natural gas (LNG or CNG), which currently account for 0.7% of CO_2 emissions from the transport sectors. Tax warehouses monitor the quantity of fuels accurately, and in many Member States they also register the amount and type of biofuels blended in the fuels. The carbon content of transport fuels is well known and does not vary much (with the possible exception of natural gas), which means default emission factors can be used.

In order to include the natural gas used in the transport sector in the EU ETS, it could either be required to pass through tax warehouses, or the fuel supplier could be designated as the regulated entity.

In many Member States tax warehouses distinguish between the use of fuel in different subsectors when they release fuels to the market through an excise duty point. They do so, for example, when different excise duty rates apply. The same mechanism could be used to exempt certain subsectors from the system.

Because tax warehouses are required to register fuels accurately for fiscal reasons, the risk of fraud is small. The risk increases when certain subsectors are excluded, such as agriculture or non-road mobile machinery.

Legislative efficiency of inclusion

Currently, several policies address greenhouse gas emissions from the transport sector, the most important directives being:
- the Fuel Quality Directive (FQD);
- the Renewable Energy Directive (RED);
- the CO_2 and Cars Directive;
- the Energy Taxation Directive (ETD).

Of these directives, the RED, FQD and CO_2 and Cars Directives address other market barriers. They affect the amount of renewable energy used in the sector, the well-to-tank emissions and the fuel efficiency of cars, respectively. Combining these measures with the inclusion of transport in the ETS may increase the effectiveness of CO_2 policy for transport, assuming that the ETS includes tank-to-wheel emissions, because the ETS would raise the cost of using fossil fuels and this increase the cost-effectiveness of the other directives. The ETD provides a price incentive to reduce fuel use, and the inclusion variant described here has largely the same effect. Therefore, having both instruments apply simultaneously could decrease the legislative efficiency. For inland waterway transport, and only on the Rhine and its tributaries, the compatibility of ETS with the Mannheim Convention requires further legal analysis.

Environmental impacts

Inclusion of transport in the EU ETS would provide a financial incentive to end-users to reduce fuel consumption and thereby emissions (the regulated entity has limited options to reduce emissions). The impacts of the inclusion of fuels in the EU ETS on fuel prices would depend on the allowance price. Assuming a price range of € 10–40 per tonne of CO_2, average EU retail prices

would increase by 2-7%. In the long term, this would reduce transport emissions by up to 5%.
Apart from the price incentive, an upstream system would not result in additional awareness-raising for emission reduction or innovation.

Social and economic impacts
The EU ETS will impose an administrative burden on the regulated entities. While the average emissions of tax warehouse keepers will be smaller than the average emissions of installations in the current EU ETS, and as a result the transaction costs higher per tonne of CO_2, we expect the *additional* transaction costs to be limited because these consist mainly of monitoring, reporting and verification (MRV) costs and these entities already have good monitoring systems for fiscal purposes. However, this depends to a large degree on the details of the MRV requirements that will be established.

The increase in fuel prices would have a small impact on disposable incomes. In some countries, the impact would be progressive, in others it would be regressive.

The increase of fuel prices for land-based transport may reduce its competitiveness vis-à-vis maritime transport. This could result in carbon leakage, but its scale would be limited as maritime transport only competes with land-based transport on a small number of routes. It could also decrease the competitiveness of filling stations on the EU borders vis-à-vis filling stations just outside the EU and encourage tank tourism. However, cross-border differences in fuel prices are already large and therefore the EU ETS will only have a modest impact on the scale of tank tourism. On an EU scale, the resulting carbon leakage would be small.

While auctioning the allowances to the transport sector will increase fiscal revenues, some of the gains will be offset by lower tax revenues (because of decreased fuel use and modal shift towards more energy-efficient modes).

Inclusion of the built environment
In order to include the built environment in the EU ETS, tax warehouse keepers would need to surrender allowances for liquid fuels sold to the built environment and fuel suppliers for the gaseous and solid fuels. They could buy the allowances at auctions or on the secondary market. In 2010, 57% of the emissions from the built environment resulted from the use of natural gas, 37% from the consumption of oil products and less than 5% from the consumption of solid fuels.

Technical feasibility of inclusion
While heating oil and other oil products pass through tax warehouses, gas and coal do not. For gas, suppliers have accurate information on the amount of gas supplied and on the carbon content. Coal suppliers are more diverse and the carbon content of coal products varies significantly. In some Member States, coal is subject to excise duties, as a result of which the suppliers are registered and quantities are monitored with sufficient accuracy. In other Member States, an MRV system needs to be established from scratch.
This could be a significant challenge because of lack of additional control mechanisms (such as the tax warehouse system) or physical limitations (as with natural gas distribution) and the variability of the carbon content of the coal sold. This could result in reduced accuracy in MRV and a higher risk of leakage to outside the system and fraud. The effort to include coal should be

balanced against the small amount of emissions arising from coal combustion in the built environment.

In case of district heating or collective heating systems, there may be boundary issues that need to be addressed. If the built environment is included in the EU ETS, so too should all district heating systems, or the fuels they use, and not just the larger installations that currently fall under the ETS.

Legislative efficiency of inclusion
Currently, several policies address greenhouse gas emissions from the built environment, the most important directives being:
- the Energy Performance of Buildings Directive (EPBD);
- the Renewable Energy Directive (RED);
- the Energy Efficiency Directive (EED);
- the Energy Taxation Directive (ETD).

The EPBD aims to improve the energy efficiency of the existing building stock and inclusion in the ETS would enhance its effectiveness by improving the cost-effectiveness of abatement options. The RED aims to enhance the use of renewable energy sources and inclusion in the ETS would increase the price difference between fossil fuels and renewable energy sources. The EED addresses mainly non-financial barriers such as knowledge, awareness and the split incentive, and the cost effect of inclusion in the ETS would provide extra leverage to deal with these barriers. The ETD, however, provides a price incentive to reduce fuel use, and the inclusion variant described here has largely the same effect. Therefore, having both instruments apply simultaneously could decrease the legislative efficiency.

Environmental impacts
Inclusion of the built environment in the EU ETS would provide a financial incentive to end-users to reduce fuel consumption and thereby emissions (the regulated entities have limited options to reduce emissions themselves). The impacts of the inclusion of fuels in the EU ETS on fuel prices would depend on the fuel and on the allowance price. Assuming a price range of € 10–40 per tonne of CO_2, average EU retail prices of heating oil and gas would increase by 3-11%. For coal, the increase in retail price would range from 6-26% in countries with relatively high coal retail prices to 20-80% in countries with relatively low retail prices. Because of the relatively inelastic demand for fuels in the built environment, in the long run the price increase would result in emissions up to 5% lower.

In Member States or regions where fossil fuels compete with peat, inclusion of the built environment in the EU ETS could have the unintended effect of increased peat consumption. This risk would be largest in regions where coal is also used, as coal will see the largest increase in price.

Apart from the price incentive, an upstream system would not result in additional awareness-raising via-à-vis emissions reduction or innovation.

Social and economic impacts
The EU ETS will impose an administrative burden on the regulated entities. For tax warehouse keepers and gas suppliers the additional administrative burden need not be heavy because of their current administrative functions. Coal product suppliers, especially in countries where coal products are not subject to energy taxes, may have a larger administrative burden. Since many of these suppliers are smaller than the average installation in the EU ETS, the

transaction costs per unit of carbon will be relatively high. However, these conclusions depends to a large degree on the details of the MRV requirements that will be established.

The increase in fuel prices could be large for households that use coal, because of the higher carbon content of coal. Inclusion in the ETS would have a regressive impact on disposable incomes. On average, the ETS price increases would equal about 1% of the consumption expenditures of lowest income quintile households using coal. In countries which currently have a lower coal price and where expenditures on coal are high, the share could be higher.

The ETS could decrease the competitiveness of fuel suppliers on the EU borders vis-à-vis fuel suppliers just outside the EU and encourage coal tourism. On an EU scale, the resulting carbon leakage would be small.

Auctioning the allowances to the tax warehouse keepers and fuel suppliers will increase fiscal revenues.

Upstream inclusion of all fuels

The upstream inclusion variant differs radically from the other two, in that all the emissions arising from the combustion of fuels in the EU ETS are included as far upstream as possible, while at the same time retaining all the other greenhouse gas emissions of large installations in the EU ETS. This variant would have significant consequences for the EU ETS, as it would imply a divergence from the stack approach for greenhouse gas emissions resulting from the combustion of fuels.

The regulated entities would be extractors and importers of raw materials as regulated entities for all fuels, except for gas. For gas, the number of regulated entities can be reduced by making transmission system operators (TSOs) responsible.

All allowances will be auctioned. Since extractors, importers and TSOs are likely to pass on the costs, all sectors will face higher costs of fossil fuel use. This could affect sectors at risk of carbon leakage. It would also affect the sectors that use fossil fuels as a feedstock (e.g. naphtha in the chemical industry) and downstream exporters of fossil fuels.

Technical feasibility of inclusion

All fuels used in the EU are either extracted in the EU or imported. Importers and extractors generally already monitor the amount of fuels and energy content for financial reasons. TSOs also monitor the natural gas that flows through their pipelines. Hence, accurate monitoring of emissions and fuels is in principle possible.

Sectors at risk of (indirect) carbon leakage would also face higher fuel prices. There are two options for addressing carbon leakage if this is deemed desirable. First, the sectors could be compensated financially in the same way as sectors using electricity may currently be compensated. Second, they could receive free allowances, which they would not surrender themselves but would sell to the regulated entities.

Non-energy use of fossil fuels does not result in emissions, as the fuels are not combusted. If this occurs in sectors exposed to carbon leakage, upstream inclusion of fuels in the EU ETS could result in carbon leakage, because installations in the EU would face higher production costs than installations outside the EU. There are three possibilities to address this. One is to provide for financial compensation, the second to allocate free allowances for feedstock use, and the third to allocate credits which could be surrendered as allowances. The first option can only be implemented at a Member State level. The second option would be simple, but bring a volatile sector under the cap, thus potentially strengthening the impact of the business cycle on the allowance price. Moreover, the number of allowances would no longer equal emissions. The third option would leave feedstock emissions out of the cap, but it would be more complex because feedstock use would need to be monitored separately and because it creates two currencies in the EU ETS.

Environmental impacts
The impacts on the emissions of the transport sector and the built environment would be the same as with the combination of inclusion variants presented above, i.e. a reduction of emissions by a few percent in these sectors.

Apart from the price incentive, an upstream system would not result in additional awareness-raising vis-à-vis emissions reduction or innovation.

Social and economic impacts
We estimate the number of entities to be less than 3,000: about 500 extractors, 1,000–1,500 importers and 1,000–1,500 installations with non-combustion emissions. Hence, the transaction costs related to MRV of emissions and trading of allowances would be significantly lower than in the current system, which comprises about 13,000 entities.

In addition, installations in sectors exposed to carbon leakage and sectors using fuels as a feedstock would need to apply for free allowances or credits, for which they would need to report their output in a base year.

Overall, the administrative costs could decrease in an upstream system because of the lower number of regulated entities responsible, but the benefits depends to a large extent on the treatment of sectors exposed to carbon leakage.

If carbon leakage were to be addressed by allocating free allowances to downstream sectors, windfall profits would still occur because the free allowances are a lump-sum transfer to the receiving industries: they would not be dependent on the production and hence the marginal costs would not be affected. Hence, the product prices would reflect the higher cost prices of fossil fuels, but not the revenues made from selling free allowances to upstream sectors.

The social and economic impacts in the transport sector and the built environment would be the same as with the combination of the inclusion variants presented above.

Impact on the allowance market
The inclusion of transport and the built environment in the EU ETS could result in a more stable demand, but it would probably not affect volatility.

The demand for allowances from the transport sector and the built environment would probably be more stable than the demand from the sectors that are currently covered by the EU ETS, with the possible exception of freight transport, because emissions from these sectors do not react as strongly to the business cycle as sectors currently included in the EU ETS and because of lower price elasticities of fuel demand. However, emissions from both sectors are projected to decrease in the coming decades. As a result, the cap for these sectors would need to decline to ensure that demand is stable.

It is not clear whether including transport and buildings in the ETS would lead to an increase in short-run price volatility or not. However, as trade in ETS allowances is not restricted to firms that are covered by the ETS, it seems unlikely that expanding ETS coverage would have any major impact on the degree of short-run price volatility. This should therefore not be a major factor in evaluating possible ETS expansion.

1 Introduction

1.1 Policy context

The EU ETS is the largest emission trading system in the world when measured by the amount of emissions covered. Having starting in 2005, the EU ETS presently covers direct emissions from large industrial installations, power plants and aviation. Sectors such as agriculture, transport, and the built environment are not included, though individual large combustion installations (boilers, CHP) located in these sectors are.

The EU ETS faces a growing imbalance between supply and demand of allowances. The European Commission's Carbon Market Report, published in 2012, identifies a number of options for structural market reform.[1] One of the options is the inclusion of new sectors which are less strongly influenced by economic cycles such as the transport and built environment. This could provide for a more stable demand for emissions and tackle the growing structural supply-demand imbalance, resulting in more predictable allowance prices. The report indicates that more analysis is needed before such a measure can be taken.

At present, emissions from the non-ETS sectors are covered by the Burden Sharing Directive, which sets targets per Member State. Member States have to implement policies to ensure that these targets are met. To some extent, GHG emissions of these sectors are also addressed by other EU directives, e.g. regulating the carbon content of transport fuel (Fuel Quality Directive) or the energy use of buildings and cars (CO_2 and Cars directive, EPBD).

Inclusion of the transport or built environment sector has been considered or implemented in other ETS in the world. In the New Zealand ETS, for example, transport fuels are included upstream (i.e. through the carbon content of the fuels imported or refined domestically). And in the Tokyo ETS, emissions from buildings are included. Also in the EU, there has been some discussion regarding the scope of the instrument.

While in theory expanding the EU ETS would be more efficient economically, the economic gains from increased efficiency could be undermined by the higher administrative burden from including many small emitters. Moreover, if the inclusion of the transport and/or built environment sector would imply higher carbon prices, the competitiveness of sectors which are exposed to international trade could deteriorate which in turn could result in carbon leakage. Therefore, design features and potential impacts need to be carefully considered before deciding on the inclusion of other sectors in the EU ETS. The present study elaborates in-depth on the design and impacts of an expansion of the scope of the EU ETS to include the transport and built environment sector.

[1] European Commission, 2012, The state of the European carbon market in 2012, COM(2012) 652 final.

1.2 Aim of the study

As stated above, one of the options for structural reform of the carbon markets is the inclusion of transport and the built environment. Before such a reform can be considered, the Commission needs a better understanding of the possible design options and the implications. This study aims to provide this analysis.

Specifically, the objective of this study is to take stock of the practical modalities that would need to be considered if energy GHG emissions related to road transport and/or the built environment would be integrated in the ETS in the mid to long term and to analyse the socio-economic and environmental implications, taking into account the existing policy instruments in these sectors.

1.3 Scope of the study

This study analyses how transport and the built environment could be integrated in the EU ETS, and what the consequences of such a measure would be for the ETS, for other regulations, and what the social, economic and environmental impacts would be. It does so in a predominantly qualitative way, since the study has an explorative character. A quantitative analysis would require making firm assumptions about many issues, such as the cap, which are well beyond the scope of this study.

The study does not address the question what the optimal policy mix would be to reduce emissions from these sectors, and whether the inclusion of these sectors in the ETS is part of such a policy mix or not. It also does not analyse other options for emissions trading in these sectors, such as a separate system for either or both sectors.

The study analyses the implications of the inclusion of transport and the built environment in the EU ETS for other EU policies aimed at these sectors, such as the CO_2 and cars directive, the energy taxation directive, the fuel quality directive, the renewable energy directive, et cetera. It does not address the question how the impacts of the inclusion of transport and the built environment in the EU ETS compare to the impacts of these policies on these sectors quantitatively. Neither addresses it the implications for sector specific policies of Member States.

In this study, the transport sector includes road, rail, and inland waterway transport as well as other machinery that use liquid fuels. Aviation is not included, as it is already included in the EU ETS. Maritime transport is also excluded from this analysis, as emissions from this sector are the subject of a separate analysis for DG CLIMA.

The built environment includes all direct emissions from buildings, both residential, public and commercial, resulting for example from the use of natural gas, coal or heating fuel for heating, cooling or cooking. Indirect emissions, such as those arising from the use of electricity or the emissions of large district heating systems are excluded from the scope of the study as they are already included in the EU ETS.

1.4 Methodology

The study has been carried in four consecutive steps, each of which is described below.

First, a set of evaluation criteria has been developed for assessing different ways to include the sectors analysed (the so-called 'inclusion variants' [2]). These criteria fall in four categories, each divided into several subcriteria:

a Environmental impacts, including the amount of emissions in the sector, emission projections, availability of abatement measures, and the risk of leakage.
b Economic impacts, such as the impact on demand for allowances, allowance price and price volatility, transaction costs, impacts on income distribution, the potential for windfall profits.
c Technical feasibility of inclusion, comprising monitoring accuracy, the feasibility of allocation, definition of boundaries of regulated entities and sensitivity for fraud.
d Legislative efficiency under which the interaction with other legislation is analysed as well as the EU competence.

Second, a review of existing or proposed trading schemes and a literature review have been carried out in order to identify the most relevant design parameters and develop an information base on design choices and their implications. This review has revealed that the regulated entity, the method for allocation of allowances and the sectoral scope are the most important design parameters. Other design parameters, such as the geographical scope, monitoring and reporting requirements and enforcement follow from these main choices. Yet other design parameters that have been discussed in the literature, such as the type of trading system, are not relevant for this study as the aim is to study the inclusion in the EU ETS.

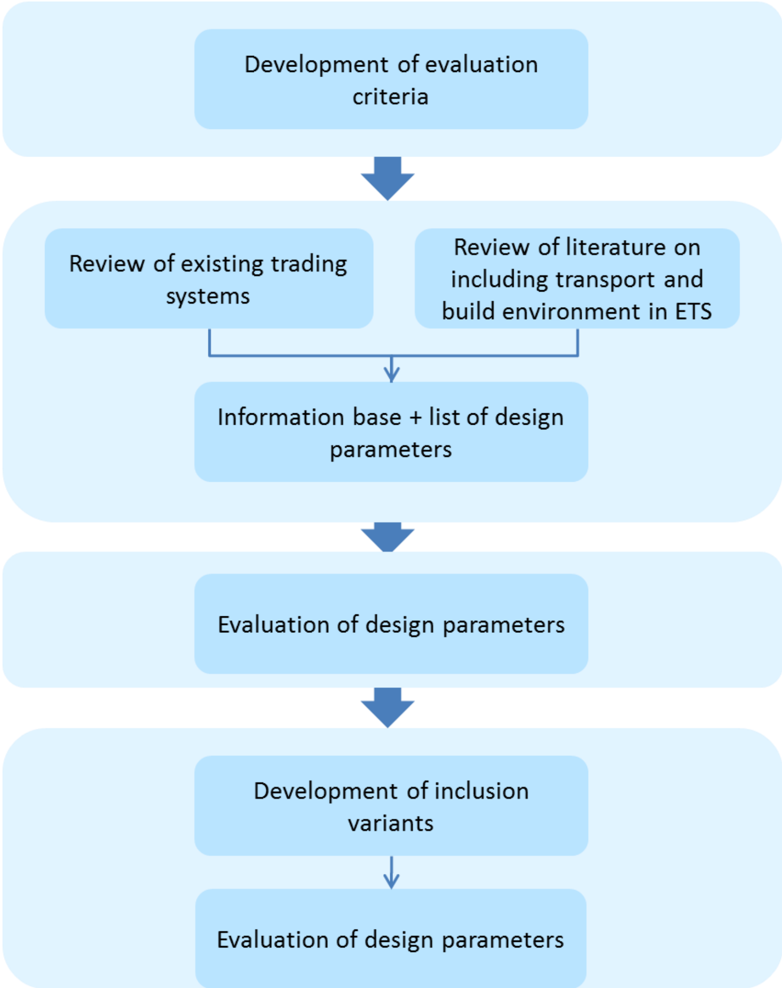
Third, different choices for individual design parameters have been evaluated using the criteria defined in the first step. This evaluation has been based on the information base developed in the first step and other relevant literature and data sources. This step has identifies the main advantages and disadvantages of various choices on design parameters and has allowed for the selection of inclusion variants (i.e. coherent sets of design choices) for further analysis.

Finally, after a selection of inclusion variants, three variants have been evaluated using the criteria defined in the first step. The main report focuses on the evaluation of the inclusion variants. Details of the methodology, as well as other relevant outputs, can be found in the Annexes to this report.

A schematic overview of the methodology is presented in Figure 1.

[2] For a definition of these and other terms used in this report, please refer to Annex A).

Figure 1 Schematic overview of the methodology applied in this study



1.5 Outline of the report

The next chapter presents the inclusion variants, i.e. the ways in which transport or the built environment could be included in the EU ETS. It also presents the reasons why these variants have been selected.

The next three chapters analyse the inclusion variants using the evaluation criteria developed in this project. Chapter 3 analyses the impacts and implications of the inclusion of transport emissions in the EU ETS; Chapter 4 focusses on the inclusion of the built environment and Chapter 5 analyses an upstream system in which emissions would be included upstream, i.e. at the point when carbon enters the EU economy, as opposed to the current situation where emissions are included at the point where they are created.

Chapter 6 analyses the impacts of the inclusion of either or both sectors in the EU ETS on the demand for allowances, the allowance prices and the price volatility. Chapter 7 concludes.

The annexes to this report contain the evaluation of individual design parameters and other relevant outputs. Annex A has a list of definitions used throughout this report. Evaluation criteria are presented in Annex B.

The analysis of choices on individual design parameters of transport and built environment are presented in Annex C and Annex D respectively. Annex E presents information on tax warehouse keepers, which have been selected as regulated entities in some inclusion variants. The literature included in the review is referenced in Annex F and the emission trading schemes are presented in Annex G.

2 Selection of inclusion variants

2.1 Introduction

This chapter sets out to select variants for the inclusion of transport or the built environment in the EU ETS. An inclusion variant is defined as 'a coherent set of design options for the inclusion of emissions in the transport sector or the built environment in the EU ETS'.

While in principle inclusion variants comprise of choices on all design parameters, it is clear that the most relevant design parameters are the choice of the regulated entity, i.e. the entity responsible for monitoring and surrendering allowances, the method for allocating allowances, and the sectoral scope. Most other design parameters follow from these.

The regulated entity is relevant because the choice determines to a large extent whether it is feasible to draw robust system boundaries, i.e. to ensure complete inclusion of sectoral emissions without including emissions of other sectors. The administrative costs also strongly depend on the responsible entity, as does the accuracy with which emissions can be determined. And the responsible entity determines to a large extent the geographical scope and the scope for avoidance of the system.

The allocation method is relevant for the economic impacts and the administrative complexity of the system.

The sectoral scope is relevant for the environmental effectiveness as it determines the amount of emissions that can be included. In some cases, excluding certain subsectors could also give rise to changes in competitiveness of subsectors.

This chapter sets out to describe how the inclusion variants have been selected in Section 2.2. Sections 2.3, 2.4 and 2.5 present the three inclusion variants as well as the reasons for selecting them. Section 2.6 provides a brief summary.

2.2 Selection of the inclusion variants

The selection of the inclusion variants has been based on an extensive analysis of the main design parameters.

The regulated entity has been selected on the basis of environmental, economic and feasibility criteria. The economic and feasibility criteria relate to the administrative complexity of the inclusion of these entities. That should be proportionate to the benefits of inclusion, implying that the entity should be able to accurately monitor fuels sold in or emissions from the two sectors. In the case of free allocation, the entity should preferable be able to have historic records of fuel sales or emissions. Moreover, the number of regulated entities should not be too large, as this would increase the administrative complexity. It would be an advantage if the entities already have monitoring systems in place and are already reporting sales of emissions to the authorities, as this would reduce the additional costs of the inclusion.

The most important environmental criteria is that the choice of the entity should minimise the risk of carbon leakage.

The main criteria for selecting the allocation method have been administrative complexity and economic efficiency. Both are related, but economic efficiency also implies that the allocation method should not result in windfall profits nor put a sector at a competitive disadvantage that could result in carbon leakage.

The sectoral scope is related to the regulated entity. The main criteria for the sectoral scope are the environmental effectiveness, i.e. the amount of emissions that can be included in the ETS, economic impacts, in particular on the competitiveness of subsectors; and the interaction with other policies in which may require differential treatment of certain subsectors.

2.3 Inclusion variants transport

Based on a thorough review of the individual design parameters, we have selected two variants for the inclusion of transport in de current ETS.
As mentioned in Section 2.1, these inclusion variants are defined for three design parameters: regulated entity, allowance allocation method and subsectors covered.

The selected inclusion variants for transport are shown in Table 2. In the remainder of this section the main arguments for selecting these inclusion variants are presented.

Table 2 Selected inclusion variants for transport

Variant	Regulated entity	Allowance allocation method	Subsectors covered
Variant 1a	Tax warehouse keeper	Auctioning	All transport sectors (the possibility of exempting subsectors will be analysed)
Variant 1b	Tax warehouse keeper	Fuel benchmark	All transport sectors (the possibility of exempting subsectors will be analysed)

2.3.1 Regulated entity

In principle all entities in the transport fuel supply chain could be designated as regulated entity, from importers and extractors to refineries, tax warehouses, filling stations to vehicle owners. In both inclusion variants we have selected the tax warehouse keeper regulated entity.[3]

Compared to other possible regulated entities, regulating tax warehouse keepers has three key advantages. The first is that since almost all transport fuels pass the tax warehouses (natural gas is the exception), the boundaries of the scheme could be relatively easy set. This would be more difficult for entities further upstream (refineries, importers), since at that level it is not

3 A tax warehouse keeper is defined as “a natural or legal person authorised by the competent authorities of a Member State, in the course of his business, to produce, process, hold, receive or dispatch excise goods under a duty suspension arrangement in a tax warehouse.” An tax warehouse is an authorized place where the above mentioned activities could take place under duty suspension arrangements (EC, 2008). See also Annex E.

clear which share of the fuels will be used in the transport sector. Moreover, in many Member States, tax warehouses register the amount of biofuels in the fuels they release to the market. This means that it is possible to distinguish between fossil fuels and biofuels at this level. For entities further downstream, this would require additional monitoring and reporting.

The second advantage of tax warehouse keepers as regulated entities is the extended monitoring scheme already available at these entities. Transport fuel flows are already registered at tax warehouses and hence this information could be used for the inclusion of transport in ETS as well. At more upstream or downstream (e.g. filling stations or vehicle owners) levels these kind of monitoring schemes are not available yet. For this reason the transaction costs of an ETS scheme with tax warehouse keepers as regulated entity are expected to be lowest, also because the number of entities is much smaller than for more downstream levels.

A third main advantage of tax warehouse keepers as regulated entities is the rather high level of monitoring accuracy that could be realised and the low risk of fraud. Tax warehouse keepers release fuels for sale on the market through excise duty points, at which point energy taxes become payable. For fiscal reasons, the monitoring requirements are strict. Additionally, in several Member States excise duties are differentiated different subsectors (e.g. road, rail, IWT, argiculture). This implies that it is possible to include or exclude certain subsectors, thus offering flexibility to the system.

There are between 5,000 and 10,000 tax warehouse keepers for energy products in the EU. Further upstream, the number of entities is considerably lower, which could in principle reduce the administrative costs of the inclusion of the transport sector. However, because of the monitoring systems already implemented by tax warehouse keepers, the *additional* administrative costs would probably not differ much.

The regulation of tax warehouses varies between Member States. For example, natural gas passes through excise duty points in some States, but not in others. Some States have differentiated excise duty rates for different subsectors and monitoring and enforcement systems to keep fuels for different subsectors apart, others do not. The inclusion of transport in the EU ETS would require harmonisation of some regulation for tax warehouse keepers.

In sum, the tax warehouse keeper has been chosen as the regulated entity because they are the entity furthest upstream that has accurate monitoring systems in place and is able to monitor the sale of fuels to the transport sector.

In both inclusion variants it is assumed that all tax warehouse keepers have to surrender emission allowances for fuels released to the market. In other words, all tax warehouse keepers (even the small ones) are covered by the EU ETS. Although this may result in higher transaction costs, it prevents that entities evade the system by establishing a small tax warehouse.

2.3.2 Allowance allocation method

With respect to the (harmonized) allocation methodology, auctioning is applied in the first inclusion variant. This method has several advantages over free allocation. The main ones are: it is the most economically efficient allocation method, it does not provide any perverse incentives (punishing early action), the risk of windfall profits is avoided and, since the existing auctioning infrastructure for the current ETS can be used, transaction costs are expected to be relatively low. Additionally, practical difficulties that would result from allocating the allowances for free, like accurately determining historic emissions or the development of benchmarks, are avoided.

The transport sector is not at risk of carbon leakage, as the impact of the EU ETS on transport costs is less than 10% of the sectors value added (the threshold used in the current ETS) and the trade intensity is low. Hence, this does not provide a reason for free allocation.

Although auctioning is the preferred method from an economic efficiency point of view, we have also analysed fuel benchmarking in the second inclusion variant as it may be politically relevant, e.g. because other sectors receive free allowances.

With fuel benchmarking allowances are allocated to the different tax warehouse keepers based on their historic fuel supply, which is multiplied with the benchmark. This benchmark could be defined in terms of CO_2 per Joule, for example based on the most efficient fuel. Fuel benchmarking has some of the disadvantages compared to auctioning as grandfathering, viz. that historic fuel sales need to be verified and reported, and that allocation plans need to be established. However, when compared to grandfathering based on historic emissions, a fuel benchmark can be regarded as advantageous for two reasons. First, it rewards early action in case a tax warehouse keeper supplied a large share of biofuels and/or natural gas[4]. With a fuel benchmark, the tax warehouse keeper would receive a significant number of allowances, while in case of grandfathering it will only receive a relatively small number of allowances (since the CO_2 emissions associated with biofuels/natural gas are relatively low)[5]. Additionally, a fuel benchmark aligns better with the allocation method currently applied in the current ETS (a product benchmark approach).

2.3.3 Subsectors included

In order to create a level playing field between the various modes and avoiding unintended modal shift, all regular transport modes (road, rail, IWT) are covered by both inclusion variants. In principle, the inclusion variants also comprise fuels used by agricultural vehicles and non road mobile machinery. However, as these are currently often exempted from regular excise duties on motor fuels, methods exist for separating fuels sold to these subsectors from other fuels. Chapter 3 includes an analysis of how an exemption of these fuels could be organised if it was deemed desirable.

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4 This will mainly be relevant in case a refinery of fuel supplier is acting as tax warehouse keeper, since these actors can directly affect the shares of biofuels and/or natural gas in their supply.

5 However, notice that both biofuels and natural gas are niche fuels on the European transport fuel market and hence the size of this effect is rather limited.

From a policy perspective, a stepwise introduction of ETS for the various transport modes could be an interesting options (e.g. starting with road transport and adding rail and IWT some years later). In Chapter 3 it is discussed how such stepwise approach could be designed.

2.4 Inclusion variants built environment

Based on a review of the individual design parameters we have selected two variants for the inclusion of built environment in de current ETS. These inclusion variants are defined in broad terms, i.e. based on three parameters: regulated entity, allowance allocation method and subsectors covered. The design of the other parameters (e.g. MRV, enforcement) is discussed for the selected variants in Chapter 4.

The selected inclusion variants for transport are shown in Table 2. In the remainder of this section the main arguments for selecting these inclusion variants are presented.

Table 3 Selected inclusion variants for the built environment

Variant	Regulated entity	Allowance allocation method	Subsectors covered
Variant 2a	Tax warehouse keeper (liquid fuels) or fuel supplier (gaseous and solid fuels)	Auctioning	Built environment
Variant 2b	Tax warehouse keeper (liquid fuels) or fuel supplier (gaseous and solid fuels)	Fuel benchmark	Built environment

2.4.1 Regulated entity

Because the different fuels used in the built environment are regulated differently, also different regulated entities for each of the fuels have been selected:

- Oil products. The tax warehouse keeper.
- Natural gas. The natural gas supplier that supplies directly to the final consumer.
- Coal products. The coal supplier that supplies to the final consumer either directly through truck delivery or through the sale of packed products through retailers.

The argumentation for this selection is described in two stages. In the first paragraph the choice for the level of the regulated entities in the supply chain is explained, in the second paragraph the choice to differentiate among the different fuels is explained.

Choice of level in the supply chain
For the built environment, we have determined the regulated entities at midstream level of the supply chain (the tax warehouse keepers and final fuel suppliers[6]) to be the most obvious regulated entities. The more upstream (producer/importer, transmission system operator for natural gas (TSO)) or downstream (end-user) are considered less feasible as regulated entity.
The main arguments for this choice are related to the criteria on boundary definition, monitoring accuracy and transaction costs.

- Boundary definition, monitoring accuracy. To implement a system for the built environment it is important to be able to separate emissions that take place in the built environment from emissions take place elsewhere. Such boundaries can be defined for the end-user as regulated entity as well as for the fuel suppliers and tax warehouse keepers. Having the upstream entities producer/importer or TSO as regulated entity has the drawback that it is not possible to set clear boundaries; at this levels it is unclear whether fuels will be used for energy or non-energy purposes, and whether they will be consumed in the built environment or in other sectors. This aspect also complicates monitoring and allocation (except for auctioning) to such an extent that this is the primary reason not to select the upstream entities as regulated entity for the inclusion variants.
- Transaction costs. We estimate that transaction costs for producers/ importers, tax warehouse keepers and for the fuels suppliers as regulated entities are comparable to the transaction costs for participants under the current ETS. Because of the millions of end-users, transaction costs for an down-stream system will be much higher, both for individual entities (in terms of transaction costs - for monitoring and trading - per tonne CO_2) and for the government (to implement, operate and enforce the system). The number of entities a also complicates allocation to a large extent. Auctioning requires organising active involvement of participating entities, free allocation involves data collection and verification, both will be complex operations to carry out for millions of entities. The same applies for enforcement. Complexity and related costs due to the large number of entities are the primary reasons not to select the end-user as regulated entity for the inclusion variants.

Choice between the options for regulated entities at the midstream level
Possible regulated entities at this level are the tax warehouse keepers through which excise duty for energy products is collected and the fuel suppliers.

In principle all energy products are eligible for excise duty under the ETD, but for many countries exemptions apply, especially for excise duty on coal[7] and natural gas[8]. This means that for coal and natural gas the excise duty collection system cannot be used as basis for a harmonised ETS approach in the built environment across Europe.

6 Defined as the suppliers that actual deliver to the final energy consumers.

7 Exemptions for excise duty on coal (business use): UK Lithuania; coal (non business use): France, UK, Portugal, Lithuania, Slovak Republic, Source: Excise duty tables, Part II, Energy products and Electricity (July 2013).

8 Exemptions for excise duty on natural gas(business use): UK, Poland, Lithuania, Belgium; natural gas (non business use): France, UK, Poland, Lithuania; Source: Excise duty tables, Part II, Energy products and Electricity (July 2013).

A system of excise duty-suspension arrangements has been implemented to enable trade between countries and entities without having to pay excise duty, this is called the tax warehouse system[9]. It prescribes the use of the Excise Movement and Control System (EMCS), a EU wide system through which movements of fuels between Member States are registered. The tax warehouse system currently applies to liquid oil fuels only, not to natural gas and solid fuels (e.g. coal). This means that appointing the tax warehouse keeper as regulated entity for all energy carriers is not a feasible option in the built environment, as natural gas and coal (responsible for 2/3 of all emissions in the built environment) would not be covered.
There are several reasons why the tax warehouse keeper is an important candidate for the regulated entity for oil products.

- The ETD sets minimum tariffs for fuels and differentiates between use for 'heating' and use as 'propellant'. This tariff differentiation makes it in principle possible to differentiate fuel use for heating purposes from other uses, based on administration of the excise duty by the tax warehouse keepers.
  It should be noted that use for heating purposes is not clearly defined in the Energy Taxation Directive. Therefore, 'heating' can also mean use of heating for process heat. Also, in practise, use for heating purposes will also include other energy use within the built environment, such as cooking and cooling,
- Sensitivity for fraud can be expected to be small, due to the importance of tax collection for the Member States and the financial monitoring and control mechanisms that are already in place for tax collection.

The second option for regulated entity (final fuel supplier) makes it possible to develop a harmonized approach for allocation and monitoring, for the different fuels and throughout Europe. However, this approach will have to be developed from scratch. Another important drawback is that especially for coal suppliers, there is no additional control system available, making this route more sensitive to fraud.

There are important differences in the implementation of the tax warehouse and excise duty system, across the different Member States and across the different fuels. Therefore, we have chosen to differentiate in the built environment between oil products on one side and coal and natural gas on the other side. For the oil products the tax warehouse keepers are chosen as the regulated entity, for natural gas and coal the fuel suppliers that supply directly to end-users are chosen as regulated entity.

In this way the chosen entity for the oil products stays in line with the approach taken for transport and for monitoring and control purposes use can be made of the excise duty system, thus reducing costs and sensitivity for fraud. For natural gas and coal this approach is not possible and a system will have to be developed from scratch, with the fuel suppliers as regulated entity.

[9] As defined in Council Directive 2008/118/EC concerning the general arrangements for excise duty.

2.4.2 Allocation method

Two different allocation methods will be analysed for the inclusion variants:
- auctioning;
- benchmarking based on a fuel benchmark.

The fuel benchmark is based on historic fuel supply data multiplied with a benchmark (CO_2 per MJ), which is based on the most efficient fossil fuel (e.g. natural gas).

Several approaches for the allocation of emission allowances in the built environment are possible: auctioning, grandfathering (based on historic emissions), and several types of activity benchmarks (product benchmark, heat benchmark, fuel benchmark).

The selection of the allocation methods to be used for the inclusion variants for the built environment is based on the same arguments as for transport.
- Auctioning has advantages over other allocation methods. It is an efficient method, no historic information is required, the risk of windfall profits is avoided and transaction costs are relatively low. For both the tax warehouse keepers and the fuel suppliers as regulated entities, auctioning is the preferred allocation method. The downside of auctioning is that it imposes costs on participants for acquiring allowances. In part, this is intentional, to avoid windfall profits arising from passing through the opportunity costs of free allowances. Where such costs might be considered excessive, governments could choose to (partly) reduce the impact of auctioning by transferring (part of) the auctioning revenues. For the current ETS, auctioning is considered as 'default' option under the and the grounds for exemption to auctioning as included in the existing ETS Directive do not seem to apply to the built environment.
- For both regulated entities (tax warehouse keepers and fuel suppliers) grandfathering is a possible option, making use of data that are available for these entities over previous years. However, disadvantage of this method is that it does not award early action and is not in line with
- the choice made under the current ETS that is moving away from grandfathering. This option is therefore not selected for the inclusion variants.
- For the selected regulated entities a fuel benchmark (expressed in CO_2 per MJ) is the most feasible benchmark option. It benefits fuels with lower carbon content and can be implemented using data from previous years that the selected regulated entities should provide. It must be noted that the use of a fuel benchmark might be politically sensitive because of the differences in fuels used in the built environment between Member States.

Other benchmark methods (product benchmark, heat benchmark) would require the collection of information on the efficiency of energy use at the end-users. This information is currently not available in any way.

2.4.3 Subsectors covered

The Relevant subsectors for the built environment are residential and non-residential buildings. In the inclusion variants the built environment sector is covered in total. Excluding one subsectors will introduce additional complexity for the regulated entities to distinguish between their end-users. Excluding one or more fuel types is not considered as it would introduce inequality for the different final consumers and advantages for one fuel type over other fuel types, not based on CO_2 content.

2.5 Upstream inclusion variant

One of the basic principles of the EU ETS is the stack approach: emissions are regulated where they are released into the atmosphere. Because of the very large number of end-users in the transport and built environment sectors we have selected regulated entities for these sectors that move away from this approach. The selected entities do not emit in the transport or built environment sectors themselves, but supply the sectors with fossil fuels, which subsequently result in emissions.

This different approach could be extended to the current sectors within the EU ETS, so that the same approach is used throughout the whole system, avoiding any risk of double-counting. It would also be a way to reduce the number of regulated entities in the EU ETS. It must be noted that a disadvantage of such a complete overhaul would be that the considerable amount of time, effort and money spent on developing the current ETS system with its current participants.

Some other emissions trading schemes which have been designed and implemented after the EU ETS have included fossil fuel emissions through an upstream approach. New Zealand's ETS includes producers and importers of fossil fuels, and sets a cap for the amount of carbon embedded in the fuels sold in New Zealand. Australia's ETS covers the emissions from natural gas, for which gas suppliers are made responsible. In California, natural gas suppliers and entities 'holding an inventory position' of liquid fuels are responsible for the carbon embedded in their products. In most cases, the upstream approach has been selected because it lowers the number of entities in the system and thus the transaction costs.

In an upstream approach, there are several options for the regulated entity. Tax warehouse keepers could be selected because they currently have strict monitoring requirements. An alternative would be importers or producers (extractors) of fossil fuels. We have selected the latter in order to provide more value added from an analytical perspective compared to the inclusion variants analysed in Chapters 3 and 4. Also, the tax warehouse option is not available for all fuels, so could only be used in a hybrid system (with two different types of entities). Table 4 shows the main design choices of the upstream variant.

Table 4 Selected upstream inclusion variant

Regulated entity	Allowance allocation method	Subsectors covered
Importer or extractor of liquid or solid fossil fuel TSO for gas	Auctioning	All sectors using fossil fuels, including transport and the built environment

2.5.1 Regulated entity

In an upstream approach, there are several choices for the regulated entities:

- *Extractors and importers of fuels, biomass and biofuels*; all entities extracting crude oil, coal or natural gas from underground deposits within Europe or producing biomass and biofuels from EU feedstocks or importing crude oil, coal or natural gas, biomass or biofuels from outside the EU are regarded as regulated entities. In addition, all importers of processed transport fuels are regarded as regulated entities.
- *For liquid fuels, refiners of crude oil or importers of refined fuels*; the European producers of liquid fuels (refineries and biofuels producers) and importers of processed liquid fuels from outside the EU are regarded are regulated entities.
- *For gas, transporters of natural gas*. In each EU country transmission system operators (TSO) have been appointed that carry out gas transport over the high-pressure gas network. The TSOs keep an administration of all (trans-)national transport, including import and export for each country. In the supply chains of heating oil, coal and LPG there are no equivalent entities, comparable to the TSO. The choice of the TSO as regulated entity would lead to a differentiated approach for the different fuels used in the built environment.
- *For transport fuels, and, in some Member States, for gas or coal, tax warehouses or excise duty points*. The entities that collect excise duties on release of fuel for sale in an EU Member State.
- *Fuel suppliers*. The companies supplying fuels to end-users.

Table 5 provides an overview of the regulated entities.

Table 5 First order estimate of the number of emitters per regulated entity in Europe

Regulated entity	Number of entities: liquid fuels	Number of entities: solid fuels	Number of entities: gaseous fuels
Extractor of fuels	310 oil and gas extracting companies + and producers of biofuels	50-100 mines	310 oil and gas extracting companies + unknown number of producers of biogas
Importers of fuels	200 refineries + 1,000 importers	Number of Importers not available	Number of Importers not available
Transmission System Operators	Not applicable	Not applicable	50
Tax warehouses/excise duty points	5,000-10,000 for all fuels in tax warehouses or excise duty points		
Fuel suppliers (wholesale of solid, gaseous and liquid fuels and related products)	20,000		

Sources: Eurostat Annual detailed enterprise statistics for trade, Eurostat, Structural business statistics; Eurocoal; Europeia; Epure; ENTSOG; number of importers of petroleum products extrapolated from German figures.

We have selected extractors and importers of raw materials as regulated entities for all fuels, except for gas. For gas, the number of regulated entities, and thus the administrative costs, can be reduced by making transmission system operators responsible. That would also remove the obligation from a potentially large and growing number of green gas producers.

To continue complete coverage of all activities that fall under the existing ETS, also other entities need to be covered:
- direct emissions of natural gas extraction and extraction of other fuels;
- process emissions of entities that are covered under the existing ETS.

Special attention will be required for export, as export can take place by the extractors themselves, but also further down the supply chain, for instance export of refined oil products.

2.5.2 Allowance allocation method

We propose to auction the allowances to the regulated entities for the same reasons as discussed in the previous sections. No (unintended) negative impact on the competitiveness of the regulated entities is expected as all fuel types are covered, and both 'domestically' produced (within the EU) and imported fuels are covered.

Since the regulated entities are likely to pass on the costs, all sectors will face higher costs of fossil fuel use. This could affect sectors at risk of (indirect) carbon leakage. Such sectors may still need to be compensated, in line with the concept of allocating free allowances to activities that are vulnerable to direct carbon leakage in the current system. The ETS currently allows for compensating participants that are vulnerable for indirect carbon leakage (e.g. through increased electricity prices). This could be done through financial compensation (as per the current Community-wide and fully harmonised Implementation Measures) or by giving them free allowances, which they could sell to the regulated entities (similar to the Californian system).

Non-energy use of fossil fuels (e.g. naphta as a feedstock in the chemical industry) does not result in emissions directly, as the fuels are not combusted (directly) into CO_2. As the costs of these feedstocks would rise, some sectors could become exposed to carbon leakage, for example when they compete with industries from outside the EU. This could have consequences for allocation, which are further analysed in Chapter 5.

2.5.3 Subsectors included

Upstream coverage would include all subsectors of the economy, including transport and the built environment as well as the current ETS sectors.

2.6 Conclusions

The inclusion variants that will be analysed in the subsequent chapters comprise choices on the design parameters regulated entity, the allocation method and the sectors and subsectors covered. The report will analyse three variants.
1. A variant including transport sector emissions. In this variant, tax warehouse keepers are the regulated entities. The possibility to exclude specific subsectors will be analysed. Two allocation options will be studied, viz. auctioning and allocation on the basis of a fuel benchmark.

2. A variant including building emissions. In this variant, tax warehouse keepers or fuel suppliers will be the regulated entities, depending on the type of fuel. All emissions from the sector will be included. Two allocation options will be studied, viz. auctioning and allocation on the basis of a fuel benchmark.
3. A variant that includes all emissions arising from the combustion of fossil fuels in the EU ETS. This variant would have significant consequences for the EU ETS, as it would imply a divergence from the stack approach. This variant covers all sectors that use fossil fuels. Allowances will be auctioned, and the ways to address carbon leakage will be studied.

Table 6 presents an overview of the inclusion variants. Variant 1 will be analysed in Chapter 3; variant 2 in Chapter 4 and variant 3 in Chapter 5.

Table 6 Overview of inclusion variants

Variant	Regulated entity	Allowance allocation method	Sectors and subsectors covered
Variant 1a	Tax warehouse keeper	Auctioning	All transport sectors (possible phased approach and possible exclusion of agricultural and construction vehicles)
Variant 1b		Fuel benchmark	
Variant 2a	Tax warehouse keeper (liquid fuels) or fuel supplier (gaseous and solid fuels)	Auctioning	Built environment
Variant 2b		Fuel benchmark	
Variant 3	Importer or extractor of liquid or solid fossil fuel TSO for gas	Auctioning	All sectors using fossil fuels, including transport and the built environment

3 Analysis of inclusion variant transport

3.1 Introduction

The transport sector could be included in the EU ETS through upstream coverage of tax warehouses. These entities can distinguish between fuels used in the transport sector and in other sectors, which entities more upstream the supply chain (e.g. extractors or importers of fuels) cannot. Yet, there are far fewer of these entities than of entities further downstream (e.g. filling stations or cars) which reduces the administrative costs of the system.

For reasons of economic efficiency and in order to reduce administrative complexity, the allowances would preferably be auctioned. Note that the transport sector does not have a risk of carbon leakage, as both the fuel costs are a very low share of total costs and the trade intensity is small. Still, if it is deemed desirable to allocate free allowances to the sector, this chapter analyses a subvariant with allocates allowances on the basis of a fuel benchmark.

Table 7 presents the selected inclusion variants for the transport sector.

Table 7 Selected inclusion variants for the transport sector

Regulated entity	Allowance allocation method	Subsectors covered
Tax warehouse keeper	Auctioning	All transport sectors (the possibility of exempting subsectors will be analysed)
Tax warehouse keeper	Fuel benchmark	All transport sectors (the possibility of exempting subsectors will be analysed)

This chapter analyses the inclusion variants based on the criteria set out in Section 1.4. It starts to provide essential background information on the emissions in the transport sector in Section 3.2. Section 3.3 analyses the environmental impacts in the transport sector, focussing on the incentive to reduce emissions, the risk of carbon leakage, the incentive for innovation and the effect on awareness raising. Section 3.4 analyses the economic impacts for the ETS (transaction costs, windfall profits, risk of market concentration, treatment of new entrants and entities that have taken early action), for households (impacts on disposable incomes), and the fiscal impacts. Section 3.5 analyses the technical feasibility, including the monitoring accuracy, feasibility of allocation, definition of entity boundaries and the sensitivity for fraud. Section 3.6 analyses the interaction with other policies and policy instruments aimed at reducing emissions in the built environment as well as the legislative changes required in order to include the built environment in the EU ETS and the EU competence in the matter. The short Section 3.7 analyses the enforcement and Section 3.8 concludes.

3.2 Overview of transport sector emissions and reduction options

In this section we discuss some general characteristics of the transport sector which are useful for the assessment of the various design options. The following issues are discussed: amount of emissions, emissions trend, availability and costs of emission reduction measures and the price elasticity of demand for emissions.

3.2.1 Amount of emissions

In Table 8 the total CO_2 emissions resulting from transport fuel consumption in the EU are shown. These emissions are equal to 886 Mt of CO_2 in 2011, which represents 18.8% of the total CO_2 emissions in the EU 27. This coverage assumes that biofuels have zero CO_2 emissions. It should be noticed that only the direct CO_2 emissions (Tank-To-Wheel emissions) are considered, which is in line with the current practice in EU ETS. Use of diesel contributes most to total transport CO_2 emissions (about 68%). For gasoline, LPG and natural gas these shares are ca. 30%, 1.7% and 0.7% respectively.

Table 8 Transport fuel consumption and related CO_2 emissions in the EU 27 in 2011

Transport fuel	EU 27 transport fuel consumption in 1,000t	CO_2 emissions from transport fuel consumption in Mt
Gasoline	82,647	262
Diesel	190,063	603
LPG	4,991	15
Natural gas	2,378	6
Bio-ethanol	4,518	..
Biodiesel	11,925	..
Total	**296,522**	**886**

Note: The CO_2 emissions resulting from biodiesel and bio-ethanol have not been quantified, as these emissions are highly dependent on the source of biomass that has been used. In order to estimate the CO_2 emissions from natural gas, the CO_2 emission factor of CNG has been used.

Source: Eurostat, 2013, adapted by CE Delft.

Fuels are not only used for transport purposes, but also for energy-use in other sectors (e.g. industry) or as raw material (e.g. in the chemical industry). For comparison reasons the amount of fuels consumed by the EU 27 transport sector are compared to the amount of the same fuels used for other reasons in the EU 27 (see Table 9). Particularly for natural gas and LPG the share of non-transport sectors in total consumption is high, 99% and 80% respectively. For diesel 26% of total consumption takes place outside the transport sector, while for gasoline this is only 2%.

Table 9 **Amount of fuels used (in 1,000 tonne) by the transport sector and other sectors in the EU 27 in 2011**

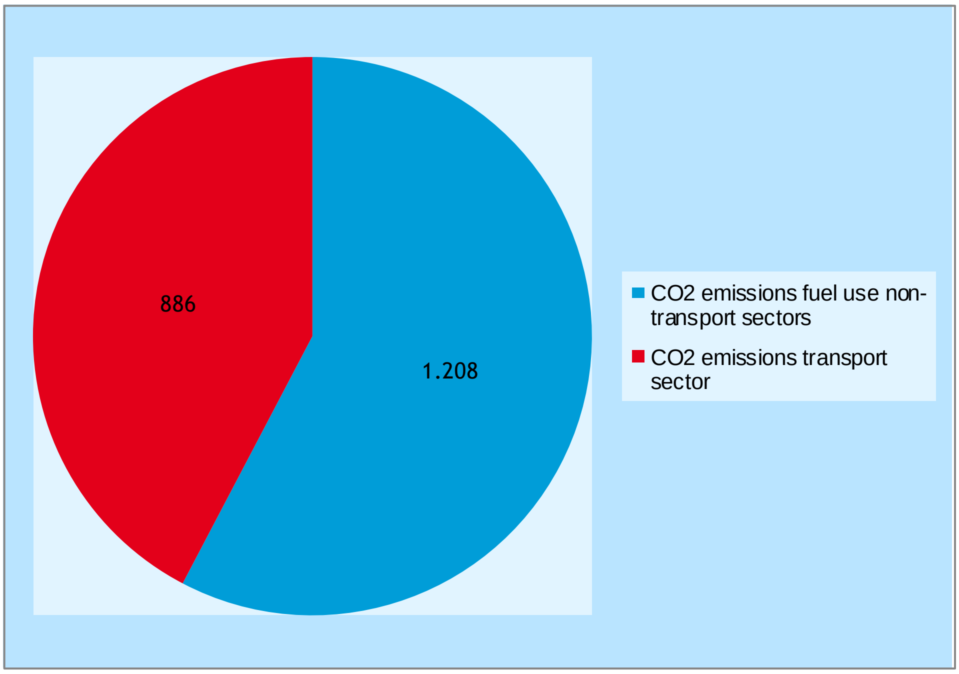
Fuel	Amount of fuels used by transport	Amount of fuels used by other sectors			Total amount of fuels used
		Non-energy use	Energy-use[a]	Total	
Gasoline	98%	1%	1%	2%	84,077
Gas/diesel oil	74%	1%	25%	26%	257,766
LPG	20%	32%	48%	80%	24,674
Natural gas	1%	4%	96%	99%	368,145
Bio-ethanol	100%	0%	0%	0%	4,525
Biodiesel	100%	0%	0%	0%	11,964

[a] Including transformation input and direct consumption in energy sector itself.

Source: Eurostat, 2013.

In Figure 2 the total CO_2 emissions related to fuel use by the transport sector and the CO_2 emissions related to the use of the same types of fuels by other sectors in the EU 27 in 2011 are graphically shown. The CO_2 emissions from the fuel used in the transport sector are slightly lower than the emissions from fuel used in other sectors: 886 Mt vs. 1,208 Mt.

Figure 2 **CO_2 emissions (Mt) related to fuel use by transport and non-transport sectors in the EU 27 in 2011**



Note: The CO_2 emissions resulting from biodiesel and bio-ethanol have not been quantified, as these emissions are highly dependent on the source of biomass that has been used. In order to estimate the CO_2 emissions from natural gas, the CO_2 emission factor of CNG has been used.

Source: Eurostat, 2013, adapted by CE Delft.

EU produced, imported and exported fuels

The fuels consumed in the EU 27 are partly produced in the EU and partly imported from outside the EU. Additionally, some of the fuels produced in the EU are exported to countries outside the EU. In Table 10 and Table 11 an overview is given of the amounts of fuels and related CO_2 emissions produced in the EU, imported and exported (notice that these are not only the transport fuels, but also the fuels used for other purposes). This overview shows that a significant share of the fuels produced (i.e. refined) in the EU 27 are exported to countries outside the EU, about 47%. Note that no data was available on the amount of *transport* fuels that are produced in, imported to and exported from the EU.

Table 10 Amount of fuels (1,000 t) produced in the EU 27, exported and imported in 2011

Fuel	EU production			Import	Total EU consumption
	Total	Export	EU consumed		
Gasoline	123,384	65,549	57,835	26,242	84,077
Gas/diesel oil	234,936	89,913	145,023	112,743	257,766
LPG	15,614	6,537	9,077	15,597	24,674
Natural gas	130,128	79,433	50,695	326,606	368,145[a]
Bio-ethanol	2,699	667	2,032	2,486	4,518
Biodiesel	9,083	2,135	6,948	5,084	12,032[a]

a The total EU consumption is not equal to the sum of EU consumed production and import, due to statistical differences in Eurostat and (distribution) losses.

Source: Eurostat, 2013.

Table 11 CO_2 emissions (Mt) related to fuels produced in the EU 27, exported and imported in 2011[b]

Fuel	EU production			Import	Total EU consumption
	Total	Export	EU consumed		
Gasoline	391	208	183	83	266
Gas/ diesel oil	745	285	460	358	818
LPG	47	20	27	47	74
Natural gas	331	202	129	830	935[a]
Total	**1,514**	**714**	**799**	**1,317**	**2,093[a]**

a The CO_2 emissions related to total EU consumption is not equal to the sum of CO_2 emissions related to EU consumed production and import, due to statistical differences in Eurostat and (distribution) losses.

b The CO_2 emissions resulting from exported biodiesel and bio-ethanol have not been quantified, as these emissions are highly dependent on the source of biomass that has been used. In order to estimate the CO_2 emissions from natural gas, the CO_2 emission factor of CNG has been used.

Source: Eurostat, 2013, adapted by CE Delft.

CO_2 emissions per subsector

The CO_2 emissions of different modes and subsectors are summarised in Table 12. The largest contributor to the EU's transport emissions is the passenger car: roughly 67% of the CO_2 emissions is emitted by these vehicles. Also heavy duty vehicles and vans contribute significantly to the total transport CO_2 emissions; these vehicles represent a share of 19% and 12% of the total transport emissions, respectively. The non-road modes have a significantly smaller share in the total emissions from transport in the EU.

Table 12 **Transport emissions relative to total emissions in the EU in 2011**

(Sub)sector	Absolute CO_2 emissions in Mt	Share of (sub)sector in total transport emissions	Share of (sub)sector in total CO_2 emissions in EU 27
Passenger cars (incl. motorcycles)	592	66.8%	12.5%
Vans	103	11.6%	2.2%
HDVs (incl. busses)	165	18.7%	3.5%
Rail passenger (diesel)	4	0.5%	0.1%
Rail freight (diesel)	3	0.3%	0.1%
Inland shipping	19	2.1%	0.4%
Transport total	**886**	**100%**	**18.8%**
Passenger transport	**596**	**67.3%**	**13%**
Freight transport	**290**	**32.7%**	**6%**

Note: Emissions related to biofuel consumption are excluded, emissions of most modes would be higher in reality therefore. Also the share of agricultural or construction vehicles are excluded from the table.

Note: Only diesel trains are included in these figures; CO_2 emissions that result from generating electricity for electric trains are already included in the existing EU ETS.

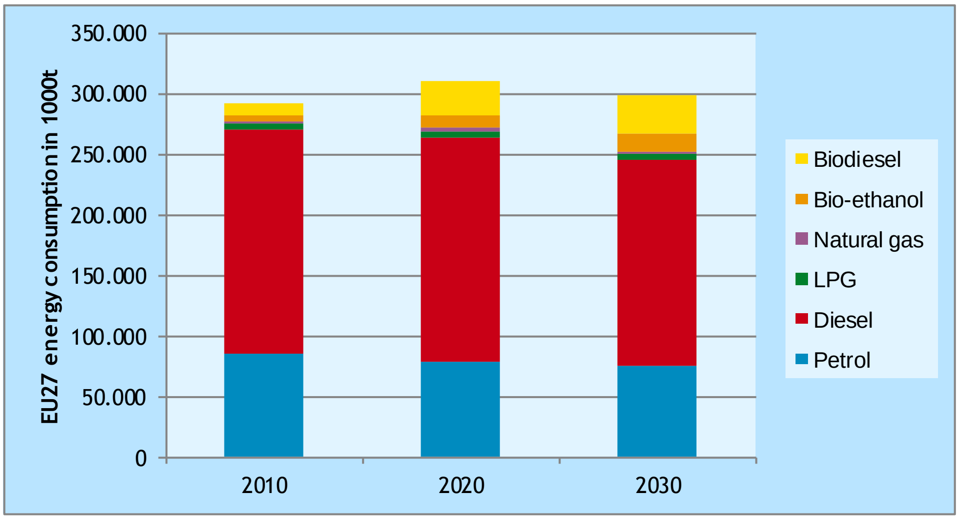
Source: European Commission, 2012 (Pocketbook); Eurostat, 2013

It should be mentioned that Table 12 does not include emissions from agricultural and construction vehicles. For these vehicles no EU-wide figures on CO_2 emissions are available. However, these vehicles are likely to significantly contribute to the total transport-related CO_2 emissions. According to Ecorys (2008) for example, the diesel consumption of agricultural and construction vehicles in the Netherlands was equal to 575 and 433 million litres respectively, which was approximately 12% of the total diesel consumption (and hence related CO_2 emissions) in the Netherlands. It is unclear to what extent these numbers apply to other EU countries, let alone to the EU as a whole.

3.2.2 Emissions trend

There are many scenario/trend calculations that estimate the development of CO_2 emissions in the transport sector. The PRIMES-GAINES Reference Scenario estimates that total fuel consumption in transport will initially increase (increased transport demand offsets more fuel-efficient vehicles), but hereafter starts to decrease, as is shown in Figure 3. The PRIMES-GAINES scenario also shows that biofuel consumption will double between 2010 and 2020, hereafter the shares of both bio-ethanol and biodiesel will still increase, although at a lower pace.

Figure 3 Energy consumption trend for different fuels



Note: 2010 figures are based on Eurostat. The figures for 2020 and 2030 are estimated by CE Delft based on the development of consumption of the various energy carriers as shown in the PRIMES-GAINES Reference Scenario 2010.

Sources: Eurostat, 2013; Primes Reference Scenario, 2010, adapted by CE Delft.

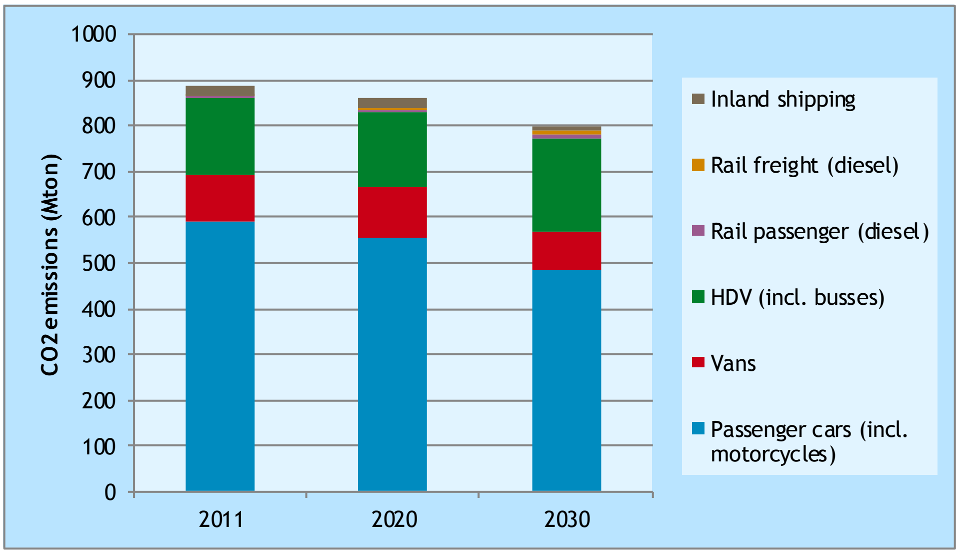
When applying the current CO_2 emission content of these fuels to Figure 4, it results that CO_2 emissions will decrease by approximately 9% between 2010 and 2030. However, the carbon content of the different fuels will be lowered over the next years (PRIMES, 2010). This results from EU regulations, such as the FQD, which obliges fuel producers to reduce the carbon content of their fuels by 6% in 2020. If the FQD is kept constant after 2020, the total CO_2 reduction would not be 9% but 14%.

Increasing the amount of biofuels will be an important mean to reach this goal (CE Delft, 2013). The expected emission trend that may result from this increased use of biofuels is difficult to estimate though. Whether an increase of biofuel consumption would truly reduce the life cycle carbon emissions from gasoline and diesel depends on the biomass that is used on the one hand, and on whether CO_2 effects of land use changes are included in the calculations on the other. Especially, this latter-mentioned aspect is important, as the FQD and RED currently do not take these ILUC emissions into account. As long as no (sufficient) measures are taken to account for emissions from ILUC, the carbon emissions of supplied biofuels may not be very different from conventional fuels or may even increase GHG emissions (CE Delft, 2013). These arguments also indicate the importance of including the CO_2 emissions from ILUC effect in the ETS. If the system accounts for such effects, biofuels with high life cycle CO_2 emissions would become less attractive to produce/supply. The EC (2012) recently published a proposal on including ILUC effects when estimating GHG emissions of biofuels which may be used for this purpose.

Emission trends for EU fuel consumption in different subsectors

In Figure 4 the trend in CO_2 emissions for various transport modes is shown. As mentioned before, it is expected that the total transport CO_2 emissions will decline over the next 20 years. This reduction in CO_2 emissions will be mainly the result of a drop in CO_2 emissions from passenger cars. On the other hand, the total CO_2 emissions from (road) freight transport and mainly from heavy duty vehicles are expected to increase significantly till 2030.

Figure 4 **Trend in CO_2 emissions for various transport modes**



Source: PRIMES-Gaines reference scenario, TREMOVE; adapted by CE Delft.

3.2.3 Regulated entities

There are between 5,000 and 10,000 tax warehouse keepers for energy products in the EU. This estimate is based on an extrapolation of data in one Member State and has been checked with several experts (see Section C.2.1). All entities upstream from tax warehouses cannot distinguish between sectors where their products are consumed. Entities further downstream such as filling stations and vehicles are numerous and would thus result in a high administrative burden. Table 38 provides an overview of the number of entities.

Table 13 **First order estimation of the number of emitters per regulated entity in Europe**

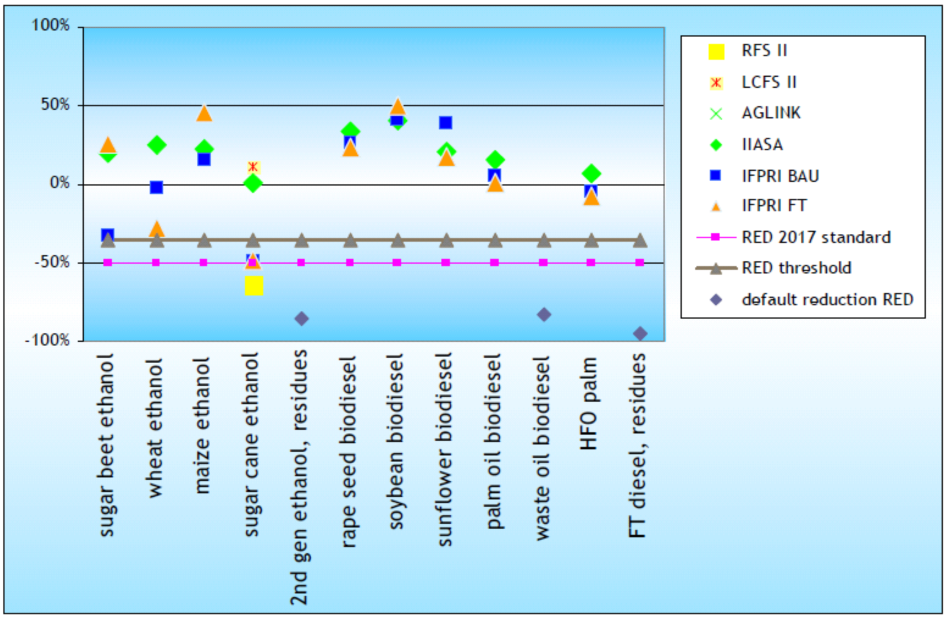
Regulated entity	Number of emitters
Extractor/importer of raw materials	500 + large number of small biomass producers
Refinery + importer of transport fuels / Fuel blenders	500-1,000
Fuel blenders	500-2,000
Tax warehouse keeper	5,000-10,000
Fuel supplier	5,000-10,000
Filling station	Ca. 134,000
Vehicle	Ca. 250 million

3.2.4 Availability and costs of emission reduction measures

There are many different emission reduction measures that could be applied to reduce the GHG emissions of transport (CE Delft, 2006; Inregai AB, 2006; Ifeu et al., 2003). Both technical and non-technical (i.e. behavioural or operational) options could be implemented (AEA et al., 2010). Which measures could be actually applied differ significantly between subsectors though.
For that reason we discuss the reduction measures for the transport sector as a whole, road transport, rail transport and inland waterway transport (IWT) separately. No evidence has been found on specific emission reduction measures for agricultural or construction vehicles. Therefore, these subsectors are not discussed here.

Emission reduction measures for the transport sector as a whole
By increasing the production/supply of biofuels (or alternative fuels), the carbon intensity of transport fuels could be reduced and hence the GHG emissions of transport could be lowered. However, there is a lot of uncertainty on the reduction potential and abatement costs of biofuels. This is due to GHG emission increases that may result from land-use changes (ILUC effects)[10], which many studies do not take into account (CE Delft and TNO, 2012). The net GHG emission reduction potential of various types of biofuels is shown in Figure 5. On the vertical axis the percentage of greenhouse gas reductions of biofuels compared to conventional fuels is shown, while on the horizontal axis various types of biofuels are shown. The results are based on various agro-economic models (see legend)[11]. As is evidenced in Figure 5, the net GHG effect of biofuels is rather uncertain and in many cases current biofuels result in a net increase in GHG emissions. For the longer term more 'effective' biofuels may be expected (e.g. biofuels from waste), but their abatement potential is still very uncertain (CE Delft and TNO, 2012).

Figure 5 GHG emission reduction potential (incl. ILUC effects) of different biofuels



Source: CE Delft, 2010c.

The marginal abatement costs of biofuels (i.e. the ones that result in net GHG reductions) are uncertain as well. However, from CE Delft and TNO (2012) it is clear that these costs will probably be very high; ICCT (2011, cited in CE Delft and TNO, 2012) estimates that the cost effectiveness could be as

10 ILUC relates to the consequence of releasing more carbon emissions due to indirect land use changes around the world. This is induced by the fact that pristine lands are cleared and converted to new cropland, in order to produce the crops for feed and food that were diverted elsewhere to biofuels production. These emissions may be very significant, depending on the type of crop used for the biofuel production, but they are more difficult to quantify than the direct emissions of biofuels. ILUC could also negatively affect biodiversity (EP, 2011; EC, 2010).

11 Additionally, the reductions of the Renewable Energy Directive (RED) standard 2017, the RED threshold and the default reduction in the RED are presented in the figure (see lower three in the legend).

much as € 2,500 per ton CO_2[12]. Either way, regular biofuels are likely to be an expensive option. This is also the case for high biofuel blends (and gas), which also depends on the availability of an appropriate infrastructure and on the number of compatible vehicles that are on the market.

Emission reduction measures for road transport

Table 14 summarizes the main emission reduction options available for road transport. As is evidenced by Table 14, both for private and commercial transport a wide variety of technical and operational measures are available to reduce their emissions.

Table 14 Examples of emission reduction measures available for road transport

Technical measures	Non-technical measures
Both passenger and freight transport	
Conventional vehicles that are more fuel efficient (e.g. with an improved combustion engine, downsizing, low rolling resistance tyres, light-weighting, start-stop system, improved aerodynamics, etc.)	Fuel-efficient driving
Vehicles with alternative powertrains (e.g. hybrid or full-electric vehicles)	Lower driving speed
Using alternative fuels, such as CNG, LPG, or switching from petrol to diesel	Substitute road transport with non-road transport modes (e.g. rail or waterborne transport)
-	Tyre pressure monitoring
Passenger transport	
-	Vehicle downsizing
-	Choosing different road modes (e.g. moped, bus, bicycle)
-	Reducing mobility (e.g. virtual meetings, working at home)
-	Car pooling/sharing
Freight transport	
-	Improving load factors (e.g. reduce empty driving, consolidate shipments from several companies, etc.)
-	Changing routes and drive at most favourable times of the day
-	Reducing transport kilometres (e.g. change production volumes at different locations)

Sources: Based on AEA et al, 2010; Significance and CE Delft, 2010.

An overview of the reduction potential of a selection of reduction measures is shown in Table 15. Most of the technical measures will only penetrate into the transport market on the medium to long term (i.e. 3 years or longer) (CE Delft, 2006), while operational measures can be taken on a very short time-frame (i.e. within 3 years).

[12] ILUC effects are taken into account.

Table 15 Reduction potentials of various reduction options for transport

Reduction option	Reduction potential	Comments
Technical measures petrol cars	Up to 54%	Compared to a 2015 baseline passenger car
Technical measures diesel cars	Up to 35%	Compared to a 2015 baseline passenger car
Technical measures HGVs	Up to 45%	Compared to 2014 baseline vehicles
Technical measures buses	Up to 45%	Compared to 2014 baseline vehicles
Fuel efficient driving	10-15%	Compared to current baseline vehicle
Modal shift from cars to trains	1-9%	Maximum realistic reduction potential, compared to all CO_2 emissions of passenger transport in the EU
Modal shift from cars to busses	1%	Maximum realistic reduction potential, compared to all CO_2 emissions of passenger transport in the EU
Teleworking	6-8%	Maximum realistic reduction potential, compared to all CO_2 emissions of passenger transport in the EU

Sources: CE Delft and TNO (2012); CE Delft et al. (2012).

In Table 16, a first order estimate of the abatement costs of some reduction measures in the transport sector are shown. As mentioned by CE Delft and TNO (2012), abatement costs strongly depends on the methodologies, parameters, assumptions and input data used (e.g. fuel prices, discount rates, amortization periods, etc.). For that reason, comparing abatement costs provided by different sources is often difficult. Additionally, abatement costs should be presented in terms of ranges instead of point estimates to show the sensitivity for the assumptions/data used. For these reasons it is not possible to provide a complete overview of abatement costs here. Instead, we present cost estimates for packages of technologies/measures resulting in a specific reduction of CO_2 emissions.

Table 16 Reduction potential and costs for different road transport modes

Road transport mode	CO_2 emission reduction potential of a specific reduction package	Marginal abatement costs per ton CO_2
Gasoline cars	25%	-€ 100 to € 52
Diesel cars	25%	-€ 200 to -€ 69
Truck (GVW 12 tonnes)	9%	-€ 175 to € 0
Truck (GVW 12 tonnes)	15%	-€ 50 to € 150
Truck (GVW 40 tonnes)	30%	-€ 250 to -€ 50
Truck (GVW 40 tonnes	40%	-€ 5 to € 250
Fuel efficient driving	10-15%	- € 10 to -€ 100
Switch to CNG	Ca. 20%	€ 200 - € 400
Switch to LNG	9-12%	In the range of € 700

Source: CE Delft and TNO, 2012.

Note: Due to the very high uncertainty in the estimation of abatement costs for electric vehicles (EVs) and fuel cell electric vehicles (FCEVs) it is not possible to provide reliable ranges for the abatement costs for these technologies/fuels. However, based on some assessments carried out in CE Delft and TNO (2012) it can be concluded that the abatement costs of these technologies are probably very high (at least on the short term) and (largely) above the other figures presented in the table.

Emission reduction measures for rail transport

An overview of the GHG emission reduction measures available for diesel rail transport is given by AEA et al. (2009). The main results from this study are summarized in Table 17.

Table 17 GHG emission reduction options and potential for diesel railway transport

Reduction measure	Reduction potential	Payback time
Mass reduction (e.g. by double deck trains, aluminium railcar body, lightweight coach interior equipment, etc.)	2- > 10%	3-8 years
Electrification	20%-40%	> 8 years
Aerodynamic and friction reduction (e.g. Bogie farings, streamlining head and tail, aerodynamic ordering of freight cars, etc.)	Mostly < 1%, except for bogie farings: 6-7%	> 8 years
Improved air conditioning	4%	3-8 years
Driver support (driver training and in-cab displays)	5-15%	1-3 years
Traffic management	?	?
Increasing occupancy rate (passenger) or load factor (freight)	?	?

Source: AEA et al., 2009.

All operational measures could be adopted in the short term as well as some of the technical measures (e.g. some of the aerodynamic measures). However, a large share of the technical measures (e.g. mass reduction) could only be adopted on the long run, since they are only applied in case trains are replaced by new ones (CE Delft, 2006).

No specific data was available on the abatement cost of the various emission reduction measures for rail transport. However, some rough estimates of the expected payback period are presented by AEA et al. (2009) (see third column of Table 17). In general, payback periods for emission reduction measures for rail transport are moderate to long.

Emission reduction measures for IWT

AEA et al. (2009) also presents an overview of the emission reduction measures available for IWT. The main results are summarized in Table 18. It should be mentioned that the available evidence on reduction measures and their potential for IWT is rather scarce and hence uncertain.

Table 18 GHG emission reduction options and potential for inland waterway transport

Reduction measure	Reduction potential	Expected payback time
Power train improvements (more efficient engines, diesel-electric propulsion or LNG optimised engines)	10-20%	> 10 years
Reduction of required propulsion (e.g. larger units, improved propeller systems, lightweight hulls, whale tail propulsion systems)	5-30%, except for larger units, which may result in GHG emission reductions of up to 75%	Mostly unknown or < 1-3 years.
Combination of technical measures	30-50%	Varies

Source: AEA et al., 2009.

By implementing technical measures in IWT potentially 30-50% GHG emission reduction could be realised. However, inland waterway vessels have a long lifetime, so this technical reduction potential cannot be obtained in the short term; it will take time to replace the whole fleet.

According to AEA et al. (2009) data on the costs of GHG reduction options for non-road modes is very scarce, and hence data on the marginal abatement costs is not available either. However, the payback times that AEA et al. (2009) have estimated indicate that relatively large investments are needed for most technical measures available.

3.2.5 Price elasticity of fuel demand and barriers

The extent by which actors within in the transport sector will actually implement emission reduction measures strongly depend on their price sensitivity. The more sensitive actors are for price increases the more emission reduction measures they will adopt. An indicator to express the price sensitivity of transport users are price elasticities. In this section we discuss the relevant price elasticities for end-users (vehicle owners).

The price incentives provided by the inclusion of transport in ETS are (from the perspective of the end-users) comparable to fuel price increases. Therefore, the price sensitivity in the context of ETS could be best reflected by fuel price elasticities; these indicators present the relative changes in fuel consumption (or number of kilometres travelled) as a consequence of a certain relative change in the fuel price.

Price elasticity for passenger transport

PBL and CE Delft (2010) have reviewed several studies on fuel price elasticities. Based on this review they present the following set of fuel price elasticities as best guess estimates (see Table 19).

Table 19 Fuel price elasticity for passenger cars in the short- and long-term

Fuel price elasticity on:	Short-term (1 year)	Long-term (5-10 years)
Car ownership	-0.05 to -0.15	-0.2 to -0.3
Kilometres travelled by car	-0.1 to -0.2	-0.2 to -0.4
Fuel efficiency	+0.1 to +0.15	+0.3 to +0.4
Total fuel consumption	**-0.2 to -0.3**	**-0.6 to -0.8**

Source: PBL and CE Delft, 2010.

Three main conclusions can be drawn from Table 19:

- Total fuel consumption of car owners is relatively sensitive for changes in fuel prices. In the long term an increase of fuel prices by 10% may result in a reduction of total fuel consumption by 6 to 8%.
- The price elasticity appears to be higher in the long-term than in the short-term, which implies that it takes time before car owners (are able to) fully respond to price increases.
- Reductions of total fuel consumption may be caused by reduced car ownership, reduced kilometres travelled by car or improved fuel efficiency (either by more fuel efficient cars or a more fuel-efficient driving style).

No data is available on the fuel price elasticity of rail transport on fuel efficiency, nor on the amount of travelled kilometres.

As is shown by the elasticity values in Table 19 particularly in the long run fuel demand by passenger road transport is rather price sensitive. However, various barriers could be identified which prevent people to invest in more (or more effective) reduction measures (CE Delft et al., 2012):

- *Consumer Myopia;* the investment costs of fuel-efficient technologies/vehicles are often rather high, which may be a barrier to invest in these technologies. Even vehicles/technologies which result in net reductions on the total cost of ownership may not be taken up because of the high investment costs. This so-called consumer myopia is caused by the fact that consumers do not take the life-time savings from improved fuel efficiency into account, but only the first three to five years of fuel use.
- *Interest in fuel-efficiency of vehicles is low*; fuel consumption/ environmental performances of vehicles is often no top priority when buying a new vehicle. Size of the vehicle or safety issues are regarded as much more important.
- *Knowledge and awareness*; vehicle owners often have only limited knowledge on their own fuel use as well as on the options to increase the fuel-efficiency of their vehicle/driving style.
- *Lack of infrastructure*; in case of alternative fuels and electric vehicles the limited availability of charging/filling stations hamper the uptake of these vehicles.
- *Habitual behaviour*; e.g. driving behaviour is habitual and therefore it is difficult to shift to a more fuel-efficient driving style.

Some of these barriers are already addressed by other EU policies or national policies. For example, the CO_2 and Cars Directive (indirectly) addresses barriers like consumer myopia, low interest in fuel-efficiency of vehicles and lack of knowledge on own fuel use. By regulating the CO_2 emissions of new passenger cars and vans, the impact of consumer choices on the CO_2 emissions of these vehicles is reduced. The other way around, the inclusion of transport in ETS may also strengthen the impacts of the CO_2 and Cars Directive, since the former policy do address vehicle use, while the latter doesn't. A more extensive discussion on the interactive effects of inclusion of transport in ETS and EU transport Directives is presented in Section 3.6.

Price elasticity for freight transport

A recent overview of the fuel price elasticities for road freight transport is given by Significance and CE Delft (2010). The main results of this study are shown in Table 20.

Table 20 Fuel price elasticity for road freight transport according to Significance and CE Delft (2010)

Fuel price elasticity on:	Range of fuel price elasticity found in literature	Best estimate
Fuel consumption	-0.2 to -0.6	-0.3

Source: Significance and CE Delft, 2010.

The results of Significance and CE Delft (2010) show that a fuel price increase of 10% leads to a decrease of 2 to 6% in fuel consumption, with a best estimate of 3%. The decrease in fuel consumption from freight road transport results from three responses (ibid.):

- use of more efficient vehicles (-0.1);
- increase of transport efficiency (e.g. smarter logistics) (-0.1);
- decrease in demand for freight transport (-0.1).

Evidence on fuel price elasticities for rail and inland waterway transport is very scarce. CE Delft et al. (2010d) therefore assumes that the effect of a fuel price increase on the fuel efficiency of rail and inland waterway transport is equal to that of road transport. In contrast to road transport where specific elasticity estimations exist, it is also unclear what type of reactions to fuel price increases (e.g. increase transport efficiency, switching to other fuels, etc.) can be expected.

Compared to passenger transport freight transport is in general less price sensitive. Some of the barriers which prevent transport companies to invest more in fuel efficient vehicles are (CE Delft, 2012):
- *Knowledge on (effectiveness of) reduction measures*; although transport companies are often aware of the reduction technologies available, they often do not believe that they are cost effective.
- *Availability of fuel-efficient technologies*; fuel-efficient technologies are often not a standard element of new vehicles offered by OEMs.
- *Split incentives*; in some cases split incentives may hamper investments in fuel-efficient vehicles. For example, when transport companies operate under an open-book contract under which they can bill the shipper for the actual fuel consumption, the shipper is the one who benefits from investments in fuel-efficient technologies while the transport company is the one who actually have to invest.

In contrast to passenger transport, the CO_2 emissions of freight transport are not heavily regulated yet. Therefore, most of the barriers above are currently not addressed by EU policies. However, the Commission is investigating potential policies to reduce the CO_2 emissions of (particularly road) freight transport, like CO_2 labels and CO_2 standards. In case these are introduced, they may (indirectly) address the first two barriers mentioned above.

3.3 Evaluation of environmental impacts

3.3.1 Introduction

In this section we evaluate the environmental impact of both transport inclusion variants. It should be noted that this impact is largely determined by the emission cap and the resulting allowance price, and by the subsectors to be covered by the scheme. The stricter the emission cap, the higher the price and the larger the environmental impacts of the inclusion of transport in ETS. Excluding some of the subsectors of the transport sector may reduce the environmental effectiveness of the scheme.

Various aspects related to where and how emission reductions stimulated by the inclusion are do depend on the design of the scheme. Therefore, these aspects are discussed in more detail in the remainder of this section, including: incentives to reduce emissions, effects on innovation, effects on awareness raising and risks of carbon leakage.

3.3.2 Incentive to reduce emissions

The inclusion of transport in ETS may provide tax warehouse keepers an incentive to reduce emissions. However, at this level of the supply chain the number of reduction options available is rather small. The only option these entities have to increase the amount of biofuels in the blends, subject to fuel quality standards. However, as was evidenced in Section 3.2.3, the costs related to biofuels are likely to be very high (in the order of € 2,500/ton CO_2 eq.).

Tax warehouse keepers will likely pass on the costs of the emission allowances to the downstream entities. This will provide an (indirect) incentive to downstream actors to take fuel-saving measures, which in turn will reduce CO_2 emissions. As we saw in Section 3.2.3, at least for road transport[13] there are several operational and technical measures with relatively low abatement costs available and hence these options would most likely to be taken if actors act rationally. However, in reality many actors do not act rationally (due to several kinds of market barriers, see Section 3.2.5) and therefore probably not all of these measures will be taken in case transport is included in ETS. Switching to alternative fuels and far-reaching technical options (e.g. hybrid or electric vehicles) are rather expensive and it may not be expected that these kinds of options are strongly stimulated by including transport in ETS.

The extent to which reduction measures are taken in the transport sector (instead of buying allowances from other sectors) does not only depend on the abatement costs of these measures (and barriers associated with these measures), but also on the extent to which the costs of allowances are passed on by tax warehouse keepers to downstream actors (in the end: vehicle owners). In case of a competitive market, it may be expected that the additional costs are fully passed on to downstream users. However, some studies (e.g. CE Delft, 2006; Eckerhall, 2005) argue that it may be possible that some of the additional costs are internalised by tax warehouse keepers, resulting in lower profit margins for tax warehouse keepers on the one hand and smaller financial incentives to apply fuel-efficiency measures by vehicle owners on the other hand. Based on economic theory and empirical evidence it is not possible to determine to what extent the additional costs from EU ETS are passed on through the fuel supply chain (see Annex C.2.2). Therefore, we apply in this study the working assumption that all the allowance costs experienced by the tax warehouse keeper are passed on to the final consumers for 100%.

3.3.3 Effect on innovation

Next to the more short-term incentives to invest in emission reduction measures discussed in the previous section, including transport in ETS may also have an effect on innovations. Since tax warehouse keepers are not in the position to innovate themselves (in terms of lower CO_2 contents of fuels or more fuel-efficient vehicles), the effect on innovations is an indirect one; by passing on the allowance costs to consumers, the consumer demand for more fuel-efficient vehicles or fuels with lower CO_2 contents will increase and hence suppliers are (indirectly) stimulated to further develop their vehicles/fuels.

Vehicle manufacturers basically have two main options at hand to deliver more carbon-efficient vehicles. First, they could develop more fuel-efficient technologies for conventional vehicles and secondly, they could invest in vehicles with alternative drivetrains (e.g. electric vehicles, hydrogen vehicles, LNG or CNG vehicles). As was shown in Section 3.2.3 improving the fuel efficiency of conventional vehicles is often much cheaper than developing vehicles with alternative drivetrains, and hence inclusion of transport in ETS may especially contribute to these kinds of innovations. The financial incentives provided by the ETS are (in and of themselves) probably not large enough to stimulate large-scale investments in expensive options like vehicles with alternative drivetrains. Furthermore, these options often require an adjustment of the infrastructure (e.g. charging infrastructure for electric

[13] For non-road modes the marginal abatement costs are unclear (see Section 3.2.3) and it is therefore difficult to predict whether and which reduction measures will be taken if transport is included in ETS.

vehicles, LNG of hydrogen fuelling stations), which is not stimulated directly by the inclusion of transport in ETS. Additional policies are needed to realise this.

With respect to the development of fuels with a lower CO_2 content, particularly the development of second generation biofuels (with higher abatement potentials and lower abatement costs) may be incentivised by the ETS. This incentive to invest in innovative biofuels is also given by the Fuel Quality Directive.

Finally, the effects on innovations are strongly dependent on marginal abatement costs and the expectations of ETS prices. Particularly the predictability of ETS prices is important, because they provide some certainty to manufacturers/producers on the expected profitability of their investments in innovative solutions. In this respect, long-term certainty on emission targets (i.e. the ETS cap) is important, because this provides more certainty on future ETS price developments.

3.3.4 Effect on awareness raising

Next to the price incentives, the inclusion of transport in the ETS may also result in more psychological impacts, such as raising awareness of reduction options. However, these kind of impacts are mainly expected downstream, since consumers are expected to act less economically rationally than firms like tax warehouses. They are also more relevant downstream, given the limited options tax warehouse keepers have to reduce emissions.

The inclusion of transport in the EU ETS would result in a fuel price increase in both transport inclusion variants. It is unlikely that this creates more awareness than fuel price increases that occur because of increases in oil prices or increases in taxes.

3.3.5 Risk of leakage

Carbon leakage is the term often used to describe the situation that may occur if, due to costs related to climate policies, activities are transferred to countries/sectors which have laxer constraints on GHG emissions. In general, two potential risks for carbon leakage could be identified for the inclusion of transport in ETS:
- transport-related activities taking place within the EU are replaced by activities in countries not covered by the ETS, e.g. fuels bought outside the EU and consumed within the EU;
- transport-related activities are shifted to subsectors/entities not covered by ETS.

Carbon leakage to non-EU countries

Since all transport fuels (both domestically produced and imported) do have to pass a tax warehouse in the country of consumption, there is no risk on evading the ETS (and hence carbon leakage) in both inclusion variants by making use of non-EU tax warehouses. However, downstream there may be some risks of carbon leakage. As a consequence of ETS-induced price increases some vehicle owners may decide to purchase their fuel from non-EU filling stations (CE Delft, 2006; 2008). As a consequence, not all emissions that are emitted within the EU would be covered by the system (carbon leakage). However, it is expected that the size of this carbon leakage effect is limited, because:
- The impact of the ETS on fuel prices is probably relatively small (see also Section 3.4.2). The smaller the price difference between fuels sold within

the EU and without, the less attractive it becomes for vehicle drivers to make a detour to fill up outside the EU.
- Purchasing fuel outside the EU will unlikely be an attractive option for the majority of vehicle drivers, as it would require a significant detour in most cases; this would at least partially off-set cost-savings from lower fuel prices.

It is not completely clear in which transport sector the risk on carbon leakage is the largest. In comparison to road transport it should be noted that for (diesel) rail transport and IWT:
- the ranges (in terms of average number of kilometres per trip) are larger, which may make it a more attractive option to purchase fuel in non-EU countries;
- the dependency on specific infrastructure (tracks, waterways) is stronger, reducing the options to make efficient detours.

Because of these two opposite impacts it is not possible to be conclusive on the relative risk on carbon leakage at rail transport and IWT compared to road transport. However, since both modes are mainly operating within the EU, the potential risk is expected to be low (as is the case for road transport).

Carbon leakage to non-covered subsectors

Including transport in the ETS may provide an incentive to shift transport to non-covered subsectors (e.g. short sea shipping or rail/IWT in case not all sub-sectors are covered). The larger the increase in fuel prices due to the ETS, the larger the risk of this kind of carbon leakage. Particularly in case rail transport or IWT is (temporarily) excluded from the ETS, significant modal shift effects (and hence carbon leakage effects) may take place.

Both inclusion variants for transport assume that all tax warehouses are covered by the ETS, including the small ones. In this way, the risk on evasion of the ETS by starting a new, small tax warehouse that is below the participation threshold is avoided. Although the establishment of a new tax warehouse in general requires meeting some (mostly administrative) conditions (see Annex E), there are no strong barriers to starting one. Particularly in the case of high ETS prices and hence high allowance costs for tax warehouse keepers, the transaction costs of establishing a new (small) tax warehouse may be outweighed by the savings on allowance costs. For this reason covering all tax warehouses by the EU ETS has been chosen.

3.4 Evaluation of economic impacts

3.4.1 Introduction

In this section we evaluate the economic impacts of both transport inclusion variants. The following economic impacts are considered: impacts on fuel prices, competitiveness, transaction costs, equity, windfall profits, public finance, income/profits and the market for allowances. Impacts on allowance prices and price volatility are discussed in Chapter 6 because they are similar to all inclusion variants.

3.4.2 Impacts on fuel prices

Most economic impacts result from increases in fuel prices. The retail fuel price increases depend on the allowance price and on the price of fuel. The price increase ranges from approximately 2% for an allowance price of € 10 to 7-9% for an allowance price of € 40. Note, however, that these are increases over the average retail price in the EU and the situation may differ between Member State and between fuel suppliers in a Member State.

Relatively cheap fuels will experience larger price increases than relatively more expensive fuels.
Table 21 presents the impact of ETS in average EU retail prices of transport fuels.

Table 21 Impacts of ETS on average EU retail prices of transport fuels

Fuel	Retail price (€/litre)	Price including € 10/t CO_2	Price including € 20/t CO_2	Price including € 40/t CO_2
Diesel	1.42	1.44 (+2%)	1.47 (+3%)	1.52 (+7%)
Gasoline	1.53	1.55 (+2%)	1.58 (+3%)	1.63 (+7%)
LPG	0.71	0.73 (+2%)	0.74 (+5%)	0.78 (+9%)

Source: http://ec.europa.eu/energy/observatory/oil/bulletin_en.htm, accessed 6-11-2013 (retail prices)

3.4.3 Impacts on competitiveness

The inclusion of transport in the ETS may affect the competitiveness of the transport sector or sectors directly involved in the fuel supply chain in various ways. With respect to the inclusion variants defined for transport, particularly the potential impacts on the competitiveness of filling stations are relevant. Additionally, there may be some impacts on the competitiveness of individual transport sectors (e.g. road, rail, IWT), due to differences in CO_2 emissions per tonne or passenger kilometre or in the abatement costs of the potential CO_2 reduction measures available. However, shifts because of these reasons could be seen as intended effects, since they shift transport to more carbon-efficient transport modes and hence reduce total transport CO_2 emissions. For that reason we do not discuss them in more detail here.

Higher fuel prices may stimulate vehicle users to apply cross border fuelling (i.e. tank tourism by drivers residing in one country and fuelling in another country) in order to benefit from price differences in transport fuels in EU Member States and non-EU countries (Keppens and Verbeek, 2003; Raux, 2009; Verhoef, 1997). This cross border fuelling may hamper the competitiveness of EU filling stations. The negative impact on the competitiveness of filling stations is the same for both inclusion variants.

As is shown in Table 22 and Table 23, the impact of inclusion of transport in the EU ETS on road fuel prices is rather limited at current CO_2 prices. However, if CO_2 prices increase also the impacts on fuel prices increase and could become significant (ca. € 0.10 per litre if the CO_2 price is equal to € 40 per ton). Table 22 and Table 23 also show the differences between current and potential future road diesel prices (in case transport is included in EU ETS) for non-EU Member States (Switzerland and Ukraine) and two neighbouring EU Member States (Austria and Germany in case of Switzerland and Romania and Poland in case of Ukraine). These tables show that the current road diesel prices already differ significantly between these countries, particularly at the eastern border of the EU. Inclusion of transport in EU ETS may affect these price differences, but at low to modest CO_2 prices these impacts are smaller than the current differences, suggesting that at these CO_2 prices the impacts on the competitiveness of filling stations would probably be limited.

Table 22 Comparison of road diesel prices in Switzerland, Austria and Germany

	Current diesel price	Diesel prices at various CO_2 price levels		
		CO_2 price = € 10/tonne	CO_2 price = € 20/tonne	CO_2 price = € 40/tonne
Diesel prices (€/liter)				
Switzerland	1,529	1,529	1,529	1,529
Austria	1,320	1,346	1,373	1,425
Germany	1,398	1,424	1,451	1,503
Relative deviation compared to the diesel prices in Switzerland				
Austria	-14%	-12%	-10%	-7%
Germany	-9%	-7%	-5%	-2%

Note: Current prices are based on www.fuel-prices-europe.info, visited at the 2-07-2013. Impacts of CO_2 prices on fuel prices are calculated based on the tank-to-wheel CO_2 content of diesel.

Table 23 Comparison of road diesel prices in Ukraine, Romania and Poland

	Current diesel price	Diesel prices at various CO_2 price levels		
		CO_2 price = € 10/tonne	CO_2 price = € 20/tonne	CO_2 price = € 40/tonne
Diesel prices (€/liter)				
Ukraine	0,781	0,781	0,781	0,781
Romania	1,299	1,325	1,352	1,404
Poland	1,251	1,277	1,304	1,356
Relative deviation compared to the diesel prices in Ukraine				
Romania	66%	70%	73%	80%
Poland	60%	64%	67%	74%

Note: Current prices are based on www.fuel-prices-europe.info, visited at the 2-07-2013. Impacts of CO_2 prices on fuel prices are calculated based on the tank-to-wheel CO_2 content of diesel.

The competitiveness of EU filling stations for IWT and diesel trains may also be hampered by the inclusion of transport in the EU ETS. Compared to road transport the impact on competitiveness may be more severe, since in general the vessels' and trains' ranges are much larger than the driving range of road vehicles. However, as was also mentioned in Section 3.3.5, both modes are dependent on specific infrastructure that provides fewer options for making a detour to fill up outside the EU than is the case for road transport. Additionally, rail operators mostly use in-company filling stations and hence are less incentivized to look for other options. Finally, both types of transport mainly takes place within the EU and not between EU and non-EU countries.

In the literature several options to tackle the problem of tank tourism are mentioned:

- Keppens and Vereeck (2003) suggest that all outgoing transport should be forced to refuel before crossing borders. However, as also mentioned by ITS Leeds (2007), it is questionable whether such a requirement could be imposed; the free market may be harmed if EU citizens are required to fuel their vehicles at certain filling stations.
- Verhoef et al. (1997) propose (referring to road transport) to gradually decrease the amount of allowances required for fuel purchase 50 km from the border until the border is reached. However, it might also have several untoward effects: individuals would have an incentive to travel to the 50 km zone where more fuel could be obtained with less allowances, resulting in more vehicle kilometres; also, individuals residing within the area will benefit from cheaper transport fuels than a person residing outside the 50 km zone, raising an equity issue (ITS Leeds, 2007). Additionally, the free market of filling stations may be harmed due to the fact that different requirements hold for fuel sold at different filling stations.

3.4.4 Transaction cost

Transactions costs involve all costs related to implementing and operating the ETS in the built environment. They comprise of costs for ETS participants (participation costs, MRV, trading, management) and costs for governments in developing and operating the system (regulation costs, monitoring and enforcement costs and costs of the allocation of allowances).

The total transaction costs of the system depend to a large degree on the number of entities, since both governments and entities have fixed costs (i.e. costs that do not depend on the amount of entities). These costs are the costs of opening a registry, establishing a monitoring plan, reporting and verification, etcetera. Next to these costs, there are costs which are related to the amount of emissions, such as the costs of trading. In the current ETS, fixed costs are the largest component and the transaction costs per unit of emissions decreases sharply with the amount of emissions (Heindl, 2012).

Since the number of tax warehouses for transport fuels is relatively limited (ca. 5,000 to 10,000 entities, see Section 3.2.3) and most of these tax warehouses represent a considerable amount of CO_2 emissions, the transaction costs for tax warehouse keepers are considered to be relatively low. This is strengthened by the fact that tax warehouses already have administrative systems for monitoring and reporting fuel flows; by using the same systems in the inclusion variants, the transaction costs could be minimalized.

The different allocation approaches applied in the two inclusion variants may result in different transaction costs. The ‘allowance allocation specific’ transaction cost in case of auctioning are mainly related to the provision of an auctioning platform (for governments) and participating in the auctioning (for regulated entities) (see Annex C.3.3 for more details). Particularly the costs of providing an auctioning platform could be very limited, since the ones that have been assigned under the current ETS (currently EEX and ICE Future Europe) could be used for transport as well. In case a fuel benchmark is applied, the transaction costs related to the allocation of allowances are mainly related to determining the benchmark and the number of allowances to be allocated to the various entities (for governments) and reporting on historic fuel flows and application for free allowances (for regulated entities).
Since tax warehouse keepers already monitor and register the fuel flows, particularly the gathering of data on historic fuel flows and hence the

determination of the benchmark allocation have relatively low transaction costs.

The transaction costs are likely to be rather similar for both inclusion variants, i.e., they are expected to be relatively small for both, although somewhat higher in the case of a fuel benchmark because the data on historic fuel flows have to be reported and verified.

3.4.5 Equity: impacts on disposable incomes

The inclusion of transport in EU ETS will probably have a (small) negative impact on the disposable incomes of final consumers (see also Section 3.4.9). Moreover, it may also affect the income distribution of consumers. The sign (whether it is regressive or progressive[14]) and size of this impact, however, differs widely between countries/regions and depends strongly on national/regional characteristics like urbanisation rate, quality of public transport infrastructure and existing vehicle taxation regimes. In countries/ regions with high urbanisation rates, a good-quality public transport infrastructure and/or high initial vehicle taxes, owning a passenger car could be considered more like a luxury good, while in countries/regions with low urbanisation rates, poor public transport and/or low initial vehicle taxes the ownership of a passenger cars is considered more like a basic good.
The average income level of car owners will probably be higher in the former case and hence the impact on the inclusion of transport in EU ETS will be more progressive in these countries/regions than in the countries/regions in the latter case.

Although both inclusion variants for transport probably have comparable direct impacts on the income distribution of consumers, there is one important difference between both variants: in the auctioning variant, governments collect revenues which could be used to (partly) correct for unwanted income distribution impacts; when allowances are allocated for free and hence the governments do have less opportunities to compensate vehicle owners for the increased costs of transport.

3.4.6 Equity: equal treatment of regulated entities

In order to have an ETS that provides equity over time, between comparable actors within the system, the system should be designed in such a way that:

- an early mover disadvantage should be avoided, i.e. that the adoption of a reduction measure that takes place under the regulation should not be rewarded stronger than the adoption of such a measure before the regulation entered into force;
- the terms at which a newcomer can enter the market does not differ from the terms that hold for a comparable established market participant.

Early movers are both rewarded if allowances are auctioned or if allowances are allocated for free based on a fuel benchmark. Under auctioning, the early mover has to buy less allowances at the auction than the other actors in the market. Under a fuel benchmark approach, the early mover has to buy less allowances on top of the allowances that are allocated for free than the other actors in the market or could even sell some of the allowances received for

[14] Regressive refers to the situation that the inclusion of transport in the EU ETS imposes a heavier burden on low-income households than on high-income households. Progressive, on the other hand, refers to the reversed situation: the inclusion of transport in the ETS results in larger negative impacts on het incomes of high-income households than on low-income households.

free. Therefore, in both inclusion variants there is no risk on 'punishing' early movers.

With respect to the treatment of newcomers, both inclusion variants could be argued to differ somewhat. Under auctioning an incumbent and a newcomer are treated the same way in the sense that both can participate on equal terms in an auction, at least if the auctioning is carried out periodically. However, if allowances are allocated based on a fuel benchmark, newcomers run the risk that insufficient free allowances are available from the New Entrants Reserve (NER). However, also for the current system uses free allocation to incumbents in combination with an NER for newcomers, i.e. this is currently not seen as unequal treatments.[15] The risk on unequal treatment of newcomers and incumbents is therefore not considered significantly different across inclusion variants.

3.4.7 Potential for windfall profits

The two inclusion variant for transport significantly differ in the potential for windfall profits. Since windfall profits could only be realised in case the emission allowances are allocated for free to the regulated entities (only then there are opportunity costs regulated entities could pass on to final consumers), there will be no windfall profits in inclusion variant 1a (in which auctioning is applied as allowance allocation method). In variant 1b, in which a fuel benchmark is used as allowance allocation method, there is a potential for windfall profits. The extent to which windfall profits are actually realised depends the competition from outside the EU, on the elasticity of the demand and supply curve and on the market structure. Since there is no foreign competition and because the market is competitive, windfall profits are likely to occur.

3.4.8 Impact on public finance

The inclusion of transport in EU ETS may have some consequences for the national government revenues. In case of inclusion variant 1a the auctioning of allowances may provide the governments with revenues which they could use to finance the operational costs of the scheme, to reduce other transport taxes (to compensate transport users), to invest in CO_2 mitigation measures or to fund the general accounts.

Additionally, in both inclusion variants there may be an impact on other tax revenues. First, governments may eliminate or reduce existing fuel or carbon taxes to avoid doubling financial burdens on the sector.

Secondly, revenues from excise duties may decrease for various reasons; vehicle owners (who are indirectly stimulated by the inclusion of transport in ETS by an increase in fuel prices) may increase the fuel-efficiency of their transport behaviour (e.g. more fuel efficient vehicles, increased logistical efficiency), reducing fuel sales and the associated tax revenues. Additionally, changes in the fuel mix may affect excise duty revenues, in case the excise duty rates differ on the various types of fuels. Since the CO_2 emissions per kilometre are in general lower for diesel vehicles than for petrol vehicles the

[15] It must be noted here that 'equal treatment' does not necessarily mean using the same allocation approach for incumbents and newcomers. The latter can take into account the costs of the ETS into account when making their investment decision, i.e. by choosing a less carbon-intensive alternative. This is an advantage that incumbents do not have, imposing addition costs related to having to retrofit existing installations or practices. From this perspective, new entrants having to buy their allowances while incumbents receive theirs for free is also considered in line with the 'equal treatment' requirement of the EU ETS.

costs per kilometre will increase more for the latter vehicles in case transport is included in EU ETS and hence a (modest) shift from petrol to diesel vehicles may be expected. Since in general the current taxes on diesel are lower than the ones on petrol, this shift will result in lower tax revenues. Finally, a (modest) shift from road transport to rail or IWT may be expected, since the CO_2 emissions per tonne or passenger kilometre are lower for the latter modes. Also this transport effect results in a reduction in fuel tax revenues.

So, overall a net decrease in fuel tax revenues can be expected. We do not expect the allocation method applied to have an impact on the likelihood and size of these impacts. Overall, the impact on other tax revenues is expected to be more or less comparable for both inclusion variants.

3.4.9 Impact on incomes/profits

The costs of the inclusion of transport in the EU ETS (costs of implementing reduction technologies and/or costs of buying allowances) may result in lower profits of a higher share of income spent on transport for some of the actors in the fuel supply chain.

The impact on disposable income or profits also depends on the allowance allocation method applied and hence may differ between the two inclusion variants for transport. These impacts may be expected to be larger under auctioning than under free allocation, since only in the former variant the actors have to pay for the initial allocated allowances. However, it should be mentioned that in case of auctioning, the national governments could decide to use the auctioning revenues to compensate the various actors affected by the EU ETS.

Note that in this section we discussed the impacts of the allocation approach on the total profit/income levels. The impacts on the income levels of specific groups of actors may be different as discussed in Section 3.4.5.

3.4.10 Impact on concentration in the carbon market

The inclusion of transport in the EU ETS would increase the coverage of the scheme by about 45% (from ca. 2,000 Mt to 2,900 Mt, see Section 3.2.1). The actors on the transport market therefore potentially have a big impact on the market for allowances.

The number of regulated entities in case tax warehouse keepers are appointed as regulated entities (as is the case in both inclusion variants) is relatively large (5,000–10,000 entities), reducing the market power of individual entities. However, it should be noticed that some large oil companies may own a significant number of the tax warehouses, as a consequence of which these oil companies have a significant share on the market for CO_2 allowances. For example, Shell would probably possess about 3% of the upstream allowances in case transport would be included in the EU ETS and all fuels provided by Shell would pass their 'own' tax warehouses.[16] Although this is a significant market share, no risk on market concentration is expected.

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[16] The total refinery capacity in the EU is about 15,200 thousand barrels a day (BP, 2012). The refinery capacity of Shell is about 1,710 thousand barrels a day, which is ca. 11% of the total EU refinery capacity. In case transport is included in the EU ETS, the transport sector will be responsible for about 30% of the GHG emissions covered. This implies that Shell would require ca. 3% of the allowances (in case all their fuels pass their own tax warehouses).

3.5 Evaluation of technical feasibility of inclusion

3.5.1 Introduction

In this section we evaluate the technical feasibility of both transport inclusion variants. The following issues are considered: definition of installation boundaries, monitoring accuracy, feasibility of allocation and sensitivity for fraud.

3.5.2 Definition of installation boundaries

In general, the transport fuel-related CO_2 emissions covered by a specific tax warehouse keeper could be well defined. Since almost all transport fuels pass a tax warehouse, the amount and type of fuels consumed for transport are monitored and registered at this level. Also, with the exception of natural gas, all imported and exported transport fuels have to pass a tax warehouse, indicating that no additional monitoring system (next to the EMCS) should be realised for these flows. Therefore, in both inclusion variants there will not be large problems with defining clear boundaries.

From the transport fuels natural gas is the only one currently not required to pass a tax warehouse. Therefore, an alternative approach should be considered for this fuel. The most straightforward approach would be to appoint natural gas suppliers as the regulated entity, which will particularly be a feasible option as they are also appointed as regulated entity for a possible inclusion of the built environment in the EU ETS (see Section 2.4.1).
Another option may be to exclude the transport fuel natural gas from inclusion in the EU ETS. Since the market share of natural gas for transport fuels is currently very low[17], the coverage of the scheme would only marginally decline. However, this is likely to stimulate a shift from the fuels covered by the ETS to natural gas, which would results in carbon leakage and therefore reduced environmental effectiveness of the system. A third option would be to include gas in the tax warehouse system.

In many EU Member States (e.g. Denmark, France, Germany, the Netherlands, Sweden, see also Annex C.2.4) the type and amount of biofuels blended to the fuels is registered and hence the biofuel content (and in the future potentially quality) could be taken into account by the tax warehouse keeper. It is not clear in which countries these type of data are currently not registered. However, it seems quite feasible for the tax warehouse keepers in these countries to gather these kind of data as well.

Currently, not all tax warehouse keepers are able to distinguish to which transport mode fuels are delivered. However, since many tax warehouse keepers act also as excise duty points and since at these levels in many Member States different fuel tax rates are applied for road, rail and IWT transport (and also for agricultural and construction vehicles), it should be technically feasible to made this distinction at every tax warehouse. However, this may require an extension of the monitoring and reporting obligations set for tax warehouse keepers. A distinction between passenger and freight transport is not possible at the level of a tax warehouse, since at least for road transport no separate tank infrastructure exist for these two subsectors.

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17 Responsible for about 0.7% of the CO_2 emissions related to the burning of transport fuels, see Section 3.2.1.

The relevant monitoring elements per entity are:

- Identification of all regulated entities. How does the emissions authority know that all entities that fall under the system are indeed covered.
- Basis for activity data.
- Identification of fuels used in the built environment: Can the regulated entity differentiate between end-use in the built environment and end-use elsewhere?
- Use of emission factors.
- Possible trade between entities or between end-users: Trade between entities could lead to double counting (for example sale from one coal supplier to another coal supplier can result in monitoring the same fuels twice).
- Monitoring of import and export.

For the tax warehouse keeper, the monitoring requirements are:

- The regulated entity is the tax warehouse keeper.
- Identification of entities. The tax warehouse keepers are defined in the ETD Directive and each Member State keeps a registration of these entities and the type of fuels they trade. Therefore, the chances of not identifying all the tax warehouse keepers and ensuring their coverage in the system are very small.
- Basis for activity data. The tax warehouse keeper will invoice fuel volumes supplied to the market, including excise duty and will keep an administration of invoices and excise duty for taxation purposes. This is an important condition for establishing accurate monitoring for ETS purposes, as well as for the allocation in case benchmarking is used. Because of the value of these excise duties and the fiscal requirements this administration will be subject to financial assurance and other checks required by the tax authorities.
- Identification of fuels. The tax warehouse keepers' records will include type of fuel, volumes and taxation tariffs used. Some countries use the same tariff for fuels used for heating purposes and fuels used in other sectors. In these countries the excise duty administration might not be sufficient to distinguish between fuel use in the built environment and fuel use elsewhere (see also Section 4.5.5 definition of boundaries) and additional measures will have to be taken to include fuel use in the excise duty administration for the purpose of the ETS.
- Use of emission factors. Most oil products for heating purposes are commercial products with a specified calorific value and carbon content. Similar to the current ETS, standardized emission factors can be applied. If non-standard products are sold, applicable MRR[18] rules can be used to determine the emission factor.
- Trade between entities. Trade between entities is monitored through the tax warehouse system, which is implemented to separate supply to the market for consumption (when excise duty becomes chargeable), and trade between suppliers, import and export (when excise duty is not chargeable yet).
- Import and export. Movement of goods between Member States is monitored by the tax warehouse keepers through the EMCS (Excise Movement and Control System). This makes it possible to exclude exported fuels from supply to the market and include imported fuels to the fuels supplied to the market for consumption.

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[18] Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions.

3.5.3 Monitoring accuracy

The amount of CO_2 emissions ultimately released from burning transport fuels can be calculated by multiplying the total amount of transport fuels leaving the tax warehouse with (average) emission factors for the respective fuel type because the emission factors of transport fuels doe not vary much. Accurately monitoring the CO_2 emissions thus only requires accurate data on the amount and type of fuels released from tax warehouses to the vehicle owners (via fuel suppliers and filling stations). As was argued in the previous section, this kind of data (including the type and amount of biofuels blended) is registered at tax warehouses and hence could be monitored quite accurately.

3.5.4 Feasibility of allocation

The feasibility of allocation depends on the system of allocation. For auctioning, it mainly relates to whether the entities have the capacity to participate in an auction. For the fuel benchmark, the feasibility depends on whether entities have accurate information about the amount of fuels sold in a historic year.

Participation in auctioning for most of the regulated entities will not be an issue, as most of them a large companies, used to deal with complex regulations. Moreover, entities would have the possibility not to buy allowances at the auction but rather on the secondary market, or to use an intermediary to acquire allowances.

In case of a fuel benchmark, the data requirement is restricted to historic data on the amount of fuel (in MJ) supplied to end-users in the transport sector. For tax warehouse keepers, fuel volumes are easily available from the excise duty system, therefore no problem exists for this regulated entity. Only for natural gas additional data collection may be needed in countries where it is exempt from energy taxes.

It is expected that there will be no (large) issues with respect to the feasibility of the (harmonized) allocation methods applied in the two inclusion variants. Both methods are – to some extent – already applied in the current ETS and hence extending them to the transport sector seems quite well feasible.

3.5.5 Sensitivity for fraud

The main risks of fraud are related to declaring false quantities of fuel sales or false shares of biofuels. The former risk is considered to be minimal, as tax warehouse keepers have to comply with strict reporting rules for fiscal purposes. The risk of declaring higher shares of biofuels is restricted by provisions of the fuel quality directive and the renewable energy directive which require monitoring and reporting of mass balances of biofuels.

The risk of fraud would increase if certain subsectors of using transport fuels would be exempted, such as agricultural vehicles or non road mobile machinery. This would open up the opportunity for vehicles which emissions are accounted for in the ETS to use transport fuels that are meant for vehicles not included in the ETS, in this way evading the scheme. The same option for fraud currently also exist for the excise duty on transport fuels, since in many EU Member States a reduced tax rate for agricultural and/or construction vehicles are applied[19]. Therefore the same monitoring and enforcement schemes used for excise duties could be used for ETS.

3.6 Evaluation of legislative efficiency

In the European Union a wide variety of directives/regulations in the transport sector have already been implemented. This can have implications when transport is included in ETS, since there may be different interactions between this inclusion and the other (proposed) directives. In Section 3.6.1 these interactions are discussed and next it is discussed whether changes in the legislative framework of the current ETS or in other transport related directives are required to effectively include transport in ETS. Finally, we discuss the EU competence with respect to addressing the CO_2 emissions of transport by including transport in ETS.

In the remainder of this section we focus on four important transport Directives:
- The Fuel Quality Directive (FQD);
- Renewable Energy Directive (RED);
- CO_2 and Cars Regulation and CO_2 and Vans Regulation;
- Energy Taxation Directive (ETD), including proposed amendment.

If relevant also other directives/regulations will be briefly discussed, e.g. the Mannheim convention for IWT.

3.6.1 Interaction with other legislative frameworks

In this section we discuss the potential interactions between the inclusion of transport in ETS and other transport related directives. The overlap and differences in scope between them are discussed. Additionally, it is investigated whether the inclusion of transport in ETS and the various directives reinforce each other (e.g. by addressing different market barriers for more sustainable transport) or just hamper each others' effectiveness.

In the remainder of this section we first discuss the impact of other transport related directives on the environmental effectiveness of the inclusion of transport in ETS and vice versa. Next, the more practical interactions (e.g. potential overlap in data to be monitored by ETS and other directives) are discussed.

Environmental effectiveness

Fuel Quality Directive

The FQD covers Well-To-Wheel (WTW) emissions from supplied transport fuels and aims to reduce these emissions on average by 6% by 2020 as compared to 2010 levels; i.e. the FQD aims to reduce the carbon content of supplied fuels. Part of these WTW emissions (mainly the emissions from refining and processing the fuels) are already covered by the existing ETS. Including the emissions from transport in the current ETS would further increase the overlap between the ETS and the FQD, in case allowances would be required for the TTW emissions from fuel combustion.

[19] E.g. according to EC (2013) the following EU Member States apply reduced rates for fuels in the agricultural sector: Belgium, Czech Republic, Denmark, Estonia, Greece, Spain, France, Ireland, Cyprus, Portugal, Slovenia, Finland, Sweden and the UK.

The inclusion of transport in ETS and the FQD are mainly complementary policy instruments. The FQD promotes two main reduction measures: increasing alternative (low GHG intensity) fuel supply (mainly biofuels) and reducing venting and flaring at production sites. The former option is also incentivized by the inclusion of transport in ETS, but as was argued in Section 3.2.3, increasing the biofuel content of fuels is a relatively expensive reduction option and hence it may be expected that it will not be significantly incentivized by the inclusion of transport in ETS. The other way around, the inclusion of transport in ETS stimulates options like fuel efficient vehicles, increasing transport efficiency and curbing transport demand, all options that are not incentivized by the FQD. However, the FQD does indirectly interact with the ETS, since it may contribute to lower costs of meeting the CO_2 cap in the ETS by obliging a 6% reduction in the carbon content of supplied fuels, the number of allowances needed in the transport sector decreases and hence also the abatement costs decreases.

Renewable Energy Directive

The RED does not directly cover the CO_2 emissions from transport, but does do so indirectly by regulating the share of renewable energy in the total energy consumption of transport. The RED requires that 10% of the energy consumed in transport comes from renewable sources by 2020. This target will have to be met by increasing the supply/consumption of biofuels and by increasing (renewable) electricity consumption in transport (e.g. Member States may promote electric vehicles).

As for the FQD, there is a theoretical overlap between the RED and the inclusion of transport in ETS, since also the latter policy instrument stimulates the uptake of biofuels. However, because of the rather high abatement costs of biofuels, it is not expected that this CO_2 reduction option is effectively stimulated by the ETS scheme. Therefore, the RED will be complementary to the inclusion of transport in ETS. The other way around, the ETS may stimulate abatement options that are not incentivized by the RED, like fuel-efficient vehicles and increasing transport efficiency.

As for the FQD, the RED may indirectly interact with the ETS scheme, as it stimulates the production and supply of biofuels, which reduces the number of allowances needed, and thus reduces the overall costs of the ETS.

CO_2 and Cars Regulation and CO_2 and Vans Regulation

As was the case for the FQD and RED, the CO_2 and Cars Regulation and the inclusion of transport in ETS are mainly complementary policy options.
The CO_2 and Cars Regulation obligates manufacturers to reduce the average emission factor of their new passenger car fleet (in g/km). In contrast to economic instruments like ETS, this obligation overcomes barriers like consumer myopia and limited knowledge on fuel-efficient vehicles which may hamper the purchase of fuel-efficient vehicles (see Section 3.2.5). The other way around, economic instruments like ETS may (partly) solve rebound effects of CO_2 regulation for vehicles; since vehicles become more fuel-efficient thanks to the CO_2 and Cars Regulation, the usage costs of these vehicles are lowered as well, which may incentivize people to travel more. In the end, this may result in an increase in the number of kilometres driven per car.
This rebound effect may be significant (about 18 to 44% of the first order impact of the fuel efficiency improvement), as was shown by TNO et al. (2011), and hence may significantly reduce the effectiveness of the CO_2 and Cars Regulation. By including transport in the EU ETS a price is charged for every additional kilometre driven and hence the rebound effect may be reduced or even be eliminated.

Although the CO_2 and Cars Regulation and the ETS are mainly complementary policy options, indirectly they may also strengthen each other. By obligating the supply of more fuel efficient vehicles, the CO_2 and Cars Regulation reduces the number of allowances needed for transport in the ETS. Therefore, the CO_2 and Cars Regulation will reduce the costs of the ETS and strengthen the likelihood that targets are met. The other way around, the inclusion of transport in the ETS may (at least in theoretical terms) also strengthen the likelihood that the targets of the CO_2 and Cars Regulation are met. Vehicle owners are provided an incentive to buy more fuel efficient vehicles and this demand effect will increase the likelihood that manufacturers meet the targets set in the CO_2 and Cars Regulation.

All interactions between the ETS and the CO_2 and Vans Regulation are similar as they are for the CO_2 and Cars Regulation.

Energy Taxation Directive

The ETD sets minimum tax rates for all energy products in the EU, including motor fuels. In 2011 a revision proposal was published (COM/2011/169) aiming to restructure the way energy products are taxed by taking into account both their CO_2 emissions and energy content. Existing energy taxes would be split into two components (CO_2 and energy content) that, taken together, would determine the overall rate at which the product is taxed. This proposal was rejected by the European Parliament in April 2012, but discussions on amending the proposal are ongoing.

The ETD (particularly the proposed amendment of the ETD) and the inclusion of transport in ETS highly overlap with respect to the abatement options stimulated. Both instruments provide – in the end – vehicle owners a generic price incentive to reduce the CO_2 impact of their mobility behaviour. Both instruments do also address the same market barriers and their effectiveness is hampered by the same market barriers (e.g. consumer myopia, lack of knowledge of consumers) as well.

Mannheim Convention

At present Belgium, Germany, France, The Netherlands and Switzerland, which are member states of the Central Commission for Navigation on the Rhine, have agreed in a supplementary protocol of the Mannheim Convention not to levy any charge/duty solely based on navigation on vessels or their cargoes on the Rhine or its tributaries. Depending on whether the ETS can be considered to be a charge or a duty as meant in the Mannheim Convention, inclusion of IWT in the EU ETS may or may not require amendments to the Convention[20].

Conclusion

In sum, each of the investigated transport Directives will interact with the ETS if transport is included, at least to some extent. In general it seems unlikely that these regulations will stimulate opposing measures, rather, the FQD, RED and CO_2 and Cars Directive incentivize complementary measures and hence address other market barriers; combining these measures with the inclusion of transport in ETS may increase the effectiveness of CO_2 policy for transport. ETS and the (proposed amendment of the) ETD, on the other hand, are largely comparable policy instruments, aiming to realise comparable policy goals by addressing the same market barriers. For inland waterway transport, and only

20 Note that the ETS is not a tax, amongst others because the price of allowances is established on a market, and not by the government (ECJ, Case C-366/10, 21-12-2011), and the fact that allowances are tradable (Bartels, 2012). However, depending on the context, charges and duties may also be different from taxes.

on the Rhine and its tributaries, the compatibility of ETS with the Mannheim Convention requires further legal analysis.

Practical interactions

With respect to practical interactions both inclusion variants mainly overlap with the FQD and (to a lesser extent) the RED. In the FQD countries are stimulated to appoint the tax warehouse keeper as regulated entity, which may result in practical efficiencies like clearly defined boundaries for the regulated entity and monitoring and reporting systems that could be used for both policies. With respect to the latter, according to the FQD regulated entities are obliged to report on the total amount of fuels processed/stored, which is also very useful information for the inclusion of transport in ETS. Additionally, the definition and calculation method of GHG savings from biofuels as presented in the FQD could be useful for an extended ETS. However, it should be mentioned that the FQD considers life-cycle emissions, while the current EU ETS only considers direct emissions.

As shown in Annex C.2.5, the tax warehouse keeper is only occasionally appointed as regulated entity for the RED by the Member States. Therefore, the practical interactions between the RED and the inclusion variants for transport are less numerous as for the FQD. Moreover, since the data requirements of the RED and the FQD largely overlap, the additional value of the RED to the FQD with respect to practical efficiencies is limited.

The CO_2 and Cars Directive appoints the car manufactures as regulated entities and hence there are no practical interactions between this Directive and the transport inclusion variants.

Finally, tax warehouse keepers are often the regulated entity with respect to charging the (minimal) excise duty rates as required in the ETD. A lot of practical interactions between the ETD and the transport inclusion variants are therefore available, as is discussed in detail in Annex C.4 and Section 3.5.

3.6.2 Required legislative changes

For inland waterway transport, and only on the Rhine and its tributaries, the compatibility of ETS with the Mannheim Convention requires further legal analysis.

The proposed amendment of the ETD also contain some legislative issues that should be considered:

- In the proposal for amendment of the ETD it is mentioned that CO_2 emissions that are covered by the EU ETS are exempted from the CO_2 element of the energy taxation. This means that transport could not be included in the EU ETS if the revised ETD is adopted.
- The current ETD provides the opportunity of a zero tax rate on fuels used for agricultural vehicles. However, in the proposal for amendment of the ETD it is mentioned that a zero tax rate for these vehicles is not longer justifiable by objective reasons and that this option should be abolished. In this light also the exemption of agricultural (and construction) vehicles in both transport inclusion variants should be reconsidered.

3.6.3 EU competence

The transport market is an international one and hence EU wide harmonisation of CO_2 policies for transport is useful. Since many transport related EU Directives (e.g. ETD, FQD, RED) are already in place, it seems that the EU is also competent to include transport in the EU ETS.

3.7 Enforcement and institutional setting

The compliance cycle consists of permitting, annual monitoring and reporting, checking compliance (including surrendering of emission allowances), applying sanctions (issuing of penalties, suspending permit and trading) and enforcement of the sanctions. For the current ETS each country has appointed a competent authority that approves the monitoring plan of an entity, issues an emissions permit and checks whether the entity is in compliance with reporting and surrendering obligations.

The existing competent authorities could also cover entities in the transport sector. In the current ETS the choice for the competent authority lies with the individual Member States. There is no reason to assume a separate authority would be worth the effort of establishing and maintaining a separate CA for this sector.

3.8 Conclusion

The analyses carried out in this chapter show that both transport inclusion variants could be implemented. Since the regulated entity in both inclusion variants – the tax warehouse keeper – is also used in most Member States for the operationalization of (almost all) excise duties on transport fuels, a monitoring scheme that could be used for the inclusion of transport in ETS is already available. Some minor monitoring issues may exist (e.g. not at all tax warehouses it will be possible to distinguish to which transport mode fuels are delivered), but arrangements to cover these issues could be relatively easy implemented.

For inclusion variant 1a (auctioning) no large negative economic impacts are expected. The risk on carbon leakage or negative competitiveness impacts is considered to be a small and the expected transaction costs are expected to relatively low. There may be some negative impacts on the aggregate income/profit levels and income distribution, but the auctioning revenues could be used to (partly) compensate for them. With respect to inclusion variant 1b (fuel benchmarking) the potential for windfall profits should be considered as a risk, comparable to that for sectors in the current ETS that receive free allocation.

Both inclusion variants are largely complementary to the current FQD, RED and CO_2 and Cars Directive. The FQD and RED stimulates the uptake of (sustainable) biofuels in transport, an expensive option that most probably will not be incentivized significantly by the inclusion of transport in the ETS. The CO_2 and Cars Directive mandates manufacturers to produce more fuel-efficient vehicles and in this way addresses market barriers like consumer myopia and lack of knowledge on fuel-efficiency of vehicles. These market barriers are not addressed by the inclusion of transport in ETS and combining ETS and CO_2 vehicle standards may therefore strengthen each other.

Both inclusion variants do have a large overlap with (particularly the proposed amendment of the) ETD. Both policy instruments address the same market barriers and stimulate the same abatement options.

There are no large legislative obstacles to implement both inclusion variants, with the possible exception of the Mannheim Convention, where its compatibility with the EU ETS requires a more detailed legal analysis.

4 Analysis of inclusion variants built environment

4.1 Introduction

The built environment could be included in the EU ETS through upstream coverage of tax warehouses (for liquid fuels) and fuel suppliers (for solid and gaseous fuels). These entities can distinguish between fuels used in the built environment and in other sectors, which entities more upstream the supply chain (e.g. extractors or importers of fuels) cannot. Yet, there are far fewer of these entities than of entities further downstream (e.g. end users) which reduces the administrative costs of the system.

For reasons of economic efficiency and in order to reduce administrative complexity, the allowances would preferably be auctioned. Note that the built environment does not have a risk of carbon leakage, as both the fuel costs are a very low share of total costs and the trade intensity is nil. Also risk of shifts to subsectors/entities not covered by ETS is considered to be small. Still, if it is deemed desirable to allocate free allowances to the sector, this chapter analyses a subvariant with allocates allowances on the basis of a fuel benchmark.

Table 24 presents the selected inclusion variants for the built environment.

Table 24 Selected inclusion variants for the built environment

Regulated entity	Allowance allocation method	Subsectors covered
Tax warehouse keeper (liquid fuels) or fuel supplier (gaseous and solid fuels)	Auctioning	Built environment
Tax warehouse keeper (liquid fuels) or fuel supplier (gaseous and solid fuels)	Fuel benchmark	Built environment

This chapter analyses the inclusion variants based on the criteria set out in Section 1.4. It starts by providing essential background information on the emissions in the built environment sector in Section 4.2. Section 4.3 analyses the environmental impacts in the built environment, focussing on the incentive to reduce emissions, the risk of carbon leakage, the incentive for innovation and the effect on awareness raising. Section 4.4 analyses the economic impacts for the ETS (transaction costs, windfall profits, risk of market concentration, treatment of new entrants and entities that have taken early action), for households (impacts on disposable incomes), and the fiscal impacts. Section 4.5 analyses the technical feasibility, including the monitoring accuracy, feasibility of allocation, definition of entity boundaries and the sensitivity for fraud. Section 4.6 analyses the interaction with other policies and policy instruments aimed at reducing emissions in the built environment as well as the legislative changes required in order to include the built environment in the EU ETS and the EU competence in the matter.
The short Section 4.7 analyses enforcement issues and Section 4.8 draws conclusions.

4.2 Overview of built environment emissions

4.2.1 Type of fuels used in the built environment

In the built environment direct CO_2 emissions mainly arise from the use of heating oil, natural gas and coal. In smaller amounts also LPG (propane, butane) is used in the built environment, either distributed with tank trucks or through the use of gas cylinders. For LPG there's also the pipeline option (especially used in Portugal[21]). In some rural areas, depending on local availability, also wood and peat are used for heating purposes.

For the purpose of this study we limited ourselves to the use of heating oil and LPG, natural gas and coal, for the purpose of heating, cooling and cooking, as these are these fuels are used the most in the built environment. We excluded the use of wood and peat as energy source, because the use of these products is small compared to the other types of fuels and, because the local markets on which they are traded, are difficult to control. However we have taken these fuels in to account if introduction of ETS for the other fuels in the built environment somehow influences the use of wood and peat (for instance when discussing possible leakage and system boundaries).
Electricity use in the built environment is not considered, since electricity production is already part of the current ETS.

4.2.2 Regional differences in Europe

When looking at reduction potentials in the built environment in Europe, it is important to realize that there are substantial regional differences.
For example, the average specific CO_2 emission in Europe is 54 kg CO_2/m^2 (per useful floor area), where the national values of kg CO_2 per floor space vary in the range from 15 kg CO_2/m^2 (Sweden) to 120 kg CO_2/m^2 (Ireland), (BPIE, 2011).
This means that countries have different reduction potentials and differ in the type of measures and incentives that are most effective. Within the 25 billion m^2 of buildings[22], shapes, sizes, styles, ages, fuels used, occupancy and location vary greatly.
Table 25 illustrates these differences. It provides an overview of the energy mix that can be found in different countries in the European Union for residential energy use.

[21] Lower Carbon Futures report: Appendix R, Environmental Change Institute et al., 2000.

[22] EU 27, together with Switzerland and Norway (Europe's Buildings Under the Microscope, BPIE, 2011).

Table 25 **Share of energy consumption in terms of final energy use in residential buildings with corresponding energy mix**

	Electricity	Heat	Gas	Oil	Coal/Coke /Lignite	Peat	Renewables	*of which biomass*	*of which solar thermal*
Austria	23,8%	13,6%	18,5%	18,5%	0,7%	0,0%	25,0%	*23,5%*	*1,5%*
Belgium	22,4%	0,2%	37,7%	35,1%	1,4%	0,0%	3,3%	*3,2%*	*0,1%*
Bulgaria	39,4%	15,1%	2,4%	1,1%	10,3%	0,0%	31,7%	*31,4%*	*0,3%*
Croatia	30,0%	7,9%	29,2%	11,8%	0,2%	0,0%	21,0%	*20,7%*	*0,3%*
Cyprus	48,1%	0,0%	0,0%	31,8%	0,0%	0,0%	20,1%	*2,3%*	*17,2%*
Czech Republic	20,7%	17,6%	34,0%	0,1%	8,7%	0,0%	18,9%	*18,8%*	*0,1%*
Denmark	19,9%	36,7%	14,4%	9,2%	0,0%	0,0%	19,9%	*19,6%*	*0,3%*
Estonia	17,7%	35,6%	5,6%	1,0%	1,3%	0,0%	39,0%	*39,0%*	*0,0%*
Finland	37,1%	29,5%	0,6%	8,2%	0,0%	0,2%	24,3%	*24,3%*	*0,0%*
France	34,6%	0,0%	30,5%	16,8%	0,5%	0,0%	17,6%	*17,4%*	*0,1%*
Germany	22,2%	7,4%	32,2%	22,9%	2,4%	0,0%	13,0%	*11,0%*	*1,0%*
Greece	27,8%	1,0%	6,4%	47,4%	0,1%	0,0%	17,3%	*14,0%*	*3,2%*
Hungary	17,6%	9,6%	53,7%	2,8%	3,1%	0,0%	13,2%	*13,1%*	*0,1%*
Ireland	26,1%	0,0%	20,8%	35,2%	10,9%	6,0%	1,1%	*0,8%*	*0,3%*
Italy	19,3%	1,8%	57,4%	9,8%	0,0%	0,0%	11,7%	*11,3%*	*0,3%*
Latvia	11,5%	26,9%	8,1%	4,0%	1,9%	0,1%	47,3%	*47,3%*	*0,0%*
Lithuania	14,7%	31,8%	9,5%	2,7%	4,5%	0,2%	36,5%	*36,5%*	*0,0%*
Luxembourg	17,1%	0,0%	44,0%	35,4%	0,0%	0,0%	3,5%	*3,3%*	*0,2%*
Malta	69,9%	0,0%	0,0%	28,8%	0,0%	0,0%	1,4%	*1,4%*	*0,0%*
Netherlands	20,9%	2,9%	72,1%	0,7%	0,0%	0,0%	3,4%	*3,1%*	*0,2%*
Poland	12,8%	22,0%	17,0%	3,5%	30,2%	0,0%	14,5%	*14,5%*	*0,0%*
Portugal	42,4%	0,2%	9,3%	21,1%	0,0%	0,0%	27,0%	*25,6%*	*1,5%*
Romania	12,7%	14,3%	29,7%	3,0%	0,2%	0,0%	40,2%	*40,0%*	*0,0%*
Slovakia	18,2%	21,6%	55,3%	0,3%	2,3%	0,0%	2,3%	*2,1%*	*0,2%*
Slovenia	23,5%	7,6%	9,6%	21,5%	0,0%	0,0%	37,7%	*35,4%*	*0,8%*
Spain	39,3%	0,0%	25,8%	17,8%	0,8%	0,0%	16,3%	*15,2%*	*1,0%*
Sweden	45,0%	36,0%	1,1%	0,7%	0,0%	0,0%	17,2%	*17,0%*	*0,2%*
United Kingdom	26,8%	0,1%	63,3%	7,1%	1,7%	0,0%	1,0%	*1,0%*	*0,0%*
EU28	**25,4%**	**7,4%**	**36,0%**	**13,7%**	**3,4%**	**0,1%**	**13,9%**	***13,2%***	***0,5%***

Bron: Eurostat.

Conclusion

Because of the differences in scope, assumptions and periods covered over the various studies, it is difficult to give an exact potential for emission reductions in the built environment, however all studies discussed here show there is a larger reduction potential than the reductions that are projected to be realised in 2030, taking current policies and trends into account.

It is important to realize there are substantial regional differences.
For instance in eastern Europe the transition from use of coal for heating purposes to other fuels is an important reduction option, which requires different incentives and actors, compared to improvement of building shells and installations, which are more important in other regions.

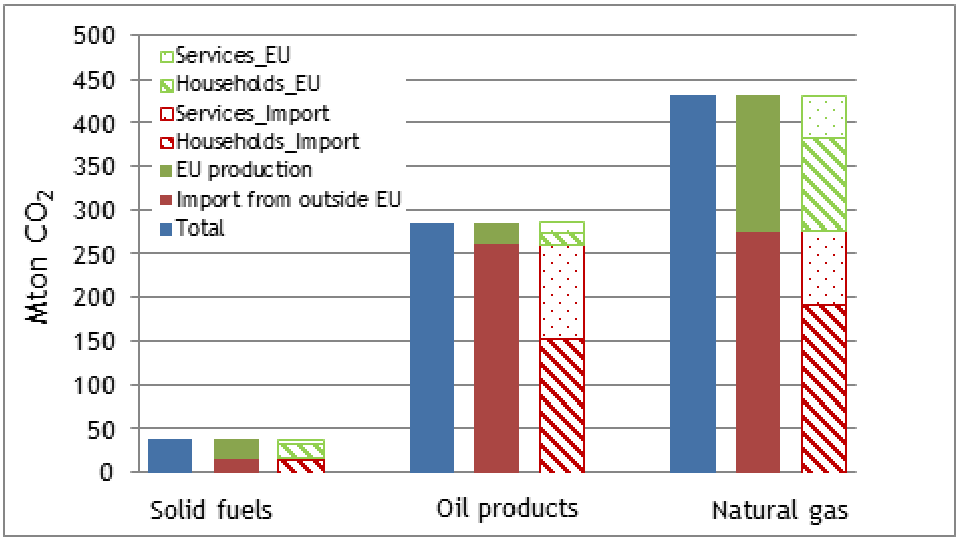
4.2.3 Amount of emissions

Direct CO_2 emissions for the built environment in the EU 27 amounted to approximately 751 million ton of CO_2 in 2010[23]. Direct CO_2 emissions result from the use of fossil fuels in this sector. Next to these direct CO_2 emissions the sector consumes electricity and heat resulting in indirect CO_2 emissions with the producers of electricity and heat. As (most) of these emissions are already covered by the EU ETS these are not further analysed in this report.

In 2010 65% of the direct CO_2 emissions was emitted by the residential sector and 35% by the service and agriculture sector (in the EU statistics no separate numbers are available for the service and agriculture sector). Figure 6 shows that 57% of the emissions result from the use of natural gas, 37% from the consumption of oil products and less than 5% from the consumption of solid fuels. Figure 6 also shows that almost 75% (the red bars) of the consumed fuels is imported from outside the EU.

Under the current scope of the EU ETS the cap is set at 2 billion allowances (2013 - excluding aviation), adding the built environment would increase the current ETS scope (excluding aviation) by about 37% (in volume of emissions covered).

Figure 6 Direct CO_2 emissions in the EU 27 for the built environment in 2010 split into emissions from solid fuels, oil products and natural gas



Source: Primes Reference Scenario, 2010.

4.2.4 Emissions trend

Figure 7 provides an overview of the expected development in direct CO_2 emissions according to the PRIMES baseline scenario for the built environment for 2020 and 2030. The figure shows that emissions are expected to drop substantially for the residential as well as the non-residential sector: 25% in 2020 (compared to 2010) and 35% in 2030 (compared to 2010), resulting in an reduction percentage (35% reduction in 20 years) of more than 2.2% per year. Emission reductions for the subsectors (residential, non-residential) separately follow the same trend. The baseline scenario includes all current trends and policies and results in an increase in energy efficiency and a further

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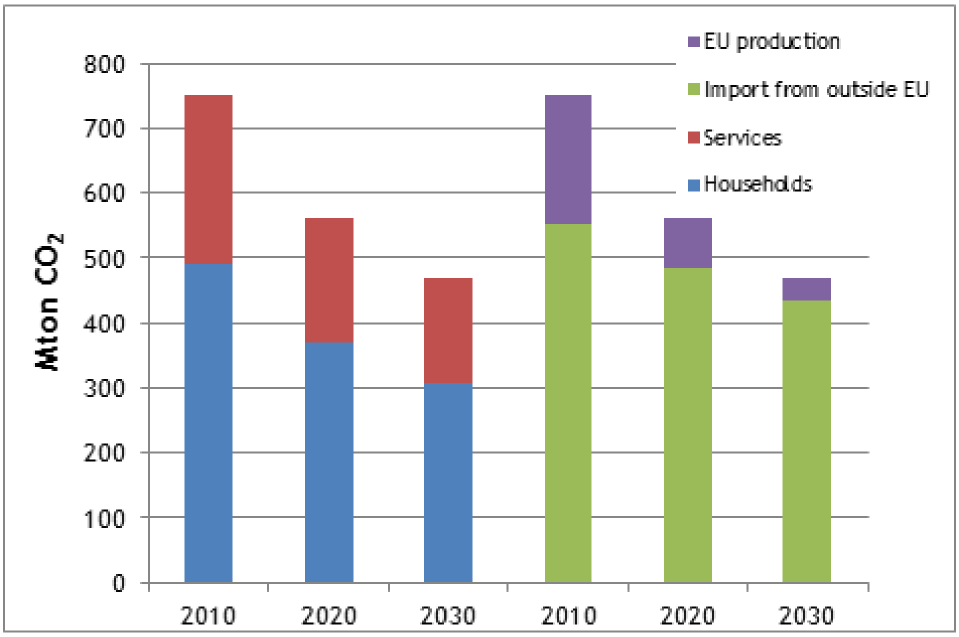
23 Primes, Ver. 4 Energy Model, EU 27: Reference scenario,; E3M Lab, National Technical University of Athens, 2010.

shift towards the use of less carbon intensive fuels. The figure furthermore shows that the share of fossil fuel imported from outside the EU is expected to increase.

The emission trend expected for the current ETS scope depends on the cap: for the current ETS (excluding aviation) the annual reduction is set at 1.74% until 2020, which is much lower than the projected emission reduction of 2.2% per year for the built environment, based on current trends and policies.

Figure 7 **Direct CO_2 emission in the EU 27 for the built environment in 2010, 2020 and 2030 split into emissions for households and the service sector (left) and emissions resulting from fuel produced in the EU and imported from outside the EU (right)**



Source: Primes Reference Scenario, 2010.

4.2.5 Regulated entities

There are between 5,000 and 10,000 tax warehouse keepers for energy products in the EU. Gas is being supplied to end-users by 1,650 companies. Extrapolation of information in two Member State indicates that there are about 4,000-8,000 suppliers of coal. Probably not all of these entities deliver fuels to the built environment, so we consider our estimate of the total number of regulated entities of 11,000 and 18,000 to be an upper bound.

More details are provided in Table 26.

Table 26 Numbers of potential regulated entities in the built environment

Regulated entity	Estimate	Basis for estimate	Source
Producers/importers (incl. processing)	500-1,000	About 310 producers of crude oil and natural gas 308 importers and producers of natural gas (partial overlap with the above) Number of importers of coal, crude oil, heating oil is unknown	– Eurostat structural business statistics – Eurostat natural gas market indicators
Transmission System Operators	~60		Energy markets in the European Union 2011
Suppliers and distributors of coal, natural gas, heating oil	Coal: 4,000 - 8,000 Gas: 1,638 Heating oil/ LPG: 10,000-20,000	Coal: exact numbers unknown, estimate based on extrapolation of information in two MS Gas: 1,638 (2011) Heating oil/ LPG: EU ~10,000 based on extrapolation of information in 10 MS	Coal: info from national excise duty contact s- Gas: Energy markets in the European Union 2011 Oil: Eurofuel (2013)
tax warehouse keepers for oil products	5,000–10,000	– Exact numbers unknown, estimate based on extrapolation information in one MS	FiFO (2005)
End-users (Owner or tenant)	200-300 million, of which 10-15 million non-residential entities	– 213,572,400 households in 2012 (EU 27 + HR) – 13,642,569 office buildings (2011)	Eurostat (2013) JRC (2011)

4.2.6 Availability of emission reduction measures

Type of measures

The built environment has a large number of measures available to reduce its direct CO_2 emissions. Table 27 provides an overview of the type of measures that are available. In principle the same type of measures can be applied in the residential and non-residential sector. The measures can be split into four categories:

1. Behavioural changes.
2. Improvements to the building shell resulting in reduction of energy losses through the shell.
3. Switching from high carbon to low or no-carbon fuels and energy sources (e.g. switching to renewable energy sources, and/or to electricity).
4. Improving the efficiency of existing conversion systems and introducing new, more efficient conversion systems.

Table 27 **Examples of emission reduction measures available in the residential and non-residential sector**

Category	Measure
1. Behavioural changes	Lowering indoor temperature
	Heating fewer rooms
2. Improving building shell	Roof insulation
	Ground floor insulation
	Wall insulation
	Improved glazing
3. Switching to low or no-carbon fuels and energy sources	From high carbon to low carbon fuels: e.g. from coal/oil to natural gas or to electricity
	From carbon to no carbon fuels: e.g. biogas, biofuels, solid biomass, geothermal
	Solar water heater
4. Improving efficiency of conversion systems	High efficient condensing boilers
	Ventilation system with heat recovery
	Heat pumps
	Seasonal storage of heat and cold
	(Micro) CHP[24]

Reduction potential

A large number of studies have been published estimating the emission reduction potential for the built environment. It must, however, be noted that reduction potentials between different studies are sometimes hard to compare because of differences in used background scenarios, discount rates, target year, implementation rate of measures and effectiveness of policies, etc.

For a summary of studies on reduction potential for the built environment see Table 28 and Annex D:

Table 28 **Summary of studies related to the emission reduction potential in the built environment**

Study	Period covered	Reduction potential	Comments
Ecofys, 2009	2005-2030	53%	Direct emissions Reductions compared to PRIMES baseline scenario
Fraunhofer, 2009	2004-2030	45% (residential)	Including electricity Reductions compared to a reference scenario including autonomous savings
	2004-2030	51% (non residential)	Idem
BPIE, 2011	2011-2020	16-35%	Including electricity Reduction compared to a baseline scenario
	2011-2050	71-90%	Idem
CE Delft, 2012	2011-2050	78 Mt (2°C scenario) 62 Mt (1°C scenario)	Behaviour measures only

24 N.B. this measure will increase fuel use in the sector but reduces overall emissions.

4.2.7 Cost of emission reduction

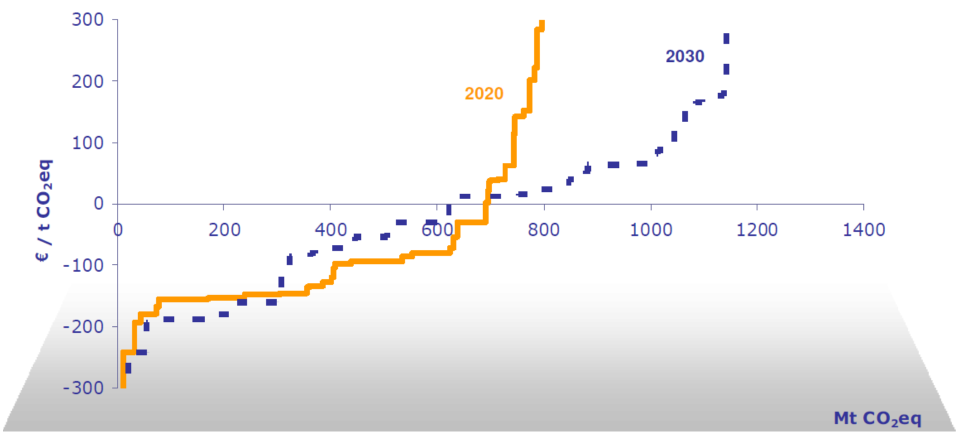
Estimates of costs of emission reductions are surrounded with substantial uncertainties. First the investments costs for improvement measures will vary depending on the type of building and the context of renovation (BPIE, 2012):

– if measures are installed as a package, they are likely to be individually cheaper and overall more effective than if they were installed individually;
– timing of the renovation may also influence the cost: if it is undertaken at the same time as maintenance measures, implementing a more energy efficient option may mean a marginal extra cost compared to a standard replacement.

Second, the calculated cost-effectiveness of measures is influenced by assumptions on: i) level of the energy costs; ii) lifetime of measures; iii) assumptions on the decrease of measure costs over time (learning effect); iv) applied discount rates.

Figure 8 provides an overall cost curve for the built environment in 2020 and 2030 from the Ecofys study. Note that this costs curve also includes measures related to savings on electricity. The figure shows that a large share of the reduction potential has negative costs. Measures with a high share in the identified reduction potential (wall insulation, roof insulation, ground insulation, glazing, improved regulation & heat distribution, high efficiency boiler) listed in Table 2 all have, in general, negative costs, but, as indicated, vary depending on the type of building, the context of renovation and other assumptions. In this study a social discount rate is used of 4%.

Figure 8 Abatement potential and specific cost of the underlying abatement options in the built environment sector in the EU 27 (residential and non-residential) in 2020 and 2030. The abatement potential is relative to the frozen technology reference scenario and the costs are calculated from a social perspective (discount rate 4%)



Source: Ecofys, 2009.

BPIE also concludes that reduction measures described in different renovation scenarios are costs-effective over the lifetime, using both societal discount rate (3%) and commercial discount rates (10% for households and business, 5% for the public sector). The calculated internal rate of return (IRR) is between 8%-10% (2020) and 10%-13% (2050) (BPIE, 2011).

Conclusion

In summary, different studies, using both societal and commercial discount rates, show that there is a substantial potential for cost effective emission reduction measures in the built environment.

4.2.8 Price elasticity

The extent to which entities within in built environment will actually implement emission reduction measures will amongst others depend on their sensitivity to respond to changes in fuel price. The (fuel) consumption responses that can be expected to result from (fuel) price increases can be explained with price elasticity's.

Madlener et al. (2011)[25] compared available studies on price and income elasticity's for gas demand in the residential sector (Table 29), showing price elasticity's ranging from -0.03 to -0.09 for the short term and from -0.10 to -0.19 for the long term.

Table 29 Overview of available studies on elasticity's for natural gas demand in the residential sector

Study	Country	Method	Data	Elasticity estimates	
				Income	Price
Asche *et al.* (2008)	12 EU countries	Shrinkage estimator*	Panel data (annual), 1978–2002	*L*: 3.32 *S*: 0.81	*L*: –0.10 *S*: –0.03
Berkhout *et al.* (2004)	Netherlands	Fixed effects	Panel data (annual), 1992–1999	*L*: –0.27	*L*: *–0.19*
Joutz *et al.* (2008)	US	Shrinkage estimator	Panel data (monthly), 1980–unclear	–	*L*: –0.18 *S*: –0.09

Notes: S and *L* denote estimates for the short and the long run, respectively. * Asche *et al.* (2008) also use fixed effects, random effects and OLS estimators, but the results appear to be rather implausible.

Source: Madlener et al., 2012.

The same study analysed the price elasticity of the residential natural gas demand for twelve OECD countries using available time series data from 1980 to 2008. For ten of the twelve countries they found an average *long-term* elasticity of –0.51 with regard to price and short-*term* price elasticity of on average –0.23. In the short run energy demand is more inelastic than in the long term, as end-users have fewer opportunities to reduce their demand in the short run than they have in the long run. The study found substantial difference between countries: the *long-run* elasticity ranged from –1.62 in Ireland and –0.14 in the Netherlands(the cause of these differences is not analysed in this study). No studies could be identified for the non-residential sector.

Madlener et al. (2011) also shows that short en long-run price elasticity in the built environment lie in the same range as the elasticities for the transport sector.

25 Reinhard Madlener, Ronald Bernstein, Miguel Ángel Alva González (2011) Econometric Estimation of Energy DemandElasticities. E.ON Energy Research Center Series. Volume 3, Issue 8, October 2011.

4.2.9 Barriers

The price elasticity for changes in the energy price is low in the built environment (a price elasticity between 0 and -1.00 is considered low).
An explanation for the low price elasticity is that several barriers are in place, which keep individual house owners and landlords from taking energy efficiency measures:

- *Split incentive*: in case of rented buildings, the landlord is the owner of the building and its installations and therefore responsible for the investment in most energy measures, but the benefit of such measures (a lower energy bill) lies with the tenant. In these cases the tenants feel the price signals but, not being the owner and with a contract for a limited lease period, is limited in its possibilities to act upon the signal. A study by the IEA on the so called split-incentive problem e.g. showed that 41% of the energy consumption for space heating for the residential as well as the non-residential sector in the Netherlands might be affected by the split-incentive problem (IEA, 2007)[26].
- *Disruptive measures*: when building is in use, installing energy measures (insulation, new glazing, new heating system) can be very disruptive for the occupants. This differs from, for instance, industrial installations, which, in many cases, are shut down at regular intervals for maintenance purposes.
- *Knowledge and awareness*. Knowledge of reduction options and awareness of many house owners regarding possible measures is still low.
- *Energy costs are low compared to other costs*. Especially for non-residential users, energy costs are relatively low compared to other costs (such as personnel costs). For these users, reduction of energy consumption usually has a low priority.

Because of these barriers, an increase in energy prices (either by introducing and energy tax or setting a cap on emissions that raise prices) will not in all case lead to implementation of energy savings measures that have a favourable payback time. In order to tackle these barriers other policy instruments will need to be implemented as well such as regulations (standards and/or permits) and information and awareness campaigns

Conclusion

Short en long-run price elasticity in the built environment lie in the same range as the elasticity's for the transport sector. Several barriers exist, such as the split incentive that keep individual house owners and landlords from taking energy efficiency measures.

4.3 Evaluation of environmental impacts

4.3.1 Introduction

This section evaluates design choices made in the selected inclusion variants against the various criteria related to the environmental impacts of including the built environment in the EU ETS.

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[26] IEA (2007) Mind the gap. Quantifying the Principal-Agent Problems in Energy Efficiency. OECD/IEA, Paris, 2007.

4.3.2 Incentive to reduce emissions

Incentives to reduce emissions are introduced through the regulated entity and through the allocation method.

Regulated entities differ in the number and type of possibilities they have to take reduction measures themselves. In addition to measures the regulated entities can implement themselves, the entities can pass on the costs of emission allowances further downstream, providing further (indirect) incentives for emission reductions to downstream actors.

Oil products – tax warehouse keeper

The tax warehouse keepers as regulated entity operate in a competitive market that is closely related to the market for transport fuels. In case of a competitive market, it may be expected that the additional costs are fully passed on to downstream users and setting a carbon price will mainly result in increase of the price of the products that the regulated entity will passed on to end-users. This will provide an incentive to those end users to reduce their direct CO_2 emissions, through efficiency measures and/or switch to low carbon fuels or biofuels. The tax warehouses have limited options to take direct emission reduction measures themselves. The only option these entities have to reduce emissions in the built environment is to supply higher blends of biofuels. However, the price differences between conventional fuels and biofuels are much higher than the current ETS prices and likely to remain higher in the short to medium term, making it more attractive for these entities to buy allowances than to supply higher biofuel blends.

Natural gas suppliers

As a direct measure, natural gas suppliers can reduce emissions in the built environment by increasing the share of biogas supplied to the end-user.
As an indirect measure the natural gas suppliers can pass on the costs of allowances by increasing the price of their product or service. Most natural gas suppliers will have a regional or national monopoly and operate in a regulated environment. This means that passing on the costs of allowances is not always possible or even allowed. Regulators should allow passing on (part of) the costs of allowances, otherwise implementation of emission trading will have no effect on the end-users. If costs can be passed on, this will result in a price signal to end-users in the built environment.

Coal suppliers

As a direct measure, coal suppliers can reduce emissions in the built environment by increasing the share of solid biomass products supplied that can replace coal in the sector (for instance wood pellets).
In a competitive market, it may be expected that the additional costs are fully passed on to downstream users by increasing the price of the product. This will result in a price signal for end-users in the built environment and an incentive to take reduction measures.

Conclusion

Regulated entities for oil and coal products operate in a competitive market and will pass on the cost of emission allowances by increasing the price of their product or service for the final consumers. This will be an incentive for end-users to take emission reduction measures and to increase demand for low carbon fuels. For these entities, the allocation methodology does not influence the incentive to reduce emissions, as full pass through of opportunity costs is assumed.

Natural gas suppliers often have a regional monopoly and operate in a regulated market. In such cases, passing on costs of allowances will depend on what the regulator will allow.

4.3.3 Risk of carbon leakage

This section analyses two types of carbon leakage.

Carbon leakage to outside EU

The ETS Directive uses a definition for carbon leakage to outside the EU related to a loss of competitiveness of ETS participants. The fuels that would be covered by the expanded system discussed here, are used within the EU. The regulated entities (tax warehouse keepers, fuel suppliers) operate within the European market and there is no risk for loss of competitiveness for these entities to outside the EU, as imported fuels are also covered by the proposed ETS system.

There is also a risk the customers of the regulated entities, the fuel end-users, would move to outside the EU. This risk is minimal because decisions on where to live or establish a company are taken on other grounds than the price of fuel alone. Fuel costs are only a small share of total costs for end-users and the relatively small increase in those total cost that would be incurred due to a carbon price is very unlikely to be a determining factor.

Leakage to sectors/entities or fuels not covered by the EU ETS

The following types of leakage could occur.

- Increased costs of fuels could lead to changes in the choice of fuels by end-users, moving to fuels not covered under the ETS. This is possible for solid fuels such as peat or (non-commercial) solid biomass products (wood, manure) replacing coal. For gas and liquid fuels this is less likely to happen. Coal use in the built environment is largest in Poland, Bulgaria, Ireland end the Czech Republic, either as hardcoal, as coke or as lignite.[27] Increased use of biomass products is an intended effect of the system and not considered as leakage. Increased use of peat is considered as leakage. We have excluded peat from this analysis, as it is used very locally and especially use in households will be difficult to control under the ETS, but this choice does lead to the possibility of leakage. Peat is mostly used in Ireland, Finland and the Baltic states.
- In case of the introduction of a minimum participation threshold (see Section 4.4.4 on transaction costs) for the fuel suppliers (in terms of the amount of fuel supplied to the built environment) could lead to growth of the number of small fuel suppliers that stay below the threshold and the amount of fuel supplied that is not covered by the system.

4.3.4 Effect on innovation

Implementation of ETS in the built environment will in general have a positive effect in the long run on innovation in the field of low-carbon technologies as these technologies will become more economically competitive due to the increase in the price of fossil fuels.

27 European Commission, 2011, The Market for Solid Fuels in the Community in 2009 and Estimates for 2010, SEC(2011) 679 final.

4.3.5 Effect on awareness raising

Oil products - tax warehouse keepers

Awareness raising in this option only takes place through the indirect carbon price effect. As the tax warehouse keeper is an administrative function, it is unlikely that it will take an active role in raising awareness. Some awareness can be created through explicitly adding carbon costs separately to the bills that end-users receive.

Suppliers of coal and natural gas

The coal and natural gas suppliers are in direct contact with their end-users, and have more possibilities to create awareness regarding the need and opportunities to reduce CO_2 emissions. Designating suppliers as regulated entities could be an incentive for them to become more active in their communication and services to create awareness for CO_2 emission reductions with their customers. Some awareness can be created through explicitly adding carbon costs to the bills that end-users will receive.

4.4 Evaluation of economic impacts

4.4.1 Introduction

This section evaluates the design choices made in the selected inclusion variants against the various criteria related to the economic impacts of including the built environment in the EU ETS. The economic criteria 'impact on allowance price' and 'price volatility' will be discussed in Chapter 6, because they are similar for all inclusion variants.

4.4.2 Impact on fuel prices

Most economic impacts on the sector result from increases in fuel prices. The retail fuel price increases depend on the allowance price and on the price of fuel. For gas and heating oil, the increase ranges from approximately 3% for an allowance price of € 10 to around 11% for an allowance price of € 40. Note, however, that these are increases over the average retail price in the EU and the situation may differ between Member State and between fuel suppliers in a Member State. Relatively cheap fuels will experience larger relative price increases than relatively more expensive fuels.

For coal, we do not have information on average EU retail prices. Based on information from three Member States, it is clear that coal price vary considerably. In some Member States the retail price of coal is three times as high as in other Member States. Here again, relatively cheap fuels will experience larger relative price increases than relatively more expensive fuels. Moreover, because coal is more carbon intensive and cheaper than other fuels, the price increase for coal is two to seven times as large as for gas and heating oil.

Table 30 provides an overview of retail prices and the impacts of inclusion in the EU ETS. For an overview of the use of the various fuels and energy sources (coal, oil, electricity biomass, district heating) in the built environment, see Section 4.2.2.

Table 30 Impacts of allowance prices on retail fuel prices

Fuel	Retail price (gas: €/kWh) (oil: €/litre) (coal: €/tonne)	Fuel Price with a carbon price of € 10/t CO_2	Fuel Price including with a carbon price of € 20/t CO_2	Fuel Price including with a carbon price of € 40/t CO_2
Natural gas	0.07	0.072 (+3%)	0.074 (+6%)	0.078 (+12%)
Heating oil	1.07	1.10 (+3%)	1.13 (+5%)	1.18 (+11%)
Coal (UK)	405	431 (+6%)	457 (+13%)	510 (+26%)
Coal (PL)	127	153 (+21%)	179 (+41%)	232 (+82%)
Coal (DE)	340	366 (+8%)	392 (+15%)	445 (+31%)

sources: European Commission, 2013: quarterly report on European Gas Markets, vol.6, issue 2, Brussels; www.energy.eu; National Statistics, 2013, Quarterly Energy Prices, September 2013; http://kfk-duisburg.de/kohle/preise-privatkunden/; http://gornictwo.wnp.pl/notowania/ceny_wegla_kw/.

4.4.3 Impacts on competitiveness

The fuels that would be covered by the system are used within the EU in the built environment. The regulated entities (tax warehouse keepers, fuel suppliers) operate within the European market and there is no risk for loss of competitiveness for these entities compared to suppliers from outside the EU, as imported fuels are also covered by the ETS.

Implementing emissions trading in the built environment has the intended effect that fuels with higher carbon intensity will have a disadvantage in the market, which can result in reduced market share for especially coal products.

Overall energy costs for the built environment will increase, which could have an effect on the competitiveness of the non-residential sector as a whole (service sector, retail), compared to other regions outside of the EU.
This effect is considered to be very limited because of the small share of energy costs in total operating costs in the non-residential sector. In addition, relocation will not be a very minor issue, as it is not possible for entities in buildings located outside the EU to provide the services locally in the EU (e.g. buildings used by governments, hospitals, universities, supermarkets, restaurants). For services where relocation is an option, many other considerations factor into such decisions than fuel costs alone.

4.4.4 Transaction cost

Transactions costs involve all costs related to implementing and operating the ETS in the built environment. They comprise of costs for ETS participants (registry costs, MRV, trading, management) and costs for governments in developing and operating the system (regulation costs, monitoring and enforcement costs and costs of the allocation of allowances).

The aggregate transaction costs for regulators have both a fixed component and a component that is depending on the number of entities. The fixed costs comprise regulatory costs, costs of maintaining a registry, costs of establishing an auctioning et cetera. The variable costs include enforcement costs and allocation costs.

The aggregate transaction costs of all entities in the system depend to a large degree on the number of entities, since each entity has a large share of fixed costs (i.e. costs that do not depend on the amount of emissions). These costs are the costs of opening a registry, establishing a monitoring plan, reporting and verification, etcetera. Next to these costs, entities have costs which are related to the amount of emissions, such as the costs of trading. In the current ETS, fixed costs are the largest component and the transaction costs per unit of emissions decreases sharply with the amount of emissions (Heindl, 2012).

Transaction costs have been an important argument for the choice of the regulated entities in this inclusion variant. There are fewer fuel suppliers and tax warehouse keepers than entities further downstream, while upstream entities, of which there may be fewer, cannot distinguish between use of fuels in the built environment and in other sectors.

However, the issue here is not the total transaction costs but rather the additional transaction costs of including the regulated entities in the EU ETS. Since some of these entities already have monitoring and reporting obligations, the additional costs may be lower than the total costs.
Below, we discuss the additional costs per type of entity.

Oil products - tax warehouse keepers
Additional transaction costs for the tax warehouse keepers will in most countries not include the costs of monitoring, and reporting could be built on the current reporting mechanisms used for tax purposes (Grayling et al., 2006). As a result, we expect the additional transaction costs to be modest in most countries.

Participants in some countries will face higher initial transaction costs, because existing excise duty tariffs will not always differentiate between fuel use in the built environment and fuel use elsewhere and additional administrative efforts might be required.

Due to the relatively large number of entities, additional transaction costs for governments will relatively high.

Natural gas suppliers
Additional transaction costs for participants will probably be relatively low. Implementation of the ETS can build upon existing monitoring systems that are operational by the natural gas suppliers (supply and billing administration). For the government, there are relatively few regulated entities which are well organised and already operating in a strictly regulated market, therefore, transaction costs for governments are expected to be relatively low.

Coal suppliers
Transaction costs for both government and participants will be relatively high compared to the other regulated entities for inclusion of the built environment. The market for coal products is less organised, involving many smaller players, with no experience in the current ETS and, in countries like France, UK and Poland, no experience with energy taxation. For the government this will mean more effort related to identifying the participants, oversight and enforcement. The participants will need to invest in monitoring and reporting systems.

Minimum participation threshold
In order to limit transaction costs it can be considered to introduce a minimum threshold to keep the smaller regulated entities out of the ETS, as was done for the sectors currently included in the EU ETS.
This is mainly relevant for coal as many smaller coal suppliers exist in the EU. Also, coal can be sold in packages through retailers such as filling stations. For natural gas and oil products a minimum threshold is not relevant as natural gas

is not distributed apart from the pipeline system and sale of LPG, butane propane in cylinders through filling stations are covered in the same way as all oil products when leaving the tax warehouse system.

However, introducing a minimum threshold for participation in the ETS will open a possibility for leakage as it would put smaller entities (below the threshold) at a competitive advantage which, given the potential cost increases due to inclusion in the ETS could be significant. This could result in entities splitting up into smaller ones in order to stay out of the system. It will also reduce the coverage somewhat, i.e. the environmental benefit of the system is reduced. Such considerations are also valid for sectors currently covered under the EU ETS. However, when the threshold for the regulated entity is defined in sales (or throughput) volume, as is the case here, instead of production capacity, splitting up the activity into smaller entities becomes very easy. Hence, a minimum threshold is not a recommended option in the built environment.

Aside from a minimum participation threshold the use of simplified MRV and simplified administrative procedures for small regulated entities can be considered in order to reduce transaction costs for these entities (monitoring is discussed in Section 4.5.2).

4.4.5 Equity: impacts on disposable incomes

Implementation of emissions trading will lead to an increase of the price of products and services supplied by the regulated entities and as such lead to higher energy costs (see Section 4.4.2). Eurostat statistics on consumption expenditure[28] show that energy expenditures rise with income, but as a share of disposable income, energy expenditures decline with higher incomes.

Currently, consumers in the EU spend on average 6% of their consumption expenditure on electricity, gas and other fuels, excluding transport fuels (detailed statistics on expenditures of gas and fuels are not available at an EU-level). On average, low income consumers spend a larger share than high income consumers: the lowest quintile spends over 7% on electricity, gas and other fuels; the top quintile less than 5%. This means that when fuel prices increase, it will have a regressive effect on incomes.

Introduction of emissions trading will add additional cost, that are fixed to the energy costs, and which are independent from income. This means that the implementation of emission trading will have a regressive impact on disposable income as the ETS costs will represent a larger share of the disposable income of low income households than of high income households.

This effect will be the largest for low-income groups that live in older houses with a bad energy performance. According to studies, carried out as part of the EPEE project[29], ‘fuel poverty’ is an issue for all European countries and between 50 and 125 million people are estimated to be affected in Europe. Fuel poverty is not a clearly defined term, but similar problems are noticed in many European countries: unpaid energy bills, diseases due to inadequate heating and self-disconnecting (households disconnecting from energy supply).

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28 Source Eurostat data on ‘Mean consumption expenditure by income quintile (in PPS)’ and ‘Structure of consumption expenditure by income quintile (COICOP level 2). Data for 2005.

29 European fuel poverty and energy efficiency project, a project financed under the Energy Intelligent Europe Program (2007–2009), www.fuel-poverty.org.

Many house-owners and tenants in low-income groups will not have the possibilities to act upon the carbon price effect, because of lack of money to invest or because of ownership, and will face higher energy costs due to the implementation of emission trading in the built environment.

Both allocation methods will add to the price effects and the impact on disposable income. Assuming that in both cases the regulated entities will try to pass on the costs of allowances, the effect on disposable income will be the same.

Table 31 shows the impacts on consumer expenditures of average EU consumers of gas and coal. Since the price increase for coal is larger than for gas, coal consumers face a larger increase in expenditures on energy. Although smaller in absolute terms, the impact is relatively larger for the bottom quintile of the income distribution.

Table 31 impacts of ETS on energy expenditures of consumers, EU 27 average

Income quintile	Expenditures on electricity, gas and fuels		Gas consumers, € 20/tonne CO_2		Coal consumers, € 20/tonne CO_2	
	€	Share of consumption expenditures	€	Share of consumption expenditures	€	Share of consumption expenditures
First quintile	1,006	7.1%	1,035	7.3%	1,121	7.9%
Second quintile	1,256	6.7%	1,292	6.9%	1,400	7.5%
Third quintile	1,407	6.1%	1,448	6.3%	1,568	6.8%
Fourth quintile	1,545	5.5%	1,590	5.7%	1,722	6.1%
Fifth quintile	1,768	4.5%	1,819	4.6%	1,971	5.0%

Note: It has been assumed that the costs for gas or coal are 50% of total energy costs. The price increase in coal assumed is the mean of the increase in Poland, the UK and Germany (see Section 4.4.2).

Source: Eurostat, data for 2005, calculation CE Delft.

The shares of expenditures on energy vary per Member State. In some, the share of expenditures is larger than 10%, which would roughly double the impacts shown in Table 31. This is the case in some Member States where coal has a major share in energy use for heating, augmenting the impact on expenditures.

4.4.6 Equity: equal treatment of regulated entities

This criterion deals with the treatment of entities that took early action (investment in emission reduction measures before inclusion into ETS).
In principle, early action should be rewarded and past inaction should not. Early movers are both rewarded if allowances are auctioned or if allowances are allocated for free based on a fuel benchmark.

- Auctioning: Any early action directly reduces the amount of allowances that needs to be bought. Hence early action is rewarded, providing a competitive edge.
- Under a fuel benchmark approach, the early mover has to buy fewer allowances on top of the allowances that are allocated for free than the other actors in the market or could even sell some of the allowances

received for free (depending on the level of the benchmark chosen). Therefore, in both inclusion variants there is no risk on 'punishing' early movers.

With respect to the treatment of newcomers, the allocation methods differ. Under auctioning an existing participant and a newcomer are treated the same way in the sense that both can participate on equal terms in an auction, at least if the auction is carried out periodically.
If allowances are allocated based on a fuel benchmark, newcomers can be allocated free allowances from a reserve for newcomers (New Entrants Reserve - NER). Because the NER can run out of allowances, new entrants run an additional risk compared to incumbents. The current ETS also uses free allocation to incumbents in combination with an NER for newcomers, but this is currently not seen as unequal treatment[30]. The additional risk for newcomers compared to incumbents is therefore not considered significantly different across inclusion variants.

It must be noted that the calculation of the amount of free allowances for new entrants in the built environment in the case of a fuel benchmark will be surrounded by significantly more uncertainty than in the case of the current ETS sectors. There is no 'standard capacity utilisation factor' that can be used for regulated entities in the built environment to derive activity levels from, to multiply with the benchmark to establish the total allocation. Only estimated sales (throughput) can be used instead, which are very uncertain.

4.4.7 Potential for windfall profits

Windfall profits can occur in situations where the regulated entity is able to pass on (a large part of) the carbon price down the supply chain as opportunity costs, while receiving allowances for free.

Auctioning

All entities have to buy their allowances either through auctioning or on the market, so there is no risk of windfall profits.

Fuel benchmark

Free allocation susceptible to windfall profits.
- Oil products – tax warehouse keeper: Markets for heating oil and LPG are competitive and closely related to transport fuels. In case of a competitive market, it may be expected that opportunity costs are fully passed on to downstream users therefore it is likely that suppliers will try to include the value of the allowances in the marginal costs. The extent by which windfall profits can actually be realised is discussed for the transport inclusion variants (Section 3.4.7)
- Natural gas suppliers: these suppliers may have a regional or national monopoly, but operate in a regulated environment. Unless regulators allow passing on (part of) the opportunity costs of the free allowances, windfall profits will not occur. Note however, that if costs are not passed on, end-users will have little incentive to reduce gas consumption. In a more competitive market, windfall profits are probable.

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[30] 'Equal treatment' does not necessarily mean using the same allocation approach for incumbents and newcomers. The latter can take into account the costs of the ETS into account when making their investment decision, i.e. by choosing a less carbon-intensive alternative. This is an advantage that incumbents do not have, imposing addition costs related to having to retrofit existing installations or practices. From this perspective, new entrants having to buy their allowances while incumbents receive theirs for free is also considered in line with the 'equal treatment' requirement of the EU ETS.

– Coal product suppliers: Like for oil products, the market for coal is competitive, causing a potential for windfall profits.

4.4.8 Impact on public finance

The main factor impacting public finance is the amount of revenues generated by the sale of allowances by governments i.e. the choice of allocation method. In case of free allocation through a fuel benchmark, no revenues are generated. In case of auctioning, the auctioning revenues will result in additional national public finances.

Aside from auctioning revenues, in both inclusion variants other tax revenues can also be influenced. First, governments may eliminate or reduce existing fuel or carbon taxes to avoid duplication of the financial burden on the sector. Second, revenues from excise duties may decrease because regulated entities and end-users will take reduction measures.

4.4.9 Impact on concentration in the carbon market

The current EU ETS covers about 45% of the EU's GHG emissions, which is ca. 2,000 Mt (European Commission, 2013). By including the built environment in the EU ETS, emissions covered under the scheme would increase with 751 Mt (see Section 4.2.2), which is ca. 38% of current EU ETS emissions. About half of these emissions are related to the use of natural gas.

As shown in Section 4.2.5, including the built environment would add 8,000–15,000 regulated entities to the current 13,000. As these entities would collectively account for an increase of emissions by 38%, they would on average be smaller than the current entities. Hence, the market power of these actors will be relatively small.

4.5 Evaluation of technical feasibility of inclusion

4.5.1 Introduction

In this section, we will discuss the technical feasibility of the inclusion of the built environment sector in the EU ETS. We will focus on the possibilities to accurately monitor CO_2 emission data at entity level, on the feasibility of an allocation system with the chosen regulated entities, on the possible challenges regarding the definition of boundaries, as well as on the sensitivity to fraud.

4.5.2 Monitoring accuracy

There are a number of elements relevant for accurately monitoring the emissions related to the use of fuels in the built environment. Some elements are closely related to the regulated entities, these are discussed per entity, some are more general and discussed together, independent of the entity type.

Relevant monitoring elements per entity:
– Identification of all regulated entities. How does the emissions authority know that all entities that fall under the system are indeed covered.
– Basis for activity data.
– Identification of fuels used in the built environment: Can the regulated entity differentiate between end-use in the built environment and end-use elsewhere?
– Use of emission factors.

- Possible trade between entities or between end-users: Trade between entities could lead to double counting (for example sale from one coal supplier to another coal supplier can result in monitoring the same fuels twice).
- Monitoring of import and export.

Each of these elements is discussed for the different regulated entities.

Oil products

- The regulated entity is the tax warehouse keeper.
- Identification of entities. The tax warehouse keepers are defined in the ETD Directive and each Member State keeps a registration of these entities and the type of fuels they trade. Therefore, the chances of not identifying all the tax warehouse keepers and ensuring their coverage in the system are very small.
- Basis for activity data. The tax warehouse keeper will invoice fuel volumes supplied to the market, including excise duty and will keep an administration of invoices and excise duty for taxation purposes. This is an important condition for establishing accurate monitoring for ETS purposes, as well as for the allocation in case benchmarking is used. Because of the value of these excise duties and the fiscal requirements this administration will be subject to financial assurance and other checks required by the tax authorities.
- Identification of fuels. The tax warehouse keepers' records will include type of fuel, volumes and taxation tariffs used. Some countries use the same tariff for fuels used for heating purposes and fuels used in other sectors. In these countries the excise duty administration might not be sufficient to distinguish between fuel use in the built environment and fuel use elsewhere (see also Section 4.5.5 definition of boundaries) and additional measures will have to be taken to include fuel use in the excise duty administration for the purpose of the ETS.
- Use of emission factors. Most oil products for heating purposes are commercial products with a specified calorific value and carbon content. Similar to the current ETS, standardized emission factors can be applied. If non-standard products are sold, applicable MRR[31] rules can be used to determine the emission factor.
- Trade between entities. Trade between entities is monitored through the tax warehouse system, which is implemented to separate supply to the market for consumption (when excise duty becomes chargeable), and trade between suppliers, import and export (when excise duty is not chargeable yet).
- Import and export. Movement of goods between Member States is monitored by the tax warehouse keepers through the EMCS (Excise Movement and Control System). This makes it possible to exclude exported fuels from supply to the market and include imported fuels to the fuels supplied to the market for consumption.

[31] Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions.

Natural gas

- The regulated entity is the natural gas supplier that supplies directly to the final consumer.
- Identification of entities. Supply of natural gas is a regulated market. Energy regulators in Member States will have an overview of natural gas suppliers.
- Basis for activity data. The basis for activity data will be the invoices that the supplier sends to its customer. In the case of natural gas, data on volumes and quality of fuel (including calorific values) supplied to end-users in the built environment will be available via the invoices sent by the suppliers. The volumes sold can be cross checked with transport information. This will allow for an accurate monitoring of the CO_2 emissions (directly linked to these parameters).
- Identification of fuels. These suppliers deliver directly to the end-user and, in principle, should be able to clearly separate supply to end-users in the built environment from supply to other end-users, based on the type of contract and also based on demand patterns[32].
- Use of emission factors. The carbon content of natural gas can vary, but is well monitored by the suppliers. To ensure a harmonized approach, the same approach to determine emission factors should be used as those currently used in the EU ETS.
- Trade between entities. Trade between entities is not an issue. Because of the distribution system, there is no trade between suppliers (outside of the high pressure transmission network). Also trade between end-users is not possible.
- Import and export. For natural gas import and export is well regulated and monitored and limited to a small number of gas transport companies.

Coal products

- The regulated entity is the coal supplier that supplies to the final consumer either directly through truck delivery or through the sale of packed products through retailers.
- Identification of entities. Supply of coal products is a less regulated market than that of other fuels. In countries where excise duty is charged for coal products the excise duty system could be used to identify regulated entities. In other countries, registrations through the chamber of commerce and information from sector organisations could be used to identify suppliers. However, the latter leaves substantial room for non-registered suppliers, especially in rural areas.
- Basis for activity data. The basis for activity data will be the invoices that the supplier sends to its customer. For coal suppliers, the room for fraud is larger than for the other fuels, given the more dispersed and less regulated market. To increase certainty that all products are covered in the monitoring, coal suppliers should monitor both coal they purchase and coal supplied to end-users in a mass balance approach.
- Identification of fuels. These suppliers deliver directly to the end-user and, in principle, should be able to separate supply to end-users in the built environment from supply to other end-users. This can be based for instance on the type of contract or distribution addresses. Again, this does leave room for error or fraud.
- Use of emission factors. The emission factor of coal can vary considerably. Existing MRG rules could be used to determine an emission factor at the supplier level, however this can impose considerable costs.

[32] Note though that this may not be possible in cases where sites combine both buildings (e.g. offices) and production facilities.

- Trade between entities. Trade between suppliers could be difficult to control. A solution could be to assume that in principle all coal that passes through a supplier is intended for end-users in the built environment, unless the supplier can prove that deliveries are supplied to other entities regulated under the ETS system or to users outside of the ETS system.
- Import and export of coal is much less regulated and controlled, making it more sensitive for fraud. In some regions bordering non EU countries, private import of coal could occur to evade the system.

General monitoring issues
The following monitoring issues apply for all regulated entities.

Possible overlap with fuels supplied to ETS installations
Overlap (in fuels/emissions covered) can exist when fuels are supplied to installations that are covered under the current ETS. Fuels supplied to existing ETS installations should not be covered under the ETS for the built environment. At the same time, fuels supplied to buildings at the premises of existing ETS installation should be covered as part of the built environment (often supplied under a different contract and connection). This requires that the suppliers for coal and natural gas need to know which of their customers fall under the current ETS and will have to distinguish between 'industrial use' and 'building' use. There are lists available of installations that fall under the current ETS. However, it will require an effort from the side of the suppliers to clearly identify all fuels going to customers that fall under the current ETS.

For oil products, in principle the tariff differentiation between fuel use for space heating purposes and use for other purposes can be used to avoid overlap with fuels supplied to ETS installations. In some countries where the tariffs do not make this differentiation, additional measures are needed for the tax warehouse keeper to identify installations that fall under the existing ETS in its customer base. However, this may require an extension of the monitoring and reporting obligations set for tax warehouse keepers.

District heating
Fuel suppliers (coal, natural gas) or tax warehouse (oil products) as regulated entities should identify heat producers within their customer base that are not covered under the existing ETS and include emissions of fuels used by these installations in their monitoring and reporting.

Conclusion
Monitoring for oil products can be less straight forward in some countries, because the tariffs in some countries does not differentiate all fuels intended for the built environment from other fuels, this will require additional measures in some countries to include fuel use in the excise duty administration.
Monitoring of coal products will be less accurate, with more room for error and fraud, because of of the variation in coal quality, difficulties to identify all regulated entities and all of their deliveries, and because there is less control over import and export and over possible trade between end-users.

4.5.3 Feasibility of allocation

Auctioning only, no free allocation

The data requirements for auctioning are very limited. However, operating the auctioning platforms (including ensuring a thorough understanding by the entities and guaranteeing equal access) becomes more challenging if there are more regulated entities involved. Smaller entities are more likely to lack the capacity and expertise for acquiring allowances.

In this respect, the following remarks can be made for the different regulated entities:

- Oil products – tax warehouse keeper. Relatively small number of relatively large entities which will be familiar with administrative procedures but not with trading procedures, if they are not linked to oil companies that have experience in the current ETS.
- Natural gas entities. Relatively small number of relatively large stakeholders, many of them will have experience in the current ETS.
- Coal product suppliers. Larger number of entities involved, including many small entities, which makes both the system more complicated to regulate and organize, and has the risk that especially smaller entities may experience difficulties in understanding the system in general and participation in an auction in particular.

For auctioning, the allocation to new entrants and the impact of large reductions in capacity and closure of entities on allocation do not require special provisions.

Free allocation (fuel benchmark)

In case of a fuel benchmark, the data requirement is restricted to historic data on the amount of fuel (in MJ) supplied to end-users in the built environment. The data requirements for a fuel benchmark include:

- Oil products – tax warehouse keeper. Fuel volumes is easily available since it follows from the excise duty system, therefore no problem exists for this regulated entity. In some countries, differentiation based on the excise duty is not possible and additional measures will be needed to estimate the share of fuels supplied to the built environment Natural gas suppliers. Verifiable data on volumes of previous years, supplied to entities in the built environment can, in principle, be obtained from the administration of the suppliers
- Coal product suppliers. Fuel volumes are available from invoices, however it is likely that large differences will exist between accuracy and accounting practises of different coal suppliers. Verification of historic data is therefore especially crucial for this fuel type.

New entrants and closures

A specific issue for free allocation is the treatment of new entrants and closures in an upstream system. If the activity of an entity reduces significantly, or closes completely, the current ETS does not allow the entity to keep its free allowances. For the current ETS system, capacity extensions and reductions are relatively easy to define, in terms of a physical change to the installation resulting in an increased/reduced production capacity[33].

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[33] I.e. merely changing the production levels in an existing (stationary) installation is not seen as a new entrant, and has no consequences for the amount of allowances the installation is eligible to.

For an upstream systems, defining new entrants, capacity changes and closures is much more complicated. Capacity changes for the existing entities that supply fuels to the built environment can be expressed in a percentage of growth (or reduction) of the amount of fuels supplied to the built environment (compared to the previous year), but change alone does not mean that a capacity change is due to a change in activity. It will be difficult to relate changes in capacity for fuel suppliers or tax warehouses to actual physical changes.

It is important to note that especially coal and oil suppliers can more easily sell or merge part of their operations to another operation compared to existing ETS installations, because the boundaries of a customer base are very different from a geographical site . This further complicates the use of new entrants and closure rules.

Conclusion
Auctioning is a feasible option for allocation in this inclusion variant.
Fuel benchmarking is less feasible because of the difficulty to clearly define rules for new entrants, capacity changes and closures.

4.5.4 Definition of boundaries

Two issues are relevant for the definition of boundaries around the sector:
- a clear distinction between fuels supplied to the built environment and other sectors;
- position of district heating.

Split between built environment and other sectors

Oil products – tax warehouse keeper
The differentiation in energy taxation tariffs could be used to differentiate between fuel use in the built environment and use in other sectors.
However tariff differentiation alone is not sufficient, because countries can choose to use the same tariff for different uses of the same fuel.
A possible solution for this is that the excise duty administration of tax warehouse keepers in all Member States will be required to include an indication on the intended usage of each fuel shipment.

Natural gas suppliers, coal suppliers
These suppliers deliver directly to the end-user and, in principle should be able to clearly separate supply to end-users in the built environment from supply to other end-users.

Position of district heating
A specific boundary issue at the level of the fuel supplier as regulated entity is related to district heating.
According to the current ETS regulation, larger installations where heat is generated are covered, but smaller installations are not. If fuel use for heating in the built environment is to be included in the EU ETS, these smaller installations should also be covered, otherwise leakage could occur(as direct fuel use in the built environment is replaced by purchased heat).

4.5.5 Sensitivity to fraud

Fraud related to monitoring

The sensitivity to fraud for the built environment will strongly depend on the compliance systems which will be implemented.

- Trade between suppliers could be difficult to monitor and could open possibilities for fraud. This issue is not relevant for oil products or natural gas. Oil products are covered under the tax warehouse system and allowances need to be surrendered over the amount of fuels leaving this system. Trade in natural gas is physically restricted by the distribution network.

For coal products there are no controls or restrictions to prevent or monitor trade between suppliers. This could lead to the situation that one supplier sells coal to a second supplier, while the second supplier does not include this amount of coal in its monitoring.

- Coverage of imported fuels. Import of fuels could provide room for fraud. Oil products fall under the European Excise Movement and Control System (ECSM), which allows clear monitoring of fuel imports and exports between countries. Import and export of natural gas is also well regulated and limited to a small number of gas transport companies. Import and export of coal is much less regulated and controlled, making it more sensitive for fraud.

In some regions bordering non-EU countries, private import of coal could occur to evade the system.
Coal use for heating purposes within the European Union represents less than 5% of the CO_2 emissions in the built environment, but in some countries coal is much more important. A further development of the ECSM to cover coal would provide additional controls, limit this type of fraud.

- Boundary issues. The difficulties to distinguish the use of oil products in the built environment from use of oil products elsewhere may provide room for fraud. As indicated in Section 4.5.5 of this report, the main issue regarding oil products is that the current taxation tariffs may not allow clear system boundaries in some Member States. This may lead to a risk of incorrect monitoring of part of the fuels leading to a lack of submitted allowances for these.

- Monitoring of biofuels. Monitoring of the type and share of biofuels used in the built environment at the fuel supplier/ tax warehouse keeper may provide opportunities for fraud; e.g. fuel suppliers may argue that their fuels contain more biofuels (biogas) than they actually do to decrease the number of allowances they have to submit. The Renewable Energy Directive holds requirements to develop verification systems that enable verification of the sustainability criteria set under the RED and requires economic operators to trace biomass content through the use of mass balances. These requirements have not yet been implemented for all types of biofuels/biogas/biomass but should assist in preventing this type of fraud (see also Section 4.6.1 – RED).

Fraud related to allocation

Risks of fraud related to free allocation are basically the same as under the current EU ETS; namely the data to be submitted by operators in the case of free allocation of allowance can include intentional errors, which as a consequence can lead to inaccurate and/or unfair allocation. Required data are basically sales data that could be manipulated. It will be necessary to have data independently verified before submission and emission authorities should cross check submitted data with other information.

4.6 Evaluation of legislative efficiency

4.6.1 Interaction with other legislative frameworks

In this section, we analyse the implications of an inclusion of the built environment into the EU ETS for current EU policies that address emissions from this sector. We assume that inclusion of the built environment in the ETS will not replace other legislation, but will be introduced in addition to existing European legislation. This will result in a carbon price effect that will interact with the existing legislation and increase the effectiveness of these policies. Please note that due to existing policies the projected emissions in the built environment are declining. If effectiveness of these policies is increased due to inclusion of the built environment into ETS, this will, in turn, further reduce emissions and have an effect on the ETS price development.
Also legislation at national level can interact with the inclusion of the built environment in the ETS, such as the white certificate systems that exist in several European countries. However, a review of legislative implications at the national level is outside the scope of this project.

The impacts on environmental efficiency from interactions such as mentioned above are described for each of the relevant directives. The following directives are discussed:
- Energy Taxation Directive (ETD);
- Energy Performance of Buildings Directive (EPBD);
- Renewable Energy Directive (RED);
- Energy Efficiency Directive (EED).

Energy Taxation Directive[34] (ETD)

For the ETD we differentiate between the existing ETD and a proposal to revise the existing ETD[35]. The implementation of the existing ETD is explained in more detail in Annex E.

The proposal to revise the ETD was published in 2011 and includes an additional taxation based on the CO_2 content of energy products (i.e. a carbon tax). It explicitly covers fuels used for heating purposes and would introduce a minimum level for taxation at € 20 per ton of CO_2 (with an exemption for fuel use that falls under the current ETS). The objective of the proposal is to provide an incentive to reduce CO_2 emissions not covered by the current ETS by introducing a price incentive. The proposal therefore clearly overlaps with an expansion of the ETS with the built environment. The carbon tax proposal has been rejected by the European Parliament in 2012 and the Commission is currently reconsidering the proposal.

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[34] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.

[35] Commission proposal COM(2011)169.

The proposed amendment of the ETD and the inclusion of the built environment in ETS overlap strongly with respect to the abatement options stimulated and address similar barriers. Both approaches will result in the introduction of a carbon price and will increase energy prices for the end-users, thus creating more priority for CO_2 reductions. The only difference is that under the ETD proposal price increases will be more predictable than under the ETS where they can vary based on supply and demand of allowances.

Energy Performance of Buildings Directive[36] (EPBD).
The EPBD aims to improve the energy efficiency of the existing building stock (e.g. by means of a labelling systems, compulsory regular inspection of heating and cooling installations).

Its objective to improve energy efficiency of the building stock is compatible with the objectives of inclusion of the built environment in the ETS. The EPBD and the inclusion of the built environment in the ETS partly overlap with respect to the abatement options stimulated. Whereas the EPBD focuses primarily on removal of non-financial barriers such as knowledge and awareness raising and the split incentive problem, including the built environment in the ETS would bring a direct financial incentive for emission reduction and making energy efficiency measures more profitable.

There are some difference between the EPBD and the functioning of the ETS:
– The EPBD focuses on energy efficiency, whereas the ETS focuses on reduction of CO_2 emissions. As a result, the EU ETS inclusion would incentivise a broader set of mitigation measures than the EPBD.
– Under the EPBD Member States have the freedom to develop and implement their own specific national policies, whereas with inclusion within the ETS the rules are determined at the EU level.

For end-users, who do not have the choice between taking measures or buying allowances, inclusion of the built environment into the EU ETS will make energy use more costly, making energy efficiency measures more profitable, thus increasing the awareness and incentives for implementation of energy efficiency measures, which are stimulated by policies developed within the framework of the EPBD.

Energy Efficiency Directive[37] (EED*)*
The aim of the Energy Efficiency Directive is to achieve 20% savings in primary energy consumption by 2020 at the Member States Level.
As with the EPBD, the EED is primarily aimed at addressing non-financial barriers to energy efficiency such as a lack of knowledge and awareness and the split incentive, by setting an example for government buildings and by giving the energy suppliers an explicit role to organise and implement reduction measures with their end-users. Inclusion of the built environment in the ETS would bring a direct financial incentive for emission reductions and make energy efficiency measures more profitable. It will lead to accelerating efficiency improvements in the built environment because improvement measures become financially more attractive.

[36] Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings.

[37] Directive 2012/27/EU on energy efficiency.

One aspect of the EED focuses on the introduction of energy supplier obligations for energy efficiency improvements. Suppliers of electricity and natural gas should implement efficiency measures with their end-users, equivalent to 1.5% of their annual sales by volume of energy. The price incentive resulting from including the built environment into the EU ETS can support meeting this objective of the EED by making energy efficiency measures more profitable.

As an alternative to a supplier obligation, Member States have the possibility under the EED to implement other policies if these policies deliver the same amount of savings. Some Member States (a.o. Denmark, France Italy, UK) already have energy supplier obligations in place. Member States have currently different ways of monitoring these obligation, a harmonized European systems still needs a lot of development and discussion.

In the inclusion variants for the built environment the natural gas supplier is appointed as regulated entity. Depending on the implementation of this requirement by the Member States, the natural gas suppliers may face similar incentives to take energy reduction measures at end-users, making the combination less efficient in terms of legislative efficiency.

The EED will probably benefit from the introduction of built environment into the EU ETS, as the price signal will be helpful in meeting the energy efficiency target.

Renewable Energy Directive[38]

The RED aims to increase the production of renewable energy and includes national targets for the share of energy from renewable sources. Inclusion of the built environment in the ETS will help to realise objectives of the RED. The price signal introduced by inclusion of the built environment into the ETS can provide an incentive for the use of renewable energy sources in this sector such as biomass, biogas, biofuels, (passive) solar, geothermal and cold-heat storage. However, it must be noted that the costs for renewable energy options is currently still at a level that the price signal from introduction of the built environment into the EU ETS alone will most probably not lead to an acceleration of the implementation of renewable energy options.

4.6.2 EU competence

The current ETS is established under article 192 of the 'Treaty on the Functioning of the European Union' (TFEU)[39]. Under this article the powers for EU environmental action are defined.

"(1) Action by the Community relating to the environment shall have the following objectives:

- *to preserve, protect and improve the quality of the environment;*
- *to contribute towards protecting human health;*
- *to ensure a prudent and rational utilization of natural resources.*

(2) Action by the Community relating to the environment shall be based on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source, and that the polluter should pay. Environmental protection requirements shall be a component of the Community's other policies"

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38 2009/28/EC, Renewable Energy Directive.

39 Review of the Balance of Competences, Call for Evidence, Environment and Climate Change: Legal Annex, may 2013, DEFRA https://consult.defra.gov.uk/eu/balance_of_competences.

Although the built environment normally falls under the mandate of the Member States, expansion of the ETS could probably fall under the same article, because of the principle of preventive action. However, to our knowledge, this article has not yet been used to regulate environmental issues directly in the built environment. Other Directives, such as the EPBD and the EED that implement measures related to energy efficiency in the built environment are (also) directed at Member States, not at individual entities.

An issue might be that the proposed approach (regulating the supply of fuels instead of the stack approach) is not directly in line with the statement that 'environmental damage should as a priority be rectified at the source', but it could be reasoned that, although the regulated entity is not the end-user, the aim of inclusion still is to reduce emissions at the source.

4.7 Enforcement and institutional setting

The compliance cycle consists of permitting, annual monitoring and reporting, checking compliance (including surrendering of emission allowances), applying sanctions (issuing of penalties, suspending permit and trading) and enforcement of the sanctions. For the current ETS each country has appointed a competent authority that approves the monitoring plan of an entity, issues an emissions permit and checks whether the entity is in compliance with reporting and surrendering obligations.
For the built environment, the existing competent authorities could also cover entities in the built environment. In the current ETS the choice for the competent authority lies with the individual Member States. There is no reason to assume a separate authority would be worth the effort of establishing and maintaining a separate CA for the built environment.

4.8 Conclusion

The analysis shows that in principle it is possible to implement an emissions trading system along the lines of the two inclusion variants. Such a system will provide incentives for additional CO_2 emission reductions, as the regulated entities most likely will increase the price of their products and services, which will lead to increases in the energy price for the end-consumers in the built environment.

However, our analysis shows that there are a number of significant issues that need to be resolved to ensure an effective and efficient trading system for the built environment. These issues include:

- The tax warehouse keeper as selected regulated entity for oil products is in some Member States currently not able to clearly distinguish between fuels used for heating purposes in the built environment and those used in other sectors. Implementation of more harmonised administrative requirements is required in some Member States, to ensure differentiation of the intended fuel use, based on the excise duty collection system.
- Regulation under the ETS will be more difficult for coal products as the market for coal is less regulated and also comprises smaller entities supplying local markets, and distribution by truck is relatively hard to control. This makes data availability for allocation and MRV more limited, resulting in an increased sensitivity for fraud and a relatively high administrative burden.
  The control over coal suppliers as regulated entity could improve if the ETD is further harmonised and implemented for coal products, including

the implementation of EMCS for coal products. This would create a similar situation for coal products compared to the oil products. The issues mentioned above will also impact the monitoring accuracy for coal and oil products.

- The inclusion variants do not follow the current ETS stack approach and implementation will require significant changes and additions to scope and definitions used in the current Emissions Trading Directive. It will require the addition of a new type of activity (supply of fuels to the built environment) with a new type of regulated entity (fuel supplier, tax warehouse keeper) for whom new definitions will have to be developed.

The analysed inclusion variants differ in the allocation approach. Auctioning as allocation approach will result in a more simple system design, avoiding the need for data collection and allocation and new entrant & closure rules.
The system design for a fuel benchmark is more complex, due to the need for data collection and the need for new entrant & closure rules. It will be difficult to clearly define rules for new entrants, capacity changes and closures making a fuel benchmark as allocation approach less feasible.

Implementation of an ETS will have a regressive impact on the disposable income of end-users, weighing heavier on those with lower incomes.
The impact will be felt most by low income groups in older dwellings with a low energy performance, while in general these groups will not have the means or the possibility (in case of rented housing) to take structural emission reductions measures. Within this groups, users of coal will be effected even more, as coal will have the highest carbon cost and use of other fuels will require in most cases a change in heating installations and the availability of a gas network (in case of a change to natural gas). This could be a politically sensitive issue. Member States could contemplate using auctioning revenues to offset some of the undesired impacts on disposable incomes.

Although several issues need to be addressed, we conclude that the selected regulated entities for oil and natural gas make it possible to implement an ETS system (for these fuels) that can be accurately monitored and enforced, with limited potential for fraud. The most important issue is that in some countries possibly additions to the tax warehouse administration are needed to make sure that tax warehouse keepers in all Member States can differentiate between fuels used in the built environment and fuels used elsewhere.

Special attention is required for the choice of the coal supplier as regulated entity. Our analysis shows that implementation of the ETS in the built environment for coal will be more difficult compared to implementation for oil products and natural gas. Transaction costs will be relatively high, both for the government and for the participants. Monitoring will probably be less accurate and sensitivity to fraud will be higher. In some countries coal is exempted from energy taxation, making it in these countries more difficult to verify whether all coal suppliers are included in the system and whether all import is included and export is excluded.
Excluding coal use from the expansion of the ETS to the built environment is not an option. In some countries (Poland, Bulgaria, Ireland, Czech Republic) coal has a relevant market share and this would provide an incentive to shift to a fuel with a high carbon content.

5 Analysis of upstream ETS variant

5.1 Introduction

The previous two chapters have analysed inclusion variants that included the transport sector and the built environment as far upstream as possible (in order to minimise the administrative complexity) while keeping the rest of the ETS intact. As a result, the regulated entities were close enough to the fuel consumers to be able to identify the sector in which the fuels were used.
This would mean that the resulting EU ETS becomes a hybrid system, with the current ETS sectors still being addressed through the 'stack' approach and the transport and built environment sectors through the fuel streams.

This chapter analyses a radically different option, viz. to include all emissions arising from the combustion of fuels in the EU ETS as far upstream as possible, while keeping all non-combustion GHG emissions that are currently included in the EU ETS also in. This variant would have significant consequences for the EU ETS, as it would imply a divergence from the stack approach also for the current sectors.

The regulated entities would be the extractors and importers of raw materials for all fuels, except for natural gas. For gas, the number of regulated entities, and thus the administrative costs, can be reduced by making transmission system operators responsible for the surrender of allowances.
For non-combustion emissions, the individual emitting installations would remain the responsible entity.

We propose to auction the allowances to the extractors, importers and TSOs. This would have the advantage of using an efficient method of allocation with a lower administrative burden than free allocation and removing the risk of windfall profits. No negative effect is expected on the competitiveness of the regulated entities themselves. However, since extractors, importers and TSOs are likely to pass on the costs to their customers, all sectors will face higher fuel costs. This could affect sectors at risk of carbon leakage. It would also affect the sectors that use fossil fuels as a feedstock (e.g. naphtha in the chemical industry) and downstream exporters of fossil fuels. This issue needs to be addressed separately in a fully upstream inclusion variant.

Table 32 summarises the upstream inclusion variant.

Table 32 Selected upstream inclusion variant

Regulated entity	Allowance allocation method	Subsectors covered
Importer or extractor of liquid or solid fossil fuel TSO for gas Point sources for non-energy related GHGs	Auctioning	All sectors using fossil fuels, including transport and the built environment

The remainder of this chapter analyses the upstream inclusion variant. Section 5.2 presents an overview of the emissions covered in an upstream system and the number of regulated entities. Section 5.2 analyses the impacts of auctioning as an allocation approach, and ways to address allocation-related issues that arise from choosing a fully upstream system, such as carbon leakage. Section 5.4 analyses the environmental impacts. The economic impacts are analysed in Section 5.5. Section 5.6 analyses the technical feasibility of the upstream approach, and Section 5.7 concludes.

5.2 Emissions and regulated entities

5.2.1 Emissions

Total volume of emissions covered by this third inclusion variant would be about 83% of all GHG emissions within the EU (based on PRIMES, data for 2010). Table 33 provides an overview. The impact of this variant on emissions would result from the cap.

Table 33 Emissions in the scope of an upstream ETS (2010)

	Mton CO_2 eq.	Percentage of GHG emissions EU
Total GHG emissions EU	4,834	
Energy related GHG emissions under current ETS	1,897	39%
Non-energy related GHG emissions under the current ETS	280	6%
Transport CO_2 emissions	1,050	22%
Built environment CO_2 emissions	751	16%
Total coverage of inclusion variant 3	4,019	83%

Source: Primes reference line.

5.2.2 Regulated entities

The regulated entities in this inclusion variant are:

1. The companies extracting energy carriers within the geographic scope of the ETS (except for natural gas).
2. The importers of energy carriers (except for natural gas).
3. The transmission system operators of natural gas.
4. Installations emitting greenhouse gases which do not result from the combustion of fuels.
5. Possibly aircraft operators, because fuels used in international aviation are not imported in the EU (see Section 5.3).

Based on data presented in Table 34, we estimate the number of entities to be less than 3,000 if aircraft operators are excluded. By comparison, the current ETS has approximately 13,000 regulated entities.

Table 34 Number of regulated entities in an upstream ETS

Regulated entity	Number of entities: liquid fuels	Number of entities: solid fuels	Number of entities: gaseous fuels
Extractor or producers of fuels	310 oil and gas extracting companies + unknown number of producers of biofuels	50-100 mines	310 oil and gas extracting companies + unknown number of producers of biogas
Importers of fuels	200 refineries + 1,000 non-refining importers	Unknown number of importers	Unknown number of importers
Transmission System Operators	n.a.	n.a.	50
Aviation operators	5,500 (current ETS)	n.a.	n.a.
Point sources for non-energy related GHGs	600-1,200 (5-10% of installations)		

Source: Eurostat, Structural business statistics; Eurocoal; Europeia; Epure; ENTSOG; number of importers of petroleum products extrapolated from German figures.

5.3 Allocation options

The default option for allocation under the existing ETS is auctioning.
No (unintended) negative impact on the competitiveness of the fuel extractors or importers, or TSOs, is expected in case auctioning is used for all these regulated entities in the fully upstream inclusion variant, as all fuel types are covered, and both fuels produced within the EU and imported fuels are covered. Therefore, we propose to auction the allowances to the extractors, importers and TSOs.

Since upstream coverage results in higher fuel prices for downstream sectors, it could put fuel-intensive sectors that compete with non-EU industries at a competitive disadvantage. This could result in carbon leakage as non-EU firms gain market share or production moves out of the EU to countries with less stringent climate policies. Hence, sectors and sub-sectors deemed to be exposed to a significant risk of carbon leakage may require a special treatment according to the same logic for which they currently receive free allowances. In the upstream system proposed , any carbon leakage would concern 'indirect carbon leakage'[40]. Compensating downstream companies for such competitiveness effects would be similar to the compensation for indirect carbon leakage as foreseen for electricity prices in Article 10.a.6 of the ETS Directive.

40 Through the increased costs of purchased fuel and electricity rather than direct (through the costs of buying allowances).

There are two ways in which carbon leakage in fuel-intensive sectors can be addressed, if deemed necessary:

1. Through the issuance of free allowances to the companies in exposed sectors. These companies could sell the allowances to regulated entities, thus offsetting the cost increase caused by the ETS for the downstream operators.
2. By direct financial compensation for indirect carbon leakage due to increased fuel prices.

If the former option is chosen, the existing benchmarking rules for free allocation could still be applied, with the difference that the allowances are not issued to the regulated entities. As basis for allocation, currently the historic activity levels (of production or heat use or fuel use) are used, and the expected activity levels in case of new or changing installations. This approach could be maintained, although ex-post evaluations have shown that in spite of free allocation, carbon costs are passed though in the product prices and result in windfall profits (CE Delft, 2010, see also Section 5.5.4)[41].

It must be noted, that this approach would require a mechanism to withhold an equivalent amount of allowances from the auction as issued to the vulnerable downstream operators to maintain the overall level of the system's cap. This requires establishing upfront the amount of fuels that will be sold to vulnerable sectors. This could be based on historic verified emission data of current ETS participants, which could deviate substantially from actual patterns in fuel sales[42, 43]. An alternative approach could be to adopt an ex-post correction mechanism, in which the verified output data of the past year from vulnerable companies determines the amount of allowances to be auctioned in the next year. It must be noted though that the latter ex-post approach is rather politically sensitive in the context of the ETS. It may also require a different approach for the last year of the trading period.

Given the above, option 2 (direct financial compensation) seems the easier way to address the cost increase in vulnerable sectors, financed through the use of auctioning revenues. Financial compensation could occur ex-ante, based on historical activity data, or ex-post, based on monitored actual activity data. Both options 1 and 2 would require the monitoring and verification of activity data in all the companies that want to be eligible for compensation for indirect leakage in the ex-post approach.

Fuels used as feedstock for non-energy products

Non-energy use of fossil fuels (e.g. naphta as a feedstock in the chemical industry) does not result in emissions directly, as the fuels are not combusted (directly) into CO_2. Some of this carbon is released at a later stage, e.g. when the CO_2 gets released from fizzy drinks or when plastics get burnt in waste incineration. However, these emissions could occur with a considerable delay, e.g. when plastics are used as a building material or incorporated in durable consumer goods. It could be argued that, as the fully upstream system is no longer based on the stack approach, a distinction into energetic and non-

41 http://www.cedelft.eu/publicatie/does_the_energy_intensive_industry_obtain_windfall_profits_through_the_eu_ets/1038.

42 While the free allocation to current ETS sectors is also based on historic activity data, fluctuations in sales portfolio (how much of which fuel is sold to which client) are likely to be much more volatile than those in the physical production at individual plants.

43 It also does not include 'new entrants' among the downstream operators, though these could be addressed by a standard capacity utilisation factor (SCUF) as used under the current ETS.

energetic fuel use is no longer relevant. Under such an argument, the regulated entities could simply be required to cover all their fuel supply by allowances, and the carbon price effect applies to all fuel use independent of its purpose and whether (and when) it results in emissions[44].

To the extent that these sectors are competing with industries outside the EU, the system would affect their competitiveness and this could result in carbon leakage. This carbon leakage effect due to feedstock use could be addressed in the same way as the carbon leakage effect due to energetic use of fuels as described above. This removes the requirement to monitor the use of fuels for feedstock and energetic purposes separately, reducing system complexity and administrative burden.

However, if this type of carbon leakage is addressed by giving free allowances (and not by giving financial compensation), it would imply that the number of allowances surrendered in any year would no longer be equal to the amount of emissions in that year, and that the number of allowances available for emissions of CO_2 would be lower than the cap. To the extent that feedstock use is driven by the economic cycle, it would make demand for allowances more dependent on the economic cycle, which would go against the reason for including transport and the built environment.

If both financial compensation and free allowances would be considered undesirable, this type of leakage could also be addressed by giving companies that use these feedstocks credits[45]. These credits could then be sold to the regulated entities, which could surrender them to meet their obligations. In order to receive a credit, the company should demonstrate that it uses the fuels in a way that do not result in CO_2 emissions. Note that this would require the company to monitor its fuel use and to distinguish use for energetic and non-energetic purposes. The difference between credits and allowances would be that the amount of credits would not be capped ex-ante, although it would always be smaller than the cap.

Export of fuels by entities further down the supply chain

An upstream system would render exports of fuels by downstream entities more difficult, as the price level in the EU would be higher than the price level outside. Exported fuels could in principle be monitored and subtracted from the fuels sold by the legal entity to determine the surrender obligation. However, it will be difficult to trace back exported fuels to the selling regulated entity. To the extent that the price increase of exported fuels is deemed an issue, the same compensation system as described above for sectors vulnerable for indirect carbon leakage and feedstock use could be applied to cover the increased costs of exported fuels.

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44 Note that currently municipal waste incineration is excluded from the ETS, i.e. emissions from plastics that end up in MSW are not covered by the ETS. By covering all feedstock energy use in the upstream system, these emissions are included in the scope, as is the carbon content of plastics that are not incinerated, but e.g. landfilled. As such, system coverage is somewhat higher than actual emissions. This however only makes the system more conservative, with the added benefit of also stimulating material efficiency measures (using less material intensive designs, more recycling).

45 Note that we use the word credit here in a general sense, and not as a unit in a baseline-and-credit system. The credit signifies a unit of greenhouse gas not emitted and thus fits in a cap-and-trade scheme.

Carbon Capture and Storage (CCS)

Carbon storage is another possibility to avoid emissions. For storage of carbon (CCS), the same compensation systems as described above for sectors vulnerable for indirect carbon leakage and feedstock use could be applied.

International aviation and maritime bunkers

International bunkers are a special case, in that they are not imported into the EU and hence would remain outside the scope of this ETS under the current definition of regulated entities in the upstream inclusion variant. That would imply that aviation, which is currently included in the EU ETS, would be excluded. In order to keep aviation included, one could opt for including aviation through the fuel suppliers, or keep the current ETS for aviation.
An upstream system would have some disadvantages, such as avoidance of the system through increased tankering[46], and some advantages, such as reduced administrative costs compared to the downstream inclusion of aviation.
Since tankering is costly (it costs fuel to carry fuel) and limited by the fuel capacity of aircraft, this disadvantage is likely to be small compared to the reduction in administrative burden (CE Delft et al., 2005).

In contrast, the disadvantages of including maritime transport upstream are likely to outweigh the benefits because avoiding the system by bunkering elsewhere is relatively easy. There is only a small fuel penalty for carrying more fuel, ships can carry enough fuel for weeks, and historical experiences have shown that markets relocate swiftly after changes in fuel prices (CE Delft et al., 2009). Note, however, that maritime transport emissions are currently not included in the EU ETS.

Process emissions

Special attention is also required for allocation in case process emissions currently covered by the ETS should also be covered by the upstream inclusion variant. In this case, installations carrying out activities as defined in the existing ETS should still be considered as regulated entities if they have such process emissions. Under the current ETS, installations get a separate allocation for process emissions, so the current rules can continue, using only this specific allocation rule. Auctioning would also be the 'default' allocation option for these installations, though they may be considered exposed to a risk of carbon leakage. Here, the same approach for compensating for competitiveness effects can be used as discussed above.

5.4 Environmental impacts

5.4.1 Emissions covered in an upstream system

Total volume of emissions covered by this third inclusion variant would be about 83% of all GHG emissions within the EU (see Section 5.2.1).

The scope of the system is coverage of all direct emissions that take place in the EU related to the use of fuels for energy purposes and all process emissions related to activities as defined in the existing ETS under Annex 1 of the EU ETS Directive. It also covers carbon embedded in fuels that are used as feedstocks. Included in this definition are also emissions caused by the use of extracted fuels by the regulated entities themselves. Exported fuels will not cause

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[46] Tankering means that aircraft uplift more fuel than they need for the flight, so that they can use this fuel for a subsequent flight. In an upstream ETS, fuel prices in the EU would rise which would incentivise tankering for flights that start outside the EU and fly into the EU.

emissions in the EU and are therefore not covered. Aviation could be included upstream but, as discussed above, maritime should not.

Non-energy related emissions from agriculture, emissions from waste and from land use, land use change and forestry are not included in the current ETS, due to the inability to monitor such emissions with sufficient accuracy. The currently analysed upstream system also does not include these emissions.

5.4.2 Incentive to reduce emissions

Fuel importers and extractors have little scope to reduce emissions related to their fuel deliveries. The only option they have is increasing the share of biofuels in their pipeline and emission reduction of extracted fuels used on site and reducing emissions related to the extraction process.

In well-functioning markets, the cost of allowances will be passed through in fuel prices. This price signal will have an indirect effect further down the supply chain. It will stimulate end-users to take emission reduction measures.

Note that the price effect can be less for natural gas, where the TSO's are the regulated entities, and often operate in a regulated monopoly for transport of natural gas. In such situations, the transport price[47] is not based on an open market, but it is a regulated price. We assume that regulators will allow the TSO's to pass on the carbon price but some regulators might decide differently.

5.4.3 Risk of carbon leakage

There are two ways in which carbon leakage could occur:

1. Risk of carbon leakage to the rest of the world:
   In this variant, fuel costs will increase which can put sectors at risk of carbon leakage, just as in the current ETS. There are possibilities to take competitiveness issues for the relevant activities into account, as discussed extensively in Section 5.3.

2. Leakage within Europe to sectors not covered by the EU ETS:
   In principle all major fuels (oil products, natural gas, coal products) are covered by the system, with the exception of peat and non commercial biomass, as these are extracted and used locally, making it difficult to regulate. Because of an increased price difference, due to the carbon price in some countries use of peat in the built environment could increase, causing carbon leakage. Peat is mostly used in Ireland, Finland and the Baltic states.
   In EU border areas, private import (for instance by car owners) of fuels can increase if price differences with bordering non-EU countries become too big. However, as argued in Section 3.4.3 this does not appear to be a major issue.

5.4.4 Effect on innovation

By raising the cost of emissions, implementation of an upstream ETS will in general have a positive effect in the long run on innovation in the field of low-carbon technologies. These technologies will become more economically competitive due to the increase in the price of fossil fuels. For a more in-depth discussion of the impact on innovation in the transport sector and the built environment, refer to Section 3.3.3 and 4.3.4, respectively.

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47 The TSO is not the owner of the natural gas, it will charge a transport fee, to which a carbon price can be added.

5.4.5 Effect on awareness raising

Awareness raising in this inclusion variant only takes place through the carbon price effect. See also the discussion on this in Sections 3.3.4 and 4.3.5). In a fully upstream system, the current ETS sectors will therefore see the direct impact of the allocation, MRV and trading activities replaced by this more indirect impact through the carbon price, which may reduce the awareness raising effect of the ETS. However, for sectors that currently receive allowances for free, the effect of the carbon price on their fuel costs in the upstream system on awareness may be bigger.

5.5 Economic impacts

5.5.1 Introduction

This section analyses the economic impacts of a shift from the current downstream emissions trading system to an upstream system in which allowances are surrendered by extractors, importers and TSOs. It uses the criteria set out in Annex B.

Some criteria have been analysed in Chapters 3 and 4 and will not be repeated here, as they will not change under the current inclusion variant. These include impacts on competitiveness and impacts on disposable income of households.

The analysis of the impacts on the transport sector and the built environment will be more detailed than the discussion of the impact on other sectors. Impacts on the current ETS sectors are discussed, but only on a general level as a full economic impact assessment for current ETS sectors is beyond the scope of this study.

5.5.2 Transaction cost

The transaction costs of the ETS for public authorities highly depend on the number of regulated entities. Section 5.2.2 estimates these at approximately 3,000 (provided that aviation emissions are included upstream). The current ETS has approximately 13,000 regulated entities for a smaller scope (excluding transport and the built environment). Hence, the number of entities that would be required to surrender allowances would decrease significantly in an upstream system. Depending on how the risk of sectors prone to carbon leakage is assessed and addressed, the number of entities that would need to monitor their output and apply for free allowances could be significant. However, the administrative burden for these entities would probably be lower than when they also have to surrender allowances, like under the current system. No trading will be necessary for these entities, and MRV is likely to be limited to (historic) activity data (i.e. production data).

The transaction costs for the regulated entities consist of the costs for monitoring, reporting and verification, the costs for emissions trading and of non-recurrent administrative costs as for example the costs for permitting.

Since the amount of the energy carriers extracted/imported are well known from the companies' administrations, monitoring, reporting and verification should be associated with relative low costs. To monitor the carbon content of the energy carriers may in some cases constitute a new obligation. If the regulated entities do export some of their products to outside the geographic scope of the ETS, these trade flows would be exempted from the ETS. Making the distinction between trade flows to in- and outside the geographic scope can also be expected to be possible on the basis of the current administration of the regulated entities. The fact that some of the regulated entities would have experience with ETS from the current system would also help to keep the additional administrative costs low.

Any compensation using allowances, credits or financial compensation will result in additional administrative costs compared to a system without such compensation. These transaction costs are the lowest in case direct financial compensation is used, and the highest if a special type of credits is to be created. Using credits for feedstock use of fuels leads to substantial additional costs, as this would require the monitoring of feedstock use and energetic use of fuels separately by downstream users, as well as potentially tracking the origin of the fuel to the regulated entity.

In conclusion, the total administrative costs could decrease in an upstream system because the number of entities responsible for monitoring carbon would be an order of magnitude smaller than in the current ETS. However, the magnitude of these benefits depends to a large extent on the treatment of sectors exposed to carbon leakage, feedstock use and exported fuels.

5.5.3 Equity: equal treatment of regulated entities

All fuels extracted or sold in the EU are included in the same way, i.e. allowances have to be surrendered in relation to their carbon content.

Early action to reduce emissions is rewarded if emission allowances are auctioned because companies that have taken early action have to buy fewer allowances or less fuel compared to the other companies.

For the downstream sectors, all sectors are subject to the carbon price incentive in the fully upstream system, which is a first important step to equal treatment. With regard to early action by downstream entities, early movers are rewarded too since their energy bills will rise to a lesser extent compared to the other companies.

The equal treatment of newcomers and incumbents in the market is ensured as both will acquire their allowances on the auction. For new entrants among the downstream companies, the compensation can be based on standard energy intensity data instead of historical activity data.

5.5.4 Potential for windfall profits

Since the regulated entities do not receive free allowances there is in principle no potential for windfall profits at that level. For the downstream sectors receiving free allowances or compensation to offset competitiveness effects, windfall profits could occur if the marginal costs of production include the increased costs of fossil fuels but not the decreased costs of free allowances. This is likely to happen for two interrelated reasons:

1. Because the free allowances represent a lump-sum payment to the firm which will not be factorized into prices that are based on marginal costs. According to economic theory profit-maximizing firms have to set prices at the level of marginal costs, otherwise they run the risk of lowering profits, and in the end, put the viability of the company at risk.
2. Firms that want to expand their production above their amount of free allowances have to factor in the additional costs from the regulated entities into their prices because they have no free allowances to cover up for this increase. As a matter of fact, in each market, there needs to be only one firm that does not have enough free allowances to set the price at the market permanently at a higher level.

One should notice that this situation also occurs in the current ETS. Sectors at risk of carbon leakage receive free allowances but nevertheless pass on the opportunity cost of these allowances (CE Delft, 2010). The reason for this behaviour is that the marginal producer does not receive enough free allowances to cover all his emissions, so his marginal costs include the value of allowances.

Hence, when sectors exposed to carbon leakage receive free allowances, windfall profits are likely to occur because the amount of allowances will often be lower than the amount of emissions in order to give these sectors an incentive to reduce emissions.

5.5.5 Impact on public finance

Under the upstream ETS, the revenues from the EUA auctions would, just as under the current EU ETS (and the Effort Sharing Decision), be distributed over the Member States according to certain rules. The total (net) revenue from auctioning under the upstream system depends on the amount of allowances auctioned and the amount of financial compensation offered to exposed sectors (assuming the latter is financed from the auctioning revenues), and assuming the carbon price is not substantially affected by the system design.

Compared to the current EU ETS in combination with an ETS for transport and built environment as described in Chapter 3 and 4, the upstream system would be larger as it includes also emissions of small industrial installations and possibly feedstock use of fossil fuels. We assume that the small installations are often not exposed to carbon leakage and hence do not qualify for free allowances or financial compensation. As a result, we expect the auction revenues to be higher.

5.5.6 Impact on market

The upstream variant will significantly change the market. The number of regulated entities is expected to decrease from the current 13,000 for land-based emissions plus 5,500 for aviation to about 3,000 (one to two thousand importers and extractors of crude oil and coal, 50 TSOs and up to a thousand emitters of process emissions). Together these entities will be responsible for 83% of total EU emissions, i.e. substantially more emissions than the EU ETS currently has, and a number of allowances that increase proportionally . So one sixth of the number of regulated entities will be responsible for almost twice as many allowances.

The largest regulated entities are probably in the gas sector. Gas accounts for 28% of EU GHG emissions from fossil fuels (IEA, 2012) and there are about 50 TSOs. On average, TSOs are responsible for 0.6% of emissions. If one TSO is ten times as large as the average, it twill be responsible for a few percent of emissions. Similar arguments can be made for the other sectors, where the average emissions per regulated entity are smaller. Hence, we do not see a risk of market concentration.

A market with 3,000 players could be less liquid than a market with 18,000 players. However, many of the players in the current market are not actively trading and hence do not contribute to market liquidity. Jaraite et al. (2012)[48] find that the majority of firms in the current EU ETS do not trade allowances, and that smaller firms are less likely to trade than larger firms. Moreover, they

48 http://www.cere.se/documents/wp/CERE_WP2012-9.pdf.

find that banks and other financial intermediaries provide liquidity by trading allowances.

5.6 Evaluation of technical feasibility of inclusion

5.6.1 Introduction

This section analyses the technical feasibility of a shift from the current emissions trading system to an upstream system in which allowances are surrendered by extractors, importers and TSOs.

In the next paragraphs the implications for monitoring by the regulated entities as well as downstream entities that would receive compensation, the feasibility of allocation and sensitivity for fraud are discussed. Analyses carried out in Chapters 3 and 4 for the transport sector and the built environment, will not be repeated here, as they will not change under the current inclusion variant. The analysis here will focus on differences under a fully upstream system.

5.6.2 Monitoring accuracy

This inclusion variant involves several different types of regulated entities that will need to monitor either their direct emission, the emissions associated with the fuels they supply to other entities or activity levels to determine the compensation for exposed downstream entities. The monitoring set up of each entity is described in order to see whether accurate monitoring is possible for all entities involved.

The relevant issues for monitoring emissions by the regulated entity are:
- Definition of the regulated entity.
- Identification of all regulated entities. How does the emissions authority know that all entities that fall under the system are indeed covered
- Basis for activity data and emission factors.
- Monitoring of export by the regulated entity. Assumed is that export by the regulated entity is included in the monitoring, but is not added to the entity's total emission volume.

There are different types of regulated entities involved to cover all aspects of the upstream variant. The following types of regulated entities are discussed that will need to monitor their activities:
- installations that extract crude oil;
- installations that mine coal;
- entities that import coal products, crude oil and/or intermediate or refined products;
- installations that extract natural gas (own use of extracted fuels only);
- transport system operators for natural gas;
- installations emitting process emissions;
- exposed downstream entities.

Several types of downstream entities will also need to monitor their activities:
- exposed downstream entities;
- installations that use fuels as feedstock;
- downstream entities that export fuels;
- carbon storage.

Each of these issues will be discussed below to the extent that they differ from the analysis in Sections 3.5.3 and 4.5.2. Since there are significant differences between the different types of entities, we will discuss them separately.

Installations that extract crude oil

- *Definition of the regulated entity:* Regulated entities are installations that extract crude oil or other petroleum products from the underground within the geographical scope of the system.
- *Identification of all regulated entities:* For extraction special permits and concessions are required. National extraction authorities will have an overview of existing entities. The larger entities will also fall already under the current ETS, because of their combustion installations.
- *Basis for activity data and emission factors*: The regulated entities will need to monitor and report their production volume of fuels, any fuels that they might import, the use of extracted fuels on-site, the volume and carbon content of the crude oil or other fuels they supply to refineries (or other processors or end-users) within the EU, any export of crude oil or other fuels to outside the EU.
- The existing MRR[49] can be used to monitor both the direct emissions of the regulated entity and to account for the fuels and their carbon content that leave the installation.
- *Monitoring of export*: Direct export by the regulated entity should be explicitly included in the monitoring, using invoices and shipping records.

Installations that mine coal

- *Definition of the regulated entity*. Regulated entities are installations that mine coal products within the geographical scope of the system.
- *Identification of all regulated entities*. For mining special permits and concessions are required. National mining authorities will have an overview of existing entities. The larger entities will also fall already under the current ETS, because of their combustion installations.
- Basis for activity data and emission factors. The regulated entities will need to monitor and report their production volume of coal, any fuels that they might import, own use of coal, emissions that directly result from processing of mined coal, the volume and carbon content of the coal or other fuels they supply to other entities within the EU, any export of coal or other fuels to outside the EU.
  Part of the existing MRR can be used to monitor both the direct emissions of the regulated entity and to account for the fuels and their carbon content that leave the mine.
- *Monitoring of export*. Direct export by the regulated entity should be explicitly included in the monitoring, using invoices and shipping records

Installations that extract natural gas

Installations that extract natural gas will need to monitor what natural gas they extract, what is supplied to TSO and what is exported. They will also need to monitor emissions from direct consumption of extracted natura*l gas on site*.
*Other u*se of fuels will already be covered under the new system. Existing MRR rules can be applied.

[49] Commission Regulation (EU) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions.

Entities that import coal products, crude oil and/or intermediate or refined products

- *Definition of the regulated entity*. Any organisation that imports energy products from outside the EU other than natural gas (import of natural gas is covered by the TSO).
- *Identification of all regulated entities*. Products from outside the EU will have to pass through customs. Customs authorities can help to identify these importers.
- *Basis for activity data and emission factors*. Activity data for monitoring can be based on invoices of products supplied to the EU market. Depending on the type and volume of products, default emission factors can be applied or emission factors will have to be determined by sampling, both according to the MRR.
- *Monitoring of export*. Export by the regulated entity should be explicitly included in the monitoring, using invoices and shipping records.

TSO (transport system operators) for natural gas

- *Definition of the regulated entity*. Regulated entities are operators appointed in each member state to carry out gas transport over the high-pressure gas network. The TSOs keep an administration of all (trans-) national transport, including import and export for each country.
- *Identification of all regulated entities*. Each Member State has appointed one or more operators responsible for the high pressure gas network. Note that possibly natural gas is used in installations neighbouring import or extraction sites, without passing the TSO system. Such installations should be identified separately as regulated entities.
- *Basis for activity data and emission factors*. The regulated entities will need to monitor and report emission related to own use of natural gas (CO_2), emissions related to leakage of natural gas (CH_4) that passes through the transport system and the volume and carbon content of natural gas supplied to end-users and distributors. The TSOs keep an administration of all (trans-)national transport, including import and export for each country. This administration is based on protocols to determine volumes and calorific value of the transported gas.
- The existing MRR can be used to monitor both direct emissions and fuels that leave the installation. To include fugitive emissions, this will imply the use of a mass balance approach as prescribed in the MRR.
- *Monitoring of import and export*: Both import and export of natural gas will pass through the pipelines for which the TSO's are responsible. Import into the EU should be explicitly included in the monitoring (and substantiated). Export should also be explicitly included in the monitoring (and substantiated), so it can be subtracted from the total volume of natural gas supplied to the EU market.

Installations emitting process emissions

For installations falling under the Annex 1 activities as defined in the current ETS Directive (excluding emissions from combustion), the existing MRR rules will still apply for process emissions only.

Downstream exposed entities

- *Definition of downstream exposed entity*. Any organisation that is deemed eligible for compensation to prevent (indirect) carbon leakage (either through free allowances or direct financial compensation).
- *Identification of all entities*. Most entities are likely to be the same as the ones identified under the current ETS as exposed to the risk of carbon leakage (direct + indirect).

As these installations benefit from being identified as downstream exposed entities, they are likely to play a more active role in the identification process. More importantly, as these entities are not responsible for surrendering allowances, missing some of them does not affect the environmental impact/integrity of the system.
- *Activity data* can be based on historic activity data (and energy intensity data and capacity utilisation factors for new entrants) in case of ex-ante determination of the compensation and actual activity data in case of ex-post determination. Activity data for monitoring can be based on the existing MRR.
- *Export of fuels.* See below (downstream exporting entities).

Downstream feedstock entities
- *Definition:* installations that use crude oil or fuels as feedstock for production of non-fuel related products.
- *Identification of all entities.* Most entities are likely to involved under the current ETS. The installations benefit from being identified as downstream feedstock entities, they are likely to play a more active role in the identification process. Again, as these entities are not responsible for surrendering allowances, missing some of them does not affect the environmental impact/integrity of the system.
- *Activity data* can be based on historic activity data, which should include weight and carbon content of end products.
- *Export of fuels.* see below (downstream exporting entities).

Downstream exporting entities
- *Definition:* All entities that export crude oil, coal or refined oil products out of the European Union.
- *Identification of all entities.* Eligible entities will have to apply themselves. The entities involved benefit from applying as downstream exporting entities, It will be important to verify whether export is really taking place. Again, as these entities are not responsible for surrendering allowances, missing some of them does not affect the environmental impact/integrity of the system.
- *Activity data* can be based on actual activity data, using invoices, shipping records and customs declarations.

Carbon Capture and Storage
- *Definition:* All entities that store carbon under a license according to the CCS Directive[50].
- *Identification of all entities.* Eligible entities are known to the national authorities.
- *Activity data* can be based on the register of the quantities and properties of the CO_2 streams delivered and injected, that a licensed storage site has to maintain.

50 Directive 2009/31/EC of 23 April 2009 on the geological storage of carbon dioxide.

Conclusion
The above overview of the monitoring approaches for the different entities that need to be involved for this inclusion variant show that accurate monitoring of emissions and fuels is in principle possible. For the regulated entities monitoring can be based largely on the existing MRR. Monitoring rules for the different downstream entities will need to be developed, partially based on existing records and systems.

5.6.3 Feasibility of allocation
The choice of auctioning as 'default' allocation option and the carbon leakage issues have been discussed previously.

Participation in auctioning for most of the regulated entities will not be an issue, as most of them are large companies, used to deal with market transactions.

5.6.4 Definition of installation boundaries
For coal and liquid fuel products, the installation boundaries will be defined through their environmental permits. Direct emissions of use of extracted fuels on site and all crude oil or coal products that leave the installations fall under the system and should be monitored.

For natural gas the installation can be defined as the high pressure network for which these entities are responsible and all natural gas entering or leaving these networks should be monitored, leakage of natural gas (CH_4) should be included in the monitoring.

For process emissions, the current ETS definition for installation boundaries apply.

Introduction of a minimum emission (of fuel volume) threshold can be considered to introduce simplified MMR rules or to remove smaller entities from the system. The smallest entities covered (in terms of fuel production) will probably be small coal mining operations.

5.6.5 Sensitivity for fraud
In general the regulated entities are large entities with strong internal financial controls and sensitivity for fraud by the covered entities can be regarded as small. However, small scale, private, unregistered imports over the EU border are likely to increase with a increased difference in fuel price within and outside the EU.

5.7 Conclusions

An upstream approach would involve a complete overhaul of the EU ETS.
It would change from a system where entities are responsible for the greenhouse gases emitted from their own installations, to a system where entities are responsible for the carbon they bring into the EU.

All fuels would be covered upstream and importers and extractors of fuels (TSOs in case of gas) would need to surrender allowances for each amount of carbon they bring into the EU economy. Since not all greenhouse gases results from fuel combustion, entities that cause such non-combustion emissions would also need to be covered by the system.

In an upstream system, carbon leakage would not occur at the level of the regulated entity but rather at a more downstream level. Leakage could be addressed by granting free allowances or direct financial compensation to downstream entities that are at risk. The entities could sell the free allowances to the regulated entities. The advantage of direct compensation is that it is not necessary to withhold allowances issued to exposed downstream entities from the amount to be auctioned to regulated entities.
Both approaches would have the same impacts as the current allocation of free allowances to exposed sectors.

We estimate that an upstream system would have about 3,000 entities and that it would cover over 80% of EU GHG emissions. It would have lower administrative costs than the current ETS because the number of entities would be an order of magnitude lower (assuming downstream exposed sectors will not receive and trade allowances but receive direct financial compensation). The number of entities seems to be sufficient to provide for a liquid market.

The impacts on the transport sector and the built environment are the same as the impacts of the other inclusion variants analysed in this report, because all variants would include these sectors upstream. The impacts on other sectors require further analysis.

6 Impact on EU allowance market

6.1 Introduction

One of the possible reasons to include transport and the built environment in the EU ETS would be to increase the overall supply and demand for allowances, reduce price volatility and thus provide a stronger price signal for a transition to a low carbon economy. This chapter analyses whether this could be expected or whether we might see the opposite effects. Section 6.2 analyses the impact on the price of allowances, while Section 6.3 analyses the impacts on price volatility. Conclusions are drawn in Section 6.4.

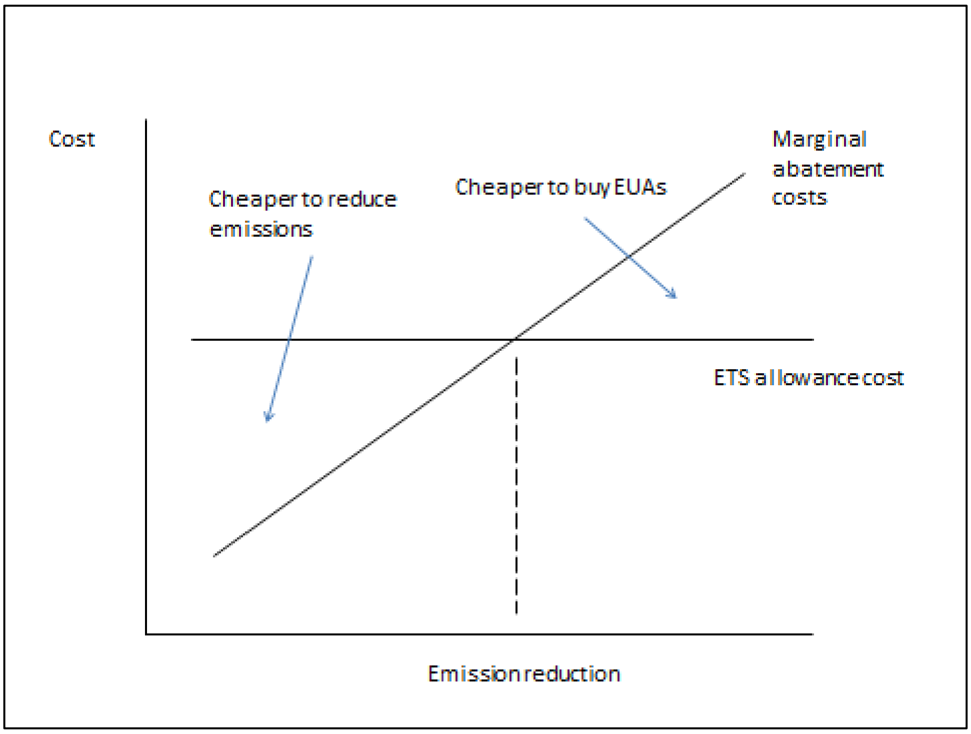
6.2 Impact on allowance price

In this section we discuss the possible long-run price impacts of including transport and the built environment in the ETS. It should also be noted that there might be quite significant short-run price impacts as well; these are covered in the next section. In general, long-run price impacts are defined as those that could be compensated by the European Commission adjusting the supply of allowances through some flexible mechanism.

6.2.1 How the allowance price is set

In the EU ETS the allowance price (EUA price) is the outcome of the market mechanism and, under present arrangements, is almost completely outside the control of policy makers once the emission reduction target (i.e. the cap) has been set. This cap, when taken with any offsetting mechanisms like CDMs, determines the supply of allowances in the market. The demand for allowances is determined by prices and the level of production within the sectors covered by the ETS, which in turn depend on various factors discussed below.

Emissions will be reduced if it is cheaper for the participating firm to take action to reduce emissions than it is to use an ETS allowance; as the EUA price increases, so will the emission reductions (see figure below). If this is aggregated across all participating firms so that, for a given level of economic production, the EUA PRICE is set at the marginal cost of reducing emissions to a level consistent with the cap.



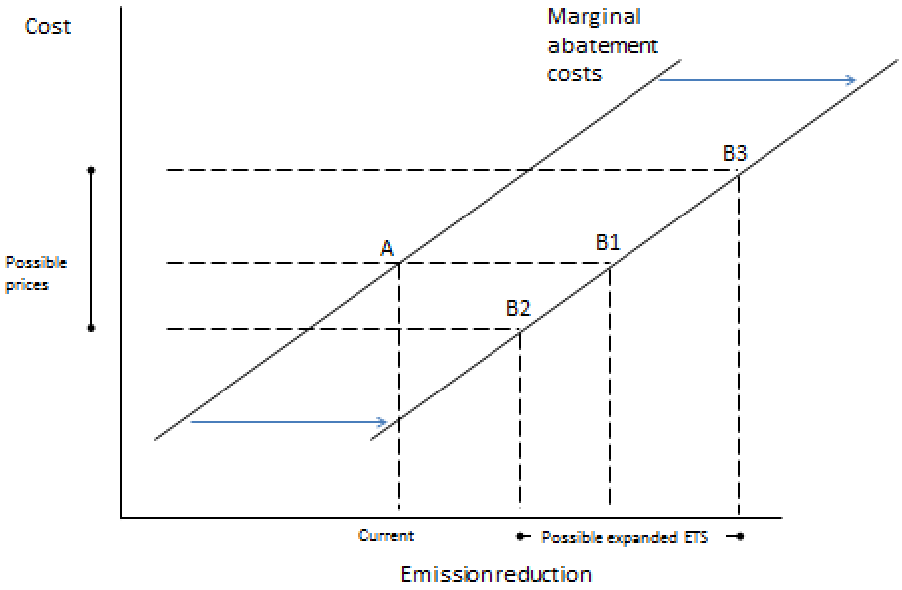
6.2.2 What if the allocation is does not match exactly?

If the EU ETS was expanded to include transport and the built environment, the cap would have to be adjusted to the inclusion of the new sectors. Price impacts depend on how tight the cap is set and if the newly added sectors would be net buyers or net sellers of emission allowances on the exchange market. Theoretically, it would be possible for the European Commission to set the cap so that the EUA price does not change. It would need to determine the reduction in emissions in transport and buildings for the carbon prices expected in the current trading period and set the cap accordingly.

However, there are some obvious practical difficulties:
- the future demand for allowances from transport and the built environment is unclear, as it is for sectors already covered by the ETS;
- the marginal costs of abatement (i.e. the relationship between the EUA price and emission reductions) are not known and will change over time;
- participating firms may not behave optimally, for example if they are unaware of their abatement options;
- abatement options do not necessarily coincide with the regulated entity. especially in the transport and built environment sectors the regulated entity most likely will not be entity that can decide if emissions will be reduce;
- there is a feedback effect between the EUA price and the level of demand for allowances (so it is not possible to take a ‘given’ level of economic production).

In addition, if external credits such as CDM credits are included in the system there could be a feedback between the EUA and the total supply (a higher EUA price makes the external options more attractive financially).

For these reasons it is impossible to predict the EUA price under the existing ETS. This would not change if the scope of the ETS was widened. Expansion of the ETS would be represented in the figure above by the Marginal Abatement Cost Curve shifting to the right. The figure below shows three possibilities for the price, depending on how the new cap is set. Moving from point A, the allowance price could be unchanged if the new cap was set at point B1. But if the new cap is too high then the price will be at point B2, if it is set too low, then the allowance price will increase to B3.



It is inevitable that including the transport and built environment in the ETS will affect the EUA price. If the European Commission wished to increase the price then it could do so by setting a restricted cap, in which the increased supply of allowances is intentionally below the expected demand from transport and buildings.

However, if we work on the assumption that the Commission is aiming not to change the EUA price, the following questions are most relevant:
- Does including transport and the built environment in the ETS make it easier to predict the demand for allowances?
- Would the effects of mis-setting the cap on the EUA price be larger or smaller if these sectors were covered in the ETS?

6.2.3 How easy is it to estimate demand for allowances from these sectors?

The main factors that influence demand for ETS allowances from the transport sector are:
- state of the economy;
- international energy prices and national fuel taxes;
- other policy, including vehicle efficiency standards;
- technological changes that could affect vehicle efficiency.

For the built environment, the factors are similar. However, our time frame is roughly ten years which represents the likely maximum length of one trading period in the EU ETS (e.g. 2020-30). As the stock of buildings changes much more slowly than the stock of vehicles, this makes changes in regulation and technology much less likely to have a significant impact on the demand for ETS allowances. In general, one can state that the transport and built environment sector have less elastic demand curves for carbon than the industry sector – a factor that contributes to the higher stability that adding these sectors would bring to the carbon market.

It should also be borne in mind that we are only considering the direct demand for allowances from the built environment, as the power generation sector is already included in the ETS. Almost all of the demand for allowances will come from the use of gas for space heating, water heating and cooking. This means that the demand for allowances will be dependent on weather patterns but we assume that this is more likely to have an impact on short-term demand and that, over the longer term, changes in weather balance out. This factor is therefore considered in the next section.

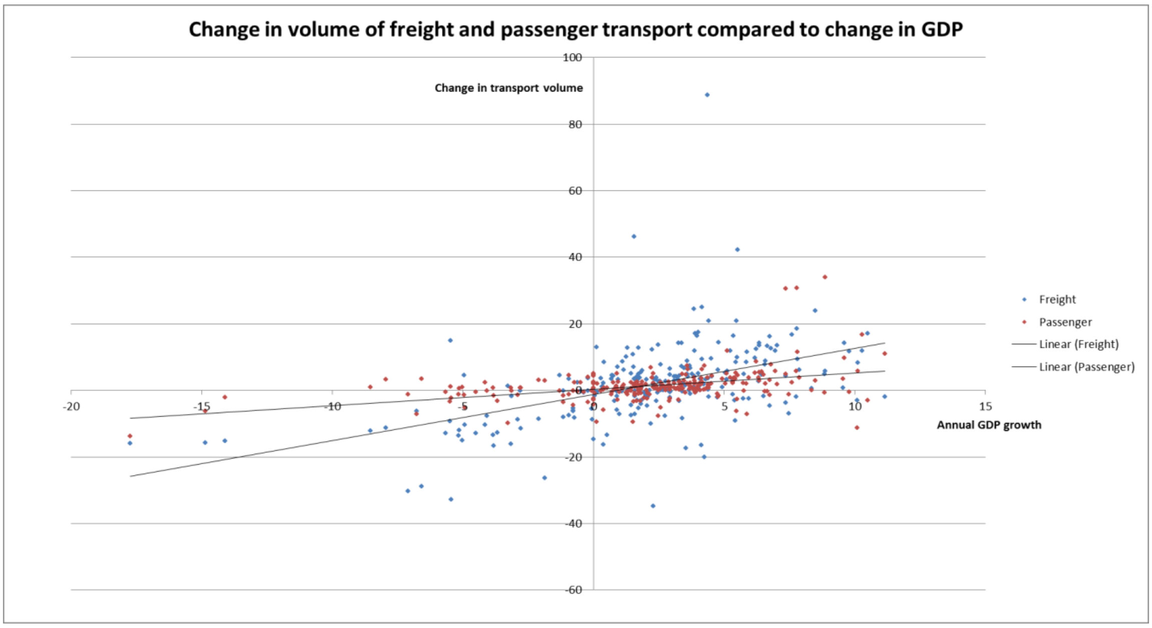
The four demand factors above are considered in turn. The key question is whether these factors are easier to predict for transport than for the other sectors that are already included in the ETS.

Response to changes in economic growth

The figure below shows annual percentage changes in passenger and freight transport, compared against annual change in GDP. Each data point represents one year of growth in one Member State[51] for the period available from Eurostat (2003-11). Lines of best fit have been added to the chart. From this we can see that the volume of freight is quite sensitive to GDP; on average for a 1% increase in GDP, the volume of freight increases by 1.4%. In comparison, for passenger transport, an increase in GDP of 1% leads to an increase in travel of just 0.4%. It should be remembered that these patterns may not persist into the future and it should be noted that it can be difficult to predict future transport demand.

The current ETS sectors provide a mixture of sensitive and non-sensitive sectors. For example, electricity demand typically changes by less than GDP, while many of the industrial sectors (e.g. steel, cement) provide inputs to highly cyclical investment goods. Although the figures show that transport is similarly mixed, we know that passenger transport accounts for the majority of transport emissions. This means that the transport sector as a whole would reduce the sensitivity of total demand for ETS allowances to changes in the rate of economic growth.

51 Croatia is excluded from the series for freight as there are no data available.



For the built environment we can draw a similar conclusion. The use of heating fuels is regarded as a basic need and, given the long timespan of buildings, therefore is rather insensitive to changes in incomes or rates of economic activity. While there is a general upward trend in household consumption of natural gas (around 1.5% pa since 1995), this is not obviously linked to rates of economic growth, with year-on-year fluctuations instead determined by weather patterns, particularly in winter months.

Response to changes in fuel prices
The interaction between international (commodity) energy prices and the EUA price is a complex one. All other things being equal, lower energy prices will increase the demand for fossil fuels and therefore for ETS allowances. However, the prices of different energy carriers do not move in synchronisation; coal prices are not directly linked to other fuels and, since 2005, the link between oil and gas prices has begun to break down. This means that it is possible for gas prices and the EUA price to increase at the same time, if power companies switch from using gas to coal plants.

In the transport and built environment sectors, the options for fuel switching are quite limited, at least in the near term. The main option for road transport is between petrol and diesel which will not have much impact on the EUA price overall. In the longer term, there is the possibility of greater uptake of electric or hydrogen vehicles but these are already included in the ETS through the power generation sector.

For the built environment, it is possible to replace gas boilers (and cookers) with electric ones (and/or heat pumps), but the rate of change is generally slow so this should have little impact within a single ETS trading period.

The question therefore becomes a less complex one of the relationship between fuel prices and fuel demand. This is represented in computer models by price elasticities (see Sections 3.2.5 and 4.2.8). These are estimated using econometric analysis of historical data sets. Although the estimates vary by country and over time, they typically show that (road) passenger transport has a relatively high price elasticity, while the elasticity for freight transport is lower. Households and offices usually have a low price elasticity. This is partly because demand for heat/warmth is a basic need and, at least in the case of offices, because the cost is such a small proportion of business costs.

Although in this report we only discuss price elasticities for transport and the built environment, the key question here is how these elasticities compare to the industrial sectors that are already covered by the EU ETS. For this we can refer to the elasticities that are used in the E3ME macro-econometric model, which in turn draw upon other published research[52].

- The built environment: -0.2.
- Industrial sectors: -0.2 to -0.4.
- Transport sectors: -0.4 to -0.7.

For transport and the built environment, the elasticities that the model uses are quite similar to those described elsewhere in this report, with the industrial sectors falling in between. It is difficult to derive a single price elasticity for the power sector as the behavioural response could be highly non-linear and depend on renewable costs, but results from modelling exercises assessing carbon prices tend to show larger responses in the power sector, implying an elasticity that is larger in magnitude than the one for the industrial sectors (and possibly also the transport sectors).

All this suggests that including transport in the ETS could increase the sensitivity of the EUA price to changes in international commodity prices, while the opposite is almost certainly true for buildings. However, it is important to take into account that a large proportion of the price consumers pay for transport fuels constitutes national taxes and excise duties. While it is not possible to fully predict future tax rates in all the Member States, it is reasonable to assume that tax rates will be far more stable than international oil prices. As taxes account for around 50% of the total price[53] of motor fuel, the response in demand to a change in international oil prices would be half that suggested by the elasticity. This means that the demand response from the transport sector is quite similar to the response that is estimated for the industrial sectors already covered by the ETS.

There is an additional factor to consider. As noted above, prices for the different fuel types may not move in a synchronised way. This means that broadening of the fuel mix used by ETS sectors could reduce the degree of variability in the EUA price resulting from changes in a single fuel price. As the current ETS is largely made up of a mixture of coal and gas, inclusion of the transport sector would extend this to include liquid fuels as well. Therefore, including the transport sector in the EU ETS should make the EUA price less responsive to changes in any one fuel price.

In summary, there is a strong case to suggest that including the built environment in the ETS would reduce price sensitivity to changes in international fuel prices. Although less clear cut, it also seems likely that including the transport sector would also reduce EUA price sensitivity.

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[52] See www.e3me.com, the relevant equations are described in Section 4.3 of the model manual.

[53] http://www.bloomberg.com/news/2013-08-26/fuel-smugglers-costing-europe-more-than-4-billion-in-lost-taxes.html.

Response to regulatory changes
The main relevant regulation affecting the transport sector is fuel efficiency (emission) standards. As these are set at European level on a reasonably long timescale[54] they should not introduce significant uncertainty into the demand for ETS allowances. Computer modelling of the vehicle fleet is able to give a fairly accurate representation of its average efficiency, given the standards enforced.

For the built environment, there is a significant lag between the introduction of regulation and its effect on emission levels, due to the slow turnover of the capital stock. The most important factors could be those that relate to boilers (e.g. measure to increase use of condensing boilers), which have a similar lifespan to cars, and the expansion of national gas grids.

In comparison, the current ETS is heavily influenced by policies relating to the share of renewables in electricity generation. Overall, we therefore do not expect that expanding the ETS to include transport and the built environment would make the EUA more sensitive to regulatory changes.

Technology factors
For the transport and built environment sectors, technology and regulatory factors are quite closely linked. The emission standards for light-duty vehicles require that new technologies are developed and deployed in vehicles. It is unlikely that technological development will improve efficiency much beyond the rates set by the standards. While electric and hydrogen vehicles will continue to be developed, the timeframes involved are long and, when coupled with the time it takes to renew the vehicle fleet, it is possible to predict with reasonable confidence the approximate fleet shares the technologies will have up to ten years ahead.

Similarly for the built environment, while new efficient technologies continue to be developed for gas appliances (again mainly in boilers), the turnover of capital stock means that it is possible to make reasonably accurate predictions of the stock up to ten years ahead.

It is clearly not possible to predict the direction that future technology will take and perhaps (by definition) widening the scope of the EU ETS makes it more vulnerable to the introduction of a new and disruptive technology in one of the sectors it covers. However, these particular sectors do not stand out as increasing the risk.

6.2.4 How sensitive would these sectors be to different carbon prices?
The final factor in demand for allowances from the transport and built environment sectors is the impact of the changing ETS allowance price itself. For example, if these sectors proved to be responsive to a changing EUA price, they might help to support the price at a stable level.

This is unlikely to be the case, however. As outlined above and in Section 3.2.4, these sectors will not be particularly responsive to changes in fuel prices, including the ETS component. In addition, as they do not use coal, the ETS component is not as large a share of total fuel costs as it is for power generation and some of the industrial sectors. Therefore, if a gap opened between the supply and demand for allowances, it would for the main part be

54 Currently for light-duty vehicles, possibly heavy-duty vehicles in future.

other sectors that would be expected to bridge this gap by adjusting emission levels.

6.2.5 Summary

This section has explored how the inclusion of transport and the built environment in the EU ETS would impact on the EUA price. It notes that the impact is highly dependent on how the cap is set by the European Commission.

The analysis then considers the main difficulties in estimating a cap that would create a moderate and stable carbon price. It finds that while there are considerable uncertainties, these are probably less than those that exist for the sectors that are currently covered by the EU ETS, with the possible exception of freight transport. The implication is that including transport and the built environment would make it less difficult to predict the future demand for allowances. A rough calculation based on current EU emission projections suggests that a 20% error in the prediction of transport emissions would be equivalent to a 7% error in predicting total ETS emissions.

The final aspect that we look at is how sensitive the EUA price might be to an error in setting the cap. The same analysis as above suggests that the transport and built environment sectors would not be very sensitive to changes in the EUA price. This means that if the cap was mis-specified relative to an objective of not changing the EUA price, or if demand from the transport and built environment were different from expected, it would largely be up to the other sectors to adjust their emission levels and the possible range for the EUA price would increase.

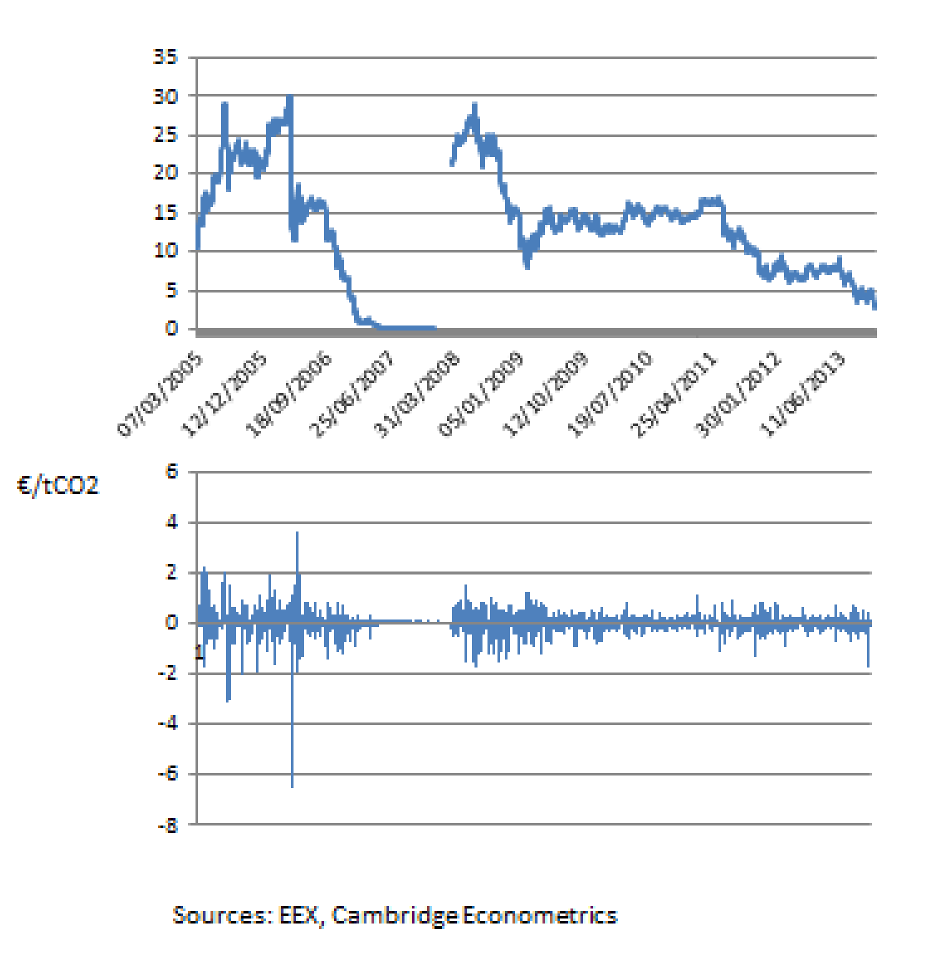
6.3 Impact on short-run price volatility

The previous section discussed how the inclusion of transport and the built environment in the ETS could lead to a carbon price that was either too high or too low in the long run. This section considers short-run changes in the EUA price. For this we refer to daily price data that are available online from the European Energy Exchange (EEX)[55].

As Figure 9 shows, there are constant deviations in the EUA price, reflecting the transactions in the market. This is the same as you would expect in any liquid financial market. The issue of volatility arises when these day-to-day changes become large and we see strong movements in the price of carbon in short periods of time.

55 http://www.eex.com/en/.

Figure 9 EUA price (top) and daily price change (bottom), 2005-2013



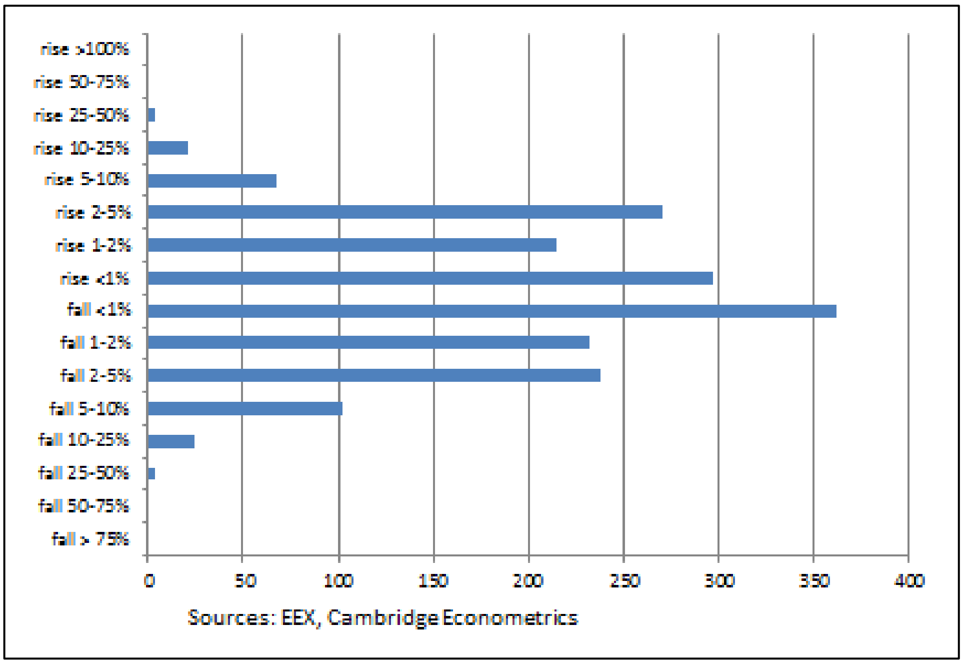
Volatility in the EUA price is generally seen as a bad thing. Companies must operate under much greater levels of uncertainty when there are large variations in the carbon price. If the true market price cannot be identified due to volatility, businesses will not be able to invest efficiently and will face higher costs as a result.

6.3.1 How does short-run price volatility arise?

As the chart above shows, and the previous section discusses, there will be natural fluctuations in the EUA price as the demand for allowances changes on a daily basis. Most of these fluctuations are quite small but in some circumstances they can lead to more substantial variations. Figure 10 provides a breakdown of the percentage EUA price changes for a single day (when the allowance price is higher than € 1/tCO_2). It shows that the daily changes exceed 5% around 12% of the time, which suggests a reasonably high degree of volatility[56].

[56] If we only include days when the allowance price is above € 5/tCO_2, the corresponding proportion is 10%, so prices are not only volatile when they are low.

Figure 10 Daily percentage variation in EUA price (when price > € 1/tCO_2)



If there is a large shock to the market then we could expect to see a large and sudden change in price. These shocks are more likely to relate to the supply of allowances (e.g. regulatory change). Otherwise, to have volatile movements in prices two things need to happen:
- there is a short-term demand shock that causes a fluctuation in prices;
- something amplifies this initial price shock to create a volatile outcome.

The question we need to address is thus whether these factors increase if transport and the built environment are included in the EU ETS.

6.3.2 Short-run changes in demand

In the previous section we showed that, in the long-term, the demand from allowances from transport and the built environment could be expected to be quite stable. In the transport sector, this is likely to be also the case for the short term.

For the built environment, however, weather patterns may cause quite substantial short-run changes in fuel consumption. The electricity sector will already be exposed to these changes to some extent (i.e. higher rates of electricity consumption for heating in cold weather) and the use of gas (and other heating fuels) by households will increase at the same time. It therefore seems quite likely that including the built environment in the EU ETS could lead to larger daily and weekly price fluctuations. The extent of these changes would likely depend on the behavioural response of the groups involved.

6.3.3 Changes to volatility

There are many reasons for volatility in financial markets, not all of which are well understood. These factors can cause relatively small initial changes in prices to quickly become large swings.

One possible reason for price volatility is a low level of liquidity in the market. This occurs when it becomes difficult to match buyers and sellers, for example due to a low number of market operators. In this case it can become difficult to determine a true market value due to a lack of information. A relatively small shift in price could lead to panic buying or selling if individual participants think that they may be unable to buy or sell allowances in the future. A lack of liquidity was one of the features of the financial crisis as many financial operators found that they were unable to sell assets whose values were falling.

On these grounds, it could be argued that including transport and the built environment in the EU ETS would lead to reduced price volatility, as liquidity would increase. It should be noted that the additional number of market participants (and therefore the impact on liquidity) would depend on the design choice of the expanded ETS.

However, higher liquidity is only beneficial if there is a degree of independence between market participants. If all the additional participants decided to buy or sell their allowances at the same time, this could increase volatility overall. It is therefore important to consider how rationally the new participants would behave which, leaving aside questions of theoretical behaviour, effectively asks the question of how well-informed they might be.

Again this is likely to depend on the design option chosen and the market strategy the entities employ. Provided that they regard the ETS as a market opportunity, a small number of large additional upstream players, likely to be well-informed, could add to market stability, although without deepening liquidity so much. In contrast, if the entities would act as transmitters of the allowance price or if individual transport/buildings users were included in the ETS directly there would obviously be many more of them but they would not be so well-informed. In this case it is possible that there would be a 'herd' mentality, leading to large swings in the EUA price, that would likely benefit large (and informed) operators at the expense of smaller ones.

The allocation mechanism may also be an important issue. It seems likely that many companies that are allocated allowances use these allowances to cover their own emissions and do not for the most part engage in trading (e.g. due to transaction costs). Trading volumes would be much higher if users were forced to buy allowances either on the market or through government auctions as this would increase familiarity with the system and reduce transaction costs.

However, the reasoning so far in this section ignores one important issue: that trade of allowances is not restricted to organisations that are covered by the EU ETS. A very large source of liquidity in the market is provided by financial institutions that trade on the market and do not face significant transaction costs. It is not clear whether the net effect of these institutions is to increase or reduce price volatility; informed investors may buy allowances when prices become low (providing price stability) but other organisations such as hedge funds may take a position on future ETS prices as part of their investment strategy (more likely increasing volatility). Either way, however, the contribution from these market participants would not change if the ETS was expanded, unless the presence of badly performed participants opened up trading advantages to financial firms.

6.3.4 Conclusions

It is inevitable that there will be day-to-day fluctuations in the EUA price and expansion of the ETS to include transport and buildings will not change this; EUA prices are fairly volatile already and seem likely to stay this way.
Our assessment suggests that there could be a small increase in these price fluctuations due to weather-related factors leading to sudden changes in demand for heating fuels (mainly gas).

However, these short-run price fluctuations in themselves do not make the system volatile. Volatility is when there are either sudden sharp changes to the price or lots of small changes in one direction over a short period of time. Price volatility is viewed negatively because it can lead to poor investment decisions and a misallocation of capital, leading to higher compliance costs than necessary for participating firms.

Overall, it is not clear whether including transport and buildings in the ETS would lead to an increase in short-run price volatility or not. There are arguments both for and against and, to a certain extent, the outcome will depend on the choice of design option. However, as trade in ETS allowances is not restricted to firms that are covered by the ETS, it seems unlikely that expanding ETS coverage is going to have a major impact on the degree of short-run price volatility.
This should therefore not be a major factor in evaluating possible ETS expansion.

6.4 Conclusion

Will the inclusion of transport and the built environment in the EU ETS create a more stable market? This chapter finds that it could result in a more stable demand, but that it would probably not affect price volatility.

The demand for allowances from the transport sector and the built environment would probably be more stable than the demand from the sectors that are currently covered by the EU ETS, with the possible exception of freight transport. However, emissions from both sectors are projected to decrease in the coming decades. As a result, the cap for these sectors would need to decline to ensure that demand is stable.

It is not clear whether including transport and buildings in the ETS would lead to an increase in price volatility or not. However, as trade in ETS allowances is not restricted to firms that are covered by the ETS, it seems unlikely that expanding ETS coverage is going to have a major impact on the degree of price volatility. This should therefore not be a major factor in evaluating possible ETS expansion.

7 Conclusions

7.1 Overall conclusions

It is possible to include transport or the built environment in the EU ETS. This report has developed five inclusion variants, i.e. ways to include these sectors:
- two upstream variants for transport, to be added to the current ETS;
- two upstream variants for the built environment, to be added to the current ETS;
- one variant which would include all fuels used in the EU economy upstream (including those used in current ETS sectors)[57].

The inclusion variants have been developed on the basis of a thorough analysis of a large number of design options and an extensive set of evaluation criteria. We find that the most important design options are the regulated entity and the allocation methodology. The most important criteria are:
- whether or not a sector can be addressed with sufficient precision (in terms of system boundaries, MRV accuracy, leakage, fraud);
- what the number of regulated entities and the associated administrative costs are.

For the transport and built environment inclusion variants, two variations are analysed, which use the same regulated entity, but a different allocation approach. The inclusion variants are summarised in Table 35.

Table 35 Overview of inclusion variants

<table>
<tr><th>Variant</th><th>Regulated entity</th><th>Allowance allocation method</th><th>Sectors and subsectors covered</th></tr>
<tr><td>Variant 1a</td><td rowspan="2">Tax warehouse keeper</td><td>Auctioning</td><td rowspan="2">All transport sectors (the possibility of exempting subsectors has been analysed)</td></tr>
<tr><td>Variant 1b</td><td>Fuel benchmark</td></tr>
<tr><td>Variant 2a</td><td rowspan="2">Tax warehouse keeper (liquid fuels)
Fuel supplier (gaseous and solid fuels)</td><td>Auctioning</td><td rowspan="2">Built environment</td></tr>
<tr><td>Variant 2b</td><td>Fuel benchmark</td></tr>
<tr><td>Variant 3</td><td>Importer or extractor of liquid or solid fossil fuel
TSO for gas
Point sources for non-energy related GHGs</td><td>Auctioning (compensation for exposed downstream entities has been analysed)</td><td>All sectors using fossil fuels, including transport and the built environment.</td></tr>
</table>

57 As well as the current non-energy-related GHG emissions, which would be regulated at their point of emission.

In the inclusion variants for the transport sector, the number of regulated entities would increase by 5,000 to 10,000 from the current 13,000. The administrative burden would increase less than proportionally, because most of the regulated entities already have monitoring and reporting requirements for fiscal reasons, on which they could build.

The inclusion variants for the built environment would result in an increase of the number of entities with 11,000 to 18,000 because of the large number of coal suppliers. This means that the administrative burden will increase considerably. In contrast to the tax warehouse keepers and the gas suppliers, the suppliers of coal would need to build up an MRV system from scratch in many Member States unless they would be excluded. This would require significant upfront costs.

In the third variant, the number of regulated entities would decrease to approximately 3,000. The administrative burden could be reduced proportionally, but could be somewhat larger when provisions are included to prevent carbon leakage.

Including the transport sector would increase the amount of emissions in the ETS by 22%, including the built environment by 16% (Table 36). If both sectors would be included, the ETS would cover 83% of EU greenhouse gas emissions. In that case, emissions from agriculture (with the exception of emissions from agricultural vehicles and machinery), from waste and from land use, land use change and forestry, and emissions of maritime transport would be the only EU emissions not included in the EU ETS.

Table 36 Emissions in the scope of an upstream ETS (2010)

	Mtonne CO_2 eq.	Percentage of GHG emissions EU
Total GHG emissions EU	4,834	
Energy related GHG emissions under current ETS	1,897	39%
Non-energy related GHG emissions under the current ETS	280	6%
Transport CO_2 emissions	1,050	22%
Built environment CO_2 emissions	751	16%
Total coverage of inclusion variant 3	4,019	83%

Source: Primes reference line.

Based on an analysis of historical emissions data and price elasticities, we conclude that inclusion of these sectors would create a demand for allowances which is less affected by economic cycles and fuel prices than demand from the current ETS sectors. As such, it may dampen the impacts of these factors on allowance prices.

The chosen inclusion variants would result in a price signal to these sectors, which would improve the cost-effectiveness of emission reduction measures. Other barriers in these sectors, such as split incentives, bounded rationality, limited information, high upfront costs, would not be reduced by their inclusion in the EU ETS. Hence, sector specific policies remain of importance. The role of the CO_2 component in the Energy Taxation Directive would need to be reconsidered.

7.2 Including the transport sector in the EU ETS

The transport sector can in principle be included in the EU ETS. The main design choices are the regulated entity and the method for allocation. The tax warehouse keeper would be the best regulated entities, as currently almost all transport fuels in the EU pass through tax warehouses which already have to comply with monitoring and reporting requirements for fiscal reasons (natural gas is the exception). In many Member States, tax warehouse keepers report the sector in which a fuel is used and in some, distinctions are made between different subsectors such as agriculture or inland waterway transport, e.g. when differentiated tax or excise duty rates apply. This means that at least in principle it is possible to exempt certain subsectors.

Transport is not exposed to a significant risk of carbon leakage under the criteria the EU currently uses. Hence, the preferred method for allocating allowances is auctioning. This is the most economically efficient way to allocate and has the lowest administrative costs. However, free allocation on the basis of a fuel benchmark is also possible, but more complicated. In that case, both the costs for developing the system as the transaction costs would increase since rules for new entrants and closures would have to be developed, and entities would need to monitor, report and verify output in a base year. Since no equivalent for an installation's capacity exists with the selected regulated entity, defining new entrants and closure rules is complicated. Moreover, free allocation would result in windfall profits for the regulated entities.

All subsectors of transport can in principle be incorporated in the EU ETS, including inland waterway transport, rail, agriculture and non road mobile machinery, because they all use fuels that pass through tax warehouses. Inclusion of all sectors would ensure that the competition between the modes is not distorted.

Natural gas supplied to the transport sector, either as LNG or as CNG, does not pass through tax warehouses and not in every Member State through excise duty points. In order not to distort the market between fuels, it would be advisable to include natural gas in the tax warehouse system, at least when used in the transport sector.

In terms of legislation, inclusion of the transport sector in ETS would provide a similar price signal as energy taxation and address similar barriers. Hence, a revision of CO_2 based national energy taxes may be warranted in order to avoid a double price signal to the transport sector. Specifically for inland waterway transport in the Rhine estuary, the compatibility of the ETS with the Mannheim Convention requires a more detailed legal analysis.

The impacts of the inclusion of fuels in the EU ETS on fuel prices would depend on the allowance price. Assuming a price range of € 10–€ 40 per tonne of CO_2, average EU retail prices would increase by 2-7%. In the long term, this would reduce transport emissions by up to 5%. The increase in fuel prices would have a small impact on disposable incomes. In some countries, the impact would be progressive, in others it would be regressive.

7.3 Including the built environment in the EU ETS

The built environment can be included in the EU ETS. The main design choices are the regulated entity and the method for allocation. For heating fuel and LPG, tax warehouses are proposed as regulated entities for the same reasons as mentioned above. Coal and natural gas do not pass through tax warehouses, and they are exempt of excise duties or other energy taxes in many Member States. For these fuels, the fuel supplier is the entity type that is most upstream in the supply chain (and consequently has the lowest number of entities), while still being able to discern between fuels supplied to the built environment and to other sectors.

The built environment is not exposed to carbon leakage under the criteria the EU currently uses. Hence, the preferred method for allocating allowances is auctioning. This is the most economically efficient and has the lowest administrative costs. However, free allocation on the basis of a fuel benchmark is also possible, but more complicated. In that case, both the costs for developing the system as the transaction costs would increase since rules for new entrants and closures would have to be developed, and entities would need to monitor, report and verify output in a base year. Since no equivalent for an installation's capacity exists with the selected regulated entity, defining new entrants and closure rules is complicated. Moreover, free allocation would result in windfall profits for the regulated entities.

Including the suppliers of gas and coal in the built environment in the EU ETS would require the development of monitoring, reporting and verification systems. For gas, all physical flows in gas networks are metered and these data can be used as a basis for monitoring emissions. For coal, the challenge would be larger because of lack of additional control mechanism (such as the tax warehouse system) or physical limitations (as in natural gas distribution) and the variability of the carbon content of coal sold. This results in reduced accuracy in MRV and a higher risk of leakage to outside the system and fraud.

Since the ETS would transmit a price signal to the end users, similar to energy taxes, care would need to be taken to avoid decreasing the efficiency of the incentives. While the price signal would make abatement options more attractive financially, it would not address other barriers, such as a lack of knowledge and awareness, the split incentive, or the disruptive nature of many reduction measures. Hence, the inclusion in ETS would not be a reason to reconsider policies aiming to remove these barriers. In fact, it would make them more cost-effective.

The impacts of the inclusion of fuels in the EU ETS on fuel prices would depend on the allowance price. Assuming a price range of € 10-€ 40 per tonne of CO_2, average retail prices would increase by 3–12% for gas and heating oil, and 9-36% for coal. In the long term, this would reduce emissions by 2%. The price increases for coal would be much higher in countries where the coal price is low.

The increase in fuel prices would have a small, regressive, impact on consumption expenditures for users of gas and heating oil. For coal users, increase in consumption expenditures for coal could be relatively large.
On average, the lowest income quintile using coal would pay about 1% of their income to ETS price increases. In countries which currently have a lower coal price and where the expenditures on coal are high, the share could be higher. To the extent that this is undesirable, the effect could be offset by fiscal measures, taking into account the receipts from auctioning allowances.

7.4 Upstream coverage of all fuels in the EU ETS

The previous sections discussed incorporating transport and the built environment in the current ETS through upstream coverage of tax warehouses and fuel suppliers, resulting in a hybrid system. Instead, it would also be possible to redesign the entire ETS to cover all fuels upstream, including fuels used in the current ETS sectors. This has the advantage that fuel use does not have to be tracked to the sectors in which they are consumed.

In such a case it would make sense to assign fuel extractors and importers with the obligation to monitor fuel sales and surrender allowances. This would minimise the number of entities covered by the system and the administrative costs. In case of natural gas, TSOs are better suited than the extractors/ importers, as there are fewer of the former and TSOs already monitor fuel quantities accurately. In addition to these entities, emissions from processes other than combustion could still be included in the EU ETS by including the emitting installations in the system.

The allowances would be auctioned as this is economically the most efficient and administratively the least complex way to allocate them. It would also prevent a large windfall for the regulated entities.

However, special provisions would need to be taken for sectors at risk of carbon leakage further downstream, as their competitiveness could be negatively impacted by the pass-through of the costs by regulated entities in the fuel prices. The current way to address them cannot be applied since installations in these sector would not be responsible for surrendering allowances for the fuels and emissions involved. Still, they could be given free allowances which they could sell to responsible entities to offset their fuel cost increases. This would require a reduction of the amount of allowances to be put up for auctioning, so as not to increase the system's cap. Alternatively, financial compensation can be offered in line with the current provisions for indirect carbon leakage in the Directive.

Special provisions may also need to be taken for exports by downstream entities and for the use of fuels as feedstock, rather than as energy carriers, as these fuels are not (directly) combusted and do not (directly) result in carbon emissions. As a result, the number of allowances surrendered would no longer equal the amount of emissions. Moreover, sectors that use fuels as feedstock and are at risk of carbon leakage could need to be compensated. There are three options to do so. One is to provide for financial compensation, the other to allocate free allowances for feedstock use and the third to allocate credits which could be surrendered as allowances. The second option would be simple, but bring a volatile sector under the cap, thus potentially strengthening the impact of the business cycle on the allowance price.
The third option would be more complex, but would leave feedstock emissions out of the cap.

Such a complete overhaul of the EU ETS would require analyses that are beyond the scope of this study. What is clear from this study is that it would bring over 80% of EU emissions under the ETS cap. The emissions outside the scope would be from agriculture (with the exception of emissions from agricultural vehicles and machinery), from waste and from land use, land use change and forestry, as these emissions do not result from the use of fuels.

The administrative costs of an upstream system would be lower than both the current system as well as the other inclusion variants discussed before, as the number of responsible entities would be reduced to approximately 3,000. The increased scope of the system, combined with the more extensive use of auctioning, will result in substantially more auctioning revenues than in the current system (comparable to the other inclusion variants discussed before). Note that if downstream would be compensated for the increased fuel costs through direct financial compensation, the public revenues will be substantially less than if the compensation takes the form of free allowances.

7.5 Impact on the allowance market

The inclusion of transport and the built environment in the EU ETS could result in a more stable demand, but that it would probably not affect price volatility.

The demand for allowances from the transport sector and the built environment would probably be less dependent on the business cycle than the demand from the sectors that are currently covered by the EU ETS, with the possible exception of freight transport which has a higher price elasticity of demand than the other sectors. However, emissions from both sectors are projected to decrease in the coming decades. As a result, the cap for these sectors would need to decline to ensure that demand is stable.

It is not clear whether including transport and buildings in the ETS would lead to an increase in short-run price volatility or not. However, as trade in ETS allowances is not restricted to firms that are covered by the ETS, it seems unlikely that expanding ETS coverage is going to have a major impact on the degree of price volatility. This should therefore not be a major factor in evaluating possible ETS expansion.

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Annex A Definitions

This annex defines central concepts used throughout this study.

Baseline-and-credit system – a baseline-and-credit trading system sets an efficiency standard and allows entities that have a better efficiency to create credits which they can sell to entities that have a worse efficiency.
In a baseline-and-credit trading system there is no absolute cap on emissions, but rather cap on the amount of emissions per unit of activity. Sometimes, a baseline-and-credit trading system has been called a relative emissions trading system.

Built environment – residential and utility buildings with installations for heating or cooling that emit greenhouse gases.

Candidate sectors – transport, the built environment and subsectors thereof.

Current ETS sectors – all sectors of which emissions are currently included in the EU ETS.

Design parameter – issues on which a choice has to be made in order to design the inclusion of direct combustion emissions of a candidate sector in the EU ETS. Examples: regulated entity, allocation of allowances, etc.

Design option – the alternatives for the design parameter. Example for allocation: grandfathering, auctioning, benchmarking, etc.

Double counting – counting emissions twice, either within an emissions trading system or in general. If emissions are double counted in an emissions trading system, two allowances are surrendered for the same unit of emissions.
If emissions are double counted between systems, they are for example accounted for both in the ETS and in the effort sharing directive.

Emissions of the transport sector – CO_2 and other GHG emissions from combustion of fuels in the transport sector. Emissions from combustion elsewhere (e.g. from electricity production for electricity used in the transport sector) are not included. Neither are emissions associated with manufacturing transport equipment, transport infrastructure, et cetera.

Emissions of the built environment – CO_2 and other GHG emissions from combustion of fuels in installations for heating or cooling in the built environment. Emissions from combustion elsewhere (e.g. from electricity production for electricity used in the built environment) are not included. Neither are emissions associated with construction, renovation, et cetera.

Evaluation criteria - criteria which should be met for a successful integration of transport and/or built environment in EU ETS. The criteria are specified in Annex B.

Implications - Economic, social and environmental impacts and required changes in regulation.

Inclusion variants – coherent sets of design options for the inclusion of transport emissions or built environment emissions in the EU ETS.

Regulated entity – the entity that is required to surrender emission allowances in an emissions trading system.

Transport sector – transport equipment for movement of passengers or freight over road, rail, and inland waterways that emit greenhouse gases. Aviation and maritime transport are not considered to be candidate sectors, as the former is already included in the EU ETS and the latter's possible inclusion is studied under different contacts. Transport via pipelines is out of the scope.

Subsectors - parts of the transport sector and built environment. Some examples of subsectors in transport are light duty vehicles (LDV), Heavy Duty Vehicles (HDV), private cars or company cars. Examples of subsectors in the built environment are residential buildings and commercial buildings.

Annex B Evaluation criteria

Evaluation criteria have a central role in the analysis throughout this report. They have been used in the analysis of individual design parameters as reported in Annex C and Annex D. The results of this analysis have guided the selection of inclusion variants (Chapter 2). The analysis of the inclusion variants has been carried out using the evaluation criteria as reported in Chapters 3, Chapter 4 and Chapter 5).

The selection criteria have been developed on the basis of impact assessment guidelines and the study specifications, taking the scope and constraints of the study into account. They have been agreed with the Client.

Table 37 presents the criteria.

Table 37 Evaluation criteria used in the study

Criterion	Sub-criterion	Indicator	Comments
Environmental impact	Magnitude of emissions	Absolute emissions (t) in the (sub)sector studied Share of total EU emissions	
	Expected emission trend	Projected emissions for 2020 and 2030, or the average annual change in emissions per year	
	Availability of emission reduction measures	The maximum technical abatement potential, either in a historical year or in a future year	Marginal abatement cost curves (if available) can be used, as well as estimates of individual measures
	Incentive to reduce emissions	The measures or types of measures which are incentivized by the inclusion in the EU ETS, both for the regulated entity, upstream and downstream	
	Risk of leakage – To outside EU – To outside EU ETS scope	Qualitative analysis	
	Effect on longer-term clean technology innovation	Qualitative analysis	Degree to which the design parameter or inclusion variant supports or hinders the development or implementation of new low-carbon technology
	Price elasticity of fuel demand	Number	Expected reaction to an (additional) (carbon) price incentive
Enforcement & technical feasibility	Monitoring accuracy	Uncertainty in emissions estimate	The criteria includes an analysis of data availability/quality issues
	Number and size of entities	Number Size in tonnes of carbon pro annum	
	Feasibility of allocation	Qualitative analysis	Is allocation of allowances in line with harmonized rules feasible?
	Definition of entity boundaries	Qualitative analysis	Is it feasible to clearly delineate which emissions are included and which are not?
	Sensitivity for fraud	Qualitative analysis	

Criterion	Sub-criterion	Indicator	Comments
Economic impact	Costs of emission reductions	Steepness of the MACC or availability of relatively cheap options	Marginal abatement cost curves (if available) can be used, or otherwise other information
	Impacts on competitiveness	Qualitative analysis	Between (sub)sectors (e.g. potential shift to other modes), or to outside the EU
	Transaction cost	Qualitative analysis	Transaction costs include costs for monitoring, reporting and verification of emissions, registry costs, costs of trading, and other costs associated with the inclusion in EU ETS The analysis distinguishes between costs for regulated entities and costs for regulators
	Impact on allowance price	Qualitative analysis	Does the inclusion of the sector(s) create an additional demand for allowances, if so, which parameters determine the demand? How will demand develop over time?
	Price volatility	Qualitative analysis	Does the inclusion of the sector(s) increase or decrease the price volatility allowances
	Equity: income distribution	Progressive/no effect/regressive	Impact on distribution of disposable income
	Equity: early action	Qualitative analysis	Treatment of entities that have taken early action to reduce emissions relative to entities that haven't
	Potential for windfall profits	Qualitative analysis	Does the inclusion variant create profits for entities that would not have occurred in absence of the inclusion?
	Impact on public finance	Qualitative analysis	
	Impact on market	Market concentration	Liquidity, risk of market concentration

Criterion	Sub-criterion	Indicator	Comments
Legislative efficiency	Interaction with other legislative frameworks?	Qualitative analysis	Covered by other legislative frameworks? Policy overlap, interaction Including esp. Renewable Energy, Energy Taxation, F-gas, Fuel Quality Standard, CO_2 and Cars, and Buildings Directives and the EU policy on security of supply (import/export, energy flows)
	Required legislative changes?	Qualitative analysis	In EU ETS Directive, other EU Directives or important national legislation (generic)
	EU competence	Qualitative analysis	

Annex C Evaluation of design parameters transport

C.1 Introduction

In this annex we assess the following design parameters for the inclusion of transport in ETS: regulated entity (Section C.2), allowance allocation method (Section C.3), MRV (Section C.4) and enforcement (Section C.5).
For the assessment of these parameters, the same criteria (or a subset of them) as for the evaluation of the inclusion variants are used (see Section 1.4 for an overview of the criteria).

The results of the analyses presented in this annex are used to choose and define the inclusion variants for transport as presented in Chapter 2. Furthermore, some of these results are used for the evaluation of the inclusion variants for transport, as carried out in Chapter 3.

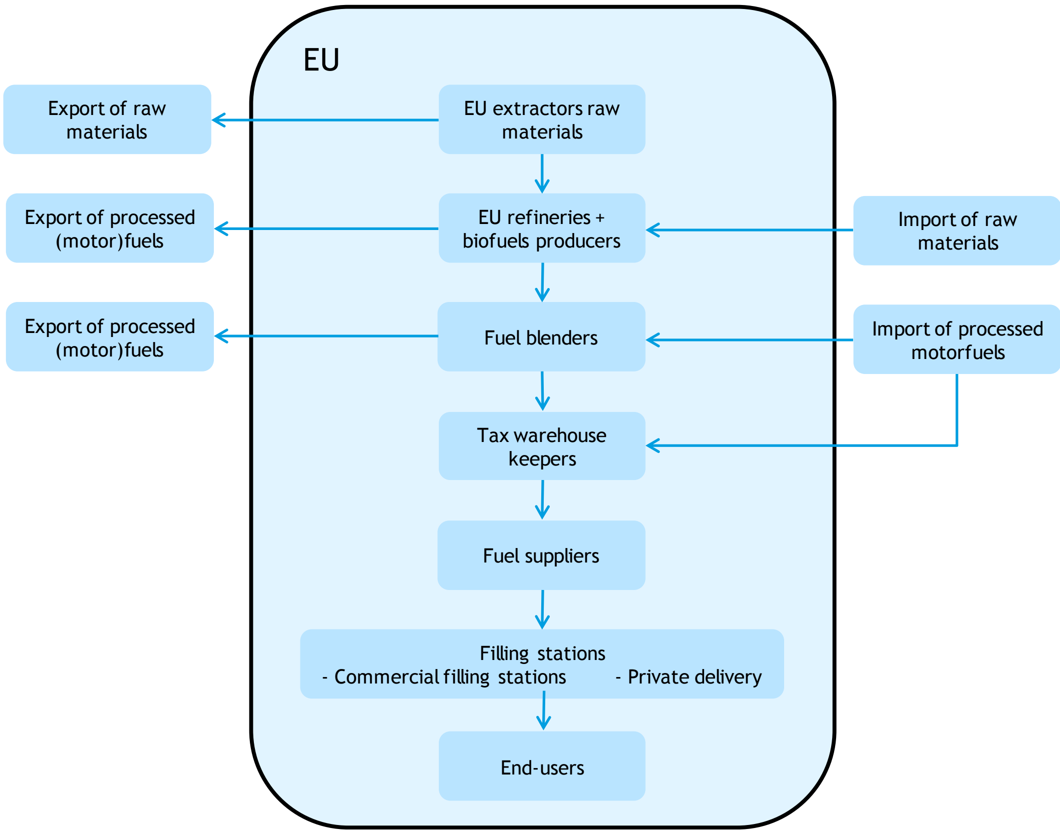
C.2 Regulated entity

In this section we analyse the design option 'regulated entity' for transport. First, we define the various types of regulated entities that could be applied for transport. Next, these options are assessed based on environmental, economic, technical feasibility and legislative criteria.

C.2.1 Options for regulated entities

The various options for regulated entities could be deduced from the fuel supply chain. In Figure 11 the fuel supply chain for petrol, diesel, LPG and biofuels is shown. For the supply chain for natural gas we refer to Annex D.

Figure 11 EU and global motor fuels supply chain



Based on these fuel supply chains we distinguish seven potentially regulated entities for transport. Since the risk of carbon leakage is very significant if imports of materials/fuels are excluded from the ETS, we also take importers into account as potentially regulated entities if necessary to prevent significant carbon leakage. For the same reason exports are considered in defining the regulated entities. The resulting definitions of regulated entities, distinguishing up-, mid- and downstream entities, are:

– Upstream regulated entities
  - *Extractor/importer of raw materials*; all entities extracting crude oil or natural gas from underground deposits within Europe or importing crude oil or natural gas from outside the EU are regarded as regulated entities. In addition, all importers of processed transport fuels are regarded as regulated entities[58]. Next to the extractors/importers of oil/natural gas also the producers/importers of biomass are considered regulated entities in this option.
  - *Refinery/importer of transport fuels*; the European producers of transport fuels (refineries and biofuels producers) and importers of processed transport fuels from outside the EU are regarded are regulated entities.
  - *Fuel blenders*: the organisations responsible for trading and blending (combining fossil and biofuels) the transport fuels. In addition, importers of processed motor fuels are regarded as regulated entities.

58 To prevent a potentially large CO_2 leakage effect by fuel suppliers importing transport fuels from outside the EU.

– Midstream regulated entities
    - *Tax warehouse keeper; t*he tax warehouse keeper is defined as "a natural or legal person authorised by the competent authorities of a Member State, in the course of his business, to produce, process, hold, receive or dispatch excise goods under a duty suspension arrangement in a tax warehouse." An tax warehouse is an authorized place where the above mentioned activities could take place under duty suspension arrangements (EC, 2008). These tax warehouses are often physically located in other entities in the supply chain (e.g. refineries). More information on tax warehouse keepers could be found in Annex E.
    - *Fuel suppliers;* the oil or trading companies supplying transport fuels to the filling stations and in some cases end consumers directly. More specifically, we consider the organisations that owns the transport fuels at the moment the fuels leave the tax warehouse.
    - *Filling stations; all individual (commercial) filling stations as well as the organisations* receiving transport fuels directly from fuel suppliers (private delivery) are regarded as regulated entities.

– Downstream regulated entities
    - *Owner of vehicles*; these are all registered owners of vehicles, like people/households owning private vehicles (passenger cars and motor cycles), lease companies, transport companies owning freight transport vehicles (trucks, vans, inland ships) or 'public' vehicles (taxi, busses, trains, etc.).

It should be noticed that one organisation could entail several types of regulated entities. For example, integrated oil companies are extractors, refineries, fuel blenders, tax warehouse keepers, fuel suppliers and owners of filling stations. However, there are also organisation which only entail one regulated entity.

A first order estimation of the number of emitters per regulated entity in Europe is given in Table 38. The approach to derive this first order estimate is explained in the following textbox.

Table 38 First order estimation of the number of emitters per regulated entity in Europe

Regulated entity	Number of emitters
Extractor/importer of raw materials	500 + large number of small biomass producers
Refinery + importer of transport fuels/fuel blenders	500-1,000
Fuel blenders	500–2,000
Tax warehouse keeper	5,000–10,000
Fuel supplier	5,000–10,000
Filling station	Ca. 134,000
Vehicle owner	Ca. 250 million

Estimation of number of emitters per regulated entity

The number and size of emitters that would be added to the EU ETS system by including transport can provide a first indication of the complexity and transaction costs involved. EU-wide information on the number of emitters associated with the different types of regulated entities in the transport sector is shown in Table 39. For some of the regulated entities no EU-wide data is available (particularly with respect to fuel blenders, tax warehouse keepers and fuel suppliers).

Table 39 Estimations of number of emitters per regulated entity in Europe

Regulated entity	Number of emitters	Source
Extractor/importer of raw materials	- About 310 extractors of crude oil and natural gas in 2010 - Number of producers of biomass is unknown - Number of importers of raw materials is unknown	- Eurostat (2013)
Refinery/importer of transport fuels	- 209 refineries/steam crackers in 2011 - Number of importers of transport fuels is unknown - At least 130 producers of biofuels	- Europia (2012) - www.epure.org www.ebb-eu.org
Fuel blender	- Number of fuel blenders is unknown	
Tax warehouse keeper	- Number of tax warehouse keepers is unknown	
Fuel supplier	- Number of fuel suppliers is unknown	
Filling station	- About 134,000 petrol stations - Number of organisations where fuel is privately delivered is unknown	- CBRE (2012)
Vehicle owner	- Ca. 240 million private vehicles in 2009 - Ca. 325,000 public road transport companies - Ca. 600,000 freight road transport companies in 2008 - Max. 800 railway companies in 2008 - Ca. 9,300 IWT companies in 2008	- Eurostat (2013) - European Commission (2011)

FiFo (2005) have examined the number of emitters per regulated entity in the German transport sector in more detail. The results of their analyses are shown in Table 40.

Table 40 Estimations of number of emitters per regulated entity in Germany in 2003

Regulated entity	Number of emitters
Extractor/importer of raw materials	Not considered
Refinery + importer of transport fuels/fuel blenders	17 producers and 75 importers
Tax warehouse keeper	Ca. 900
Fuel supplier	Ca. 1,000
Filling station	Ca. 16,000
Vehicle owner	Not considered

Based on the results presented in Table 39 and Table 40 we made a first order indication of the number of emitters per regulated entity in the transport sector in Europe. These estimations are shown in Table 41.

Table 41 First order estimation of the number of emitters per regulated entity in Europe

Regulated entity	Number of emitters
Extractor/importer of raw materials	500 + large number of small biomass producers
Refinery + importer of transport fuels/fuel blenders	500-1,000
Fuel blenders	500-2,000
Tax warehouse keeper	5,000-10,000
Fuel supplier	5,000-10,000
Filling station	Ca. 134,000
Vehicle owner	Ca. 250 million

Segmentation to subsectors
For all regulated entities we also consider a further segmentation to subsectors. Two possible sets of subsectors are considered in this respect:
- freight and passenger transport;
- transport mode: road, rail and inland waterways transport.

C.2.2 Assessment of environmental impact
In this section we assess the impact of the choice of regulated entity on the environmental effectiveness of the inclusion of transport in the EU ETS. First, we assess the impact of the regulated entity chosen on the incentives provided to apply emission reduction measures in the transport sector. Therefore, we consider three issues: the incentives to apply (existing) reduction technologies, the effect on long-term (clean technology) innovation and the awareness raising function of the inclusion of transport in EU ETS.

The impact of the inclusion of transport in the EU ETS on the effectiveness of the entire system results from the cap set. However, the effectiveness of the scheme may deteriorate due to carbon leakage. Therefore, in addition to the assessment of the impact of the choice of regulated entity on the incentives to apply emission reduction measures in the transport sector, we also assess in this section whether the risk on carbon leakage depends on the choice of regulated entity.

Incentive to reduce emissions
As discussed in Section 3.2.3 there are several reduction measures that could be applied to reduce the GHG emission in the transport sector. The types of reduction measures that are stimulated by the inclusion of transport in the EU ETS depends on the regulated entity chosen. In the remainder of this section we first discuss the incentives for emission reduction measures in case up- or midstream regulated entities are appointed and next the incentives for downstream regulated entities are discussed.

Apart from the incentive that may result from the ETS alone, it should be stressed that other regulations already exist that may, together with the ETS, provide an strengthened incentive to take (expensive) measures. This is further discussed for some alternative regulations in Section C.2.5.

Incentives for emission reduction in up- and midstream approaches
Both up- and midstream regulated entities have few measures to reduce emissions (CE Delft, 2006). Basically, all these entities have at most two reduction measures at hand, viz. increase the production/supply of biofuels (or other alternative fuels) or to reduce the amount of fuel sold to consumers.

With respect to the first measure – increasing their biofuel production/supply – particularly fuel blenders are able to apply this one[59]. Biomass or biofuel producers can decide to increase biomass/biofuel production and/or to produce biomass/-fuel with lower GHG emissions (e.g. second generation biofuels). Extractors of raw materials/refineries are not able to increase the shares of biofuels/biomass directly. At the mid-stream level, (some) tax warehouse keepers can decide to import higher blends of biofuel.
Fuel suppliers and filling stations can only indirectly increase the share of biofuels in the delivered blends, by increasing demand for fuels with the maximal allowed blend (or even demand high biofuel blends while adjusting their infrastructure). They are dependent however, on the production of these blends further upstream in the chain.

However, as was evidenced in Section 3.2.3, the costs related to biofuels, are likely to be very high (possibly € 2,500/ton CO_2 eq.). Obviously, this is much higher than the € 5-15/ton CO_2 eq. that is mentioned for emission reductions in other sectors. Therefore, it may be more attractive for up- and midstream entities to buy emission allowances from other sectors instead of producing/ supplying higher biofuel blends.

The up- and midstream regulated entities may also choose to reduce the amount of fuels sold. This could be operationalized by increasing the prices of (transport) fuels. This will provide an incentive to downstream actors to take fuel-saving measures, which in turn will reduce CO_2 emissions (Eckerhall, 2005). To what extent the price incentive received by the downstream actors depend on the specific regulated entity chosen depends on the extent by which the additional costs are passed on through the fuel supply chain; in case these costs are passed on for 100% at every link of the supply chain, the final incentive for downstream actors is independent of the regulated entity chosen. However, some studies (e.g. CE Delft, 2006; Eckerhall, 2005) argue that it may be possible that some of the additional costs are internalised (i.e. not passed on to the consumer) by some actors in the fuel supply chain; in this case the price incentive consumers experience is probably lower the further upstream the entity is located (since then there are more actors that can internalise some of the costs prior to delivering the fuel to the consumer). However, based on economic theory and empirical evidence it is not possible to determine to what extent the additional costs resulting from the EU ETS are passed on through the fuel supply chain (e.g. see CE Delft, 2010a; 2010b; Sijm et al., 2009). Therefore, we apply in this study the working assumption that all the allowance costs are passed on to the final consumers for 100%.
As mentioned before, this implies that the price incentive experienced by the final consumers doesn't depend on the regulated entity chosen[60].

[59] However, there are limits to the extent to which these actors can increase the share of biofuels in their blends, as there are (technical) limits on the biofuel content of fuels that are sold as regular diesel (7%) and gasoline (10%) to ensure vehicle compatibility (Lonza et al., 2011). For higher blends (e.g. E85; gasoline with 85% ethanol), adjustments in filling station infrastructure and in vehicles are required first. Consequently, the extent to which fuel blenders (and hereafter fuel suppliers and filling stations) can increase their biofuel supply in the short-term is equal to the difference between national regulations on the minimal share of biofuels in the blend (e.g. in the Netherlands this was 5% in 2012) and the approved maximal blend.

[60] In case less than 100% of the allowance costs are passed on to the final consumers, the price incentive of the inclusion of transport in EU ETS will be higher in case a more downstream approach is applied. As a consequence, in this case many of the impacts of the inclusion of transport in ETS are larger if a more downstream approach is applied.

Incentives for emission reduction in downstream approaches
The price incentive provided by the ETS system may incentivise vehicle owners to implement some of the emission reduction measures discussed in Section 3.2.3. For road transport several operational and technical measures with relatively low abatement costs are available and hence these options are most likely to be taken if actors act rationally (considering that this results in costs savings, while buying emission allowances results in additional costs). Switching to alternative fuels and far-reaching technical options (e.g. hybrid or electric vehicles) are rather expensive and it may not be expected that these kinds of options are strongly stimulated by including transport in ETS.

The uptake of emission reduction measures may be hampered by various kinds of barriers. For passenger transport it is often evidenced that consumers don't buy cost-effective fuel-efficient cars if the payback period of these investments is longer than 3-5 years. Also a lack of knowledge and all kind of psychological factors (e.g. they do not like to drive a small car) may hamper the uptake of fuel-efficient vehicles (CE Delft et al., 2012a). For freight transport lack of knowledge on the reduction potential of reduction measures is found as the main barrier to invest in fuel-efficient technologies (CE Delft, 2012b). Due to these kinds of barriers the price incentive provided by the ETS may be less effective than (theoretically) expected.

For non-road modes and for agricultural and construction vehicles the marginal abatement costs are unclear (see Section 3.2.3). It is therefore difficult to predict which reduction measures will be taken if the price incentive is high enough.

Effect on innovation
Next to the more short-term incentives to invest in emission reduction measures discussed in the previous section, inclusion of transport in ETS may also provide incentives to invest in long term clean technology innovations. For these kinds of investments, the expectations on marginal abatement costs and ETS price developments are key. E.g. if higher ETS prices are expected car manufacturers may intensify the investments in innovative fuel-efficient technologies. In this respect also the predictability of emission targets (i.e. certainty on the development of the cap) is important, because this provide more certainty on future ETS price developments (CE Delft, 2006).

It should be noticed, however, that innovative solutions often requires alternative regulations or infrastructure (e.g. charging infrastructure for electric vehicles). Although the price incentives provided by ETS may contribute to the realisation of these boundary conditions of innovative vehicles (e.g. at high ETS prices there may be a positive business case for suppliers of electricity to invest in charging infrastructure for electric vehicles), additional policy measures from governments will often be needed.

As was discussed for short term incentives to invest in emission reduction measures the only measure that up- and midstream entities can take themselves are investments in biofuels. Contributing to the development of second generation biofuels (with higher abatement potentials and lower abatement costs) is an option that may be incentivised by the ETS.
This incentive may be strongest in case the chosen entity is the refinery/ biofuel producer, as at this level the development of innovative biofuels will take place. The incentive to invest in innovative biofuels may be strengthen if next to the ETS price incentive also other policies that stimulate these kinds of biofuels (e.g. the Fuel Quality Directive) are implemented.

As was mentioned before, up- and midstream entities may also decide to pass on (some of) the additional costs to consumers. If fuel prices increase as a result, consumers may increase their demand for more fuel-efficient vehicles/fuels. This in turn may stimulate vehicle manufacturers to further develop fuel-efficient technologies/vehicles (Eckerhall, 2005; CE Delft, 2006). The same incentive is provided by a downstream approach.

Manufacturers basically have two main options at hand to deliver more fuel-efficient vehicles to the market (in response to expectations on high levels of future fuel prices). Firstly, vehicle/vessel manufacturers in every subsector can develop fuel-saving technologies that can improve the fuel-efficiency of their conventional vehicles. Since improving the fuel-efficiency of conventional vehicles is a relatively cheap option in contrast to alternative fuels or drivetrains (see the discussion on the availability of emission reduction measures in Section 3.2.3) and few/no adaptations are needed on current regulations or infrastructure, ETS may provide for some subsectors (i.e. road transport) enough incentive to increase the investments in these kinds of innovations. If not, combining ETS with other policies (e.g. fiscal policies) may be a possible solution.

The second option vehicle manufacturers have to deliver more fuel-efficient vehicles is to invest in vehicles with alternative drivetrains, such as electric, hydrogen or gas-powered vehicles. This option is mainly relevant for the road subsector (although for IWT liquid natural gas (LNG) vessels are a relevant option too). Since the upfront costs of these alternative drivetrains are in general very high and adaptations to the infrastructure are needed, it may be expected that including transport in the ETS alone is not sufficient to significantly stimulate innovation in such technologies. Other policies (e.g. vehicle regulation, fiscal instruments) are probably needed to significantly stimulate these innovative technologies.

Effect on awareness raising

In the previous sections we mainly discussed the price incentives provided by including transport in ETS. However, also more psychological incentives like raising awareness on reduction options may be provided by this measure, indirectly resulting in a reduction of transport emissions. Raising awareness of end-users will probably more effective than targeting actors further upstream, since the former actors (particularly private vehicle owners) generally act economically less rational than up- and midstream entities. For that reason it may be expected that a downstream approach results in the largest awareness raising impacts, since end-users are directly confronted with the measure. In case an up- or midstream regulated entity is appointed the end-users will only experience a change in fuel prices, which may not be experienced as the result of the inclusion of transport in ETS and hence will not raise additional awareness on reduction options compared to current fuel price changes.

Risk of carbon leakage

Carbon leakage is the term often used to describe the situation that may occur if, for reasons of costs related to climate policies, activities are transferred to countries/sectors which have laxer constraints on GHG emissions. In general, two potential risks for carbon leakage could be identified for the inclusion of transport in ETS:

- transport related activities taking place within the EU are assigned to non-EU countries, e.g. fuels bought outside the EU and consumed within the EU;
- transport is shifted to subsectors that are not covered by ETS.

In the remainder of this section these two risks for carbon leakage are discussed in more detail.

Carbon leakage to non-EU countries

By including import of raw materials and/or fuels in the definitions of the various regulated entities (see Section C.2.1) a large risk for evading the ETS and hence causing carbon leakage has been removed for the up- and midstream entities. For these entities no incentive to relocate outside the EU is provided.

This does not imply that no leakage can occur with an up- or midstream system though. As was described earlier, all these entities are likely to pass on (at least some of the) additional costs that result from surrendering emission allowances to their consumers. As a consequence of these price increases, some vehicle owners may evade the system and decide to purchase their fuel from non-EU filling stations (CE Delft, 2006; 2008). Since we assume that the ETS costs are fully passed on through the fuel supply chain by the up- and midstream entities, this risk on carbon leakage doesn't depend on the specific regulated entity chosen.

The attractiveness of making a detour as a consequence of the ETS may be relatively small for two reasons:

- The impact of the ETS on fuel prices may be relatively small, which is further described in Section C.2.3. The smaller the price difference, the less attractive it becomes for vehicle drivers to make a detour.
- Purchasing fuel outside the EU will unlikely be an attractive option for the majority of vehicle drivers, as it would require a significant detour in most cases; this would at least partially off-set cost-savings from lower fuel prices. However, at least some evasion of the system may be expected, especially from private vehicle owners that live near EU borders or from long-distance road freight transport that cross EU borders. As a consequence, not all emissions that are emitted within the EU would be covered by the system.

These two reasons hold for all types of transport modes. However, with respect to (diesel) rail transport and IWT it should be noticed that:

- On the one hand, their ranges (in terms of kilometres) are larger than for road transport, which may make it an attractive option to purchase fuel in non-EU countries.
- On the other hand, both modes are dependent on specific infrastructure that provides fewer options for making efficient detours than is the case for road transport.

Because of these two opposite impacts it is not possible to be conclusive on the relative risk on carbon leakage at rail transport and IWT compared to road transport. However, since both modes are mainly operating within the EU, the potential risk is expected to be low.

As for the up- and midstream approaches, a downstream approach may provide some (small) incentives for filling up in countries outside the system and hence cause carbon leakage (CE Delft, 2006; ITS Leeds, 2007). This is likely to be most attractive for road vehicle owners living near the border and for long-distance (road) freight transport. However, in a downstream system, freight transport (especially road transport) may have other options to evade the system. In case only EU-registered vehicle owners are appointed as regulated entities, it may be the case that transport companies register their vehicles in countries that fall outside the system's scope, and hereafter let them operate within the EU (from EU-based depots). If additional measures are taken to prevent this from happening, transport companies may decide to completely relocate their businesses to non-EU countries and to operate their vehicles from depots over there. The latter option is probably only interesting for those companies that already operate near EU borders or have regular routes from and to non-EU countries therefore.

Carbon leakage to non-covered subsectors

Inclusion transport in ETS may provide an incentive to shift transport to non-covered subsectors (e.g. short sea shipping or rail/IWT in case they are not included in the scheme). The larger the deviation in fuel prices due to ETS, the larger the risk on this kind of carbon leakage. Since we assume that the ETS costs are fully pass on through the fuel supply chain, this risk on carbon leakage doesn't depend on the regulated entity chosen.

Carbon leakage in case of thresholds

Including thresholds for the regulated entities that have to be included in the EU ETS may result in carbon leakage. For example, if a minimum threshold for fuel suppliers (in terms of the amount of fuel supplied to filling stations) is implanted, a growth of smaller fuel suppliers that stay below the threshold may be seen.

C.2.3 Assessment of economic impacts

The inclusion of transport in ETS may have a wide variety of economic impacts. In this section we discuss for some relevant economic impacts their dependency on the choice of regulated entity. The following impacts are considered: impacts on competitiveness, transaction costs, the distributional impacts on households' disposable incomes and the impact on the market for CO_2 allowances.

Impacts on competitiveness

The regulated entity chosen may affect the competitiveness of some of the (sub)sectors directly involved in the transport fuel supply chain or transport sectors. We consider the impacts on competitiveness for the following sectors:

- producers and distributors of transport fuels;
- filling stations;
- the transport sector;
- various transport modes.

Competitiveness of producers and distributors of transport fuels

The competitiveness of producers and distributors of transport fuels (and extractors of raw materials) could potentially only be affected by upstream schemes (extractor/importer of raw materials, producer/importer of transport fuels, fuel blenders). However, since both domestically (EU-based) produced and imported transport fuels are considered in these schemes (see Section C.2.1), the competitiveness of these agents on the EU-market is not affected in all types of schemes (see also Flachsland et al., 2011; PWC, 2002).
Whether the competitiveness of producers and distributors of transport fuels on markets outside the EU is harmed by including transport in EU ETS depends on the way the CO_2 emissions of exported transport fuels are treated.
By implementing an exemption of the obligation to hand in allowances for CO_2 emissions related to exported transport fuels (which would make sense since these emissions are emitted outside the EU) the competitiveness of these sectors on the non-EU markets could be protected. Since all transport fuels (except for natural gas) are subject to the Excise Movement and Control System (EMCS) and exports to outside the EU are monitored by this system (see also Annex E), this exemption could relatively be organised.

Inclusion of transport in ETS may also affect the relative competitiveness of the various fuel types (gasoline, petrol, LPG, natural gas, biofuels), due to different carbon contents of the fuels. However, as long as they are all included in ETS this could be considered an intended effect of the inclusion of transport in ETS, since fuel use is shifted to fuels with lower carbon content. A shift in the fuel mix, however, may also have significant impacts on air quality; e.g. the use of diesel vehicles results in higher emission levels of air pollutants compared to the use of (comparable) petrol vehicles. Member states could compensate for such a modal shift by adjusting the ratio in fuel taxes for the various fuel types or differentiating vehicle taxes to fuel type. However, this will probably result in lower levels of CO_2 emission reductions.

Competitiveness of filling stations

The competitiveness of filling stations may be harmed because of the potential of cross border fuelling (i.e. tank tourism by drivers residing in one country and fuelling in another country) to benefit from price differences in transport fuels in EU Member States and non-EU countries (Keppens and Verheek, 2003; Raux, 2009; Verhoef, 1997). This potential impact may take place (by the same extent) in case a up- or midstream approach is applied. If vehicle owners are appointed as regulated entities (downstream approach) no impacts on the competitiveness of filling stations (in border zones) are expected (since vehicle owners could not evade the scheme by filling up outside the EU).

As was shown in Section 3.4.2 the differences in fuel prices between EU countries and neighbouring (non-EU) countries could already be significant and the inclusion of transport in ETS will (at low to modest CO_2 prices) only have a small impact on these price differentials. Therefore it is expected that the impacts on the competitiveness of filling stations is rather limited.

Competitiveness of transport sector

The relative competitiveness of the EU transport sector (compared to non-EU transport companies) will not be affected by the various up- and midstream approaches, because both EU and non-EU hauliers could tank at both EU and non-EU filling stations.

In case vehicle owners are appointed as regulated entities the impacts on the competitiveness of the EU transport sector largely depends on the definition of the operator. If all vehicle owners (of both EU and non-EU registered vehicles) refuelling in the EU should submit emission allowances at the moment of refuelling the impacts on both EU and non-EU hauliers are equal and hence the impacts on the competitiveness of the EU transport sector are negligible. This option, however, probably requires the implementation of an additional administrative system for vehicles only occasionally refuelling in the EU, resulting in higher implementation and transaction costs. On the other hand, if only owners of vehicles registered in the EU are defined as regulated entities, the competitiveness of the EU transport sector may be harmed due to the fact that part of the shipments will shift to non-EU hauliers (Ifue et al., 2003).

Competitiveness of various transport modes

Inclusion of transport in EU ETS may affect the relative competitiveness of the various transport modes, depending on two factors:

- Differences in CO_2 per tonne kilometre (or passenger kilometres) between modes. Modes with relatively low CO_2 figures per tonne kilometre (trains and IWT) require less emission allowances and hence relatively benefit from inclusion in EU ETS.

– Differences in the abatement costs of the potential CO_2 reduction technologies available between modes. Modes for which relatively cheap reduction options are available (road transport) may realise relative cost benefits, thereby improving their competitiveness.

Currently, the CO_2 emissions per tonne kilometre are much higher for road transport than for rail transport and IWT (CE Delft, 2011). Even if all reduction technologies with negative costs are implemented on trucks, their CO_2 emissions per tonne kilometre will in general be higher than for rail and inland waterways transport. Therefore, in case the inclusion of transport in ETS may result in a modal shift, a shift from road transport to rail and/or IWT may be expected.

Assuming 100% pass through of the allowance costs, there will be no difference on the competitiveness of the various transport modes for the different possible regulated entities.

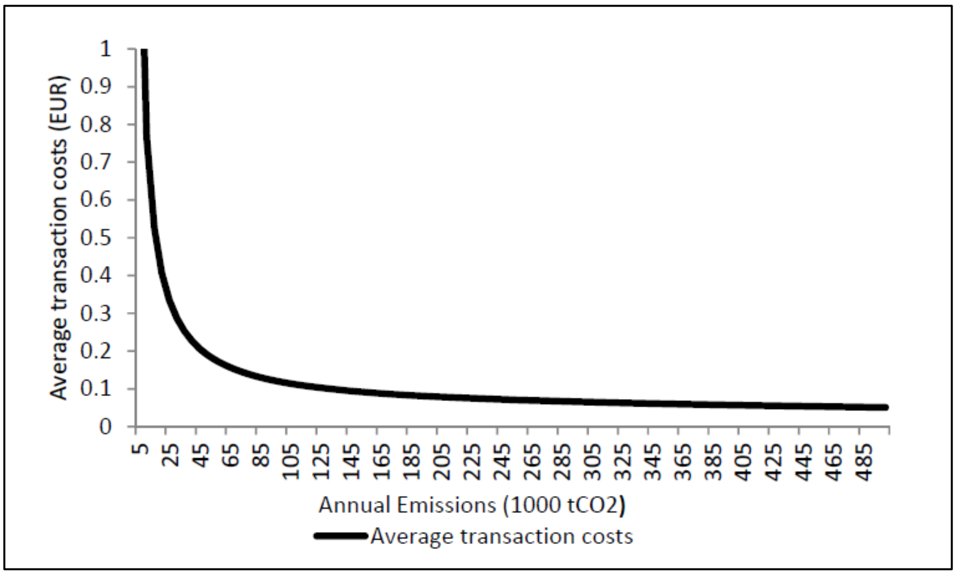
It should be noticed that the impact on the competitiveness of transport modes is an intended effect, since it shift transport to more fuel-efficient transport modes and hence reduces total transport CO_2 emissions. However, in case some subsectors are exempted from ETS (e.g. rail and/or IWT) an unwanted modal shift may exist.

Finally, a modal shift from road transport to rail or IWT transport may also have some co-benefits, like a reduction in air pollutant emissions or reduced congestion levels.

Transaction costs

Transaction costs can be distinguished into costs for ETS participants and costs for governments in developing and operating the system. The costs for participants consist of the cost of permit trading, MRV and general information costs (cost of examining the costs and reduction potential of possible abatement technologies/measures and internal decision-making on investments). For the current EU ETS, the MRV costs are the main part of transaction costs for participants. Heindl (2012) finds, based on an empirical study on the transaction costs of German firms currently participating in the EU ETS, that MRV costs accounts for ca. 69% of the total transaction costs.
The transaction costs for governments consist of regulation costs, monitoring and enforcement costs and costs of the allocation of allowances.
The average transaction costs for small emitters are higher than for large emitters (see for example Heindl, 2012). Therefore, an extension of the EU ETS with many small emitters may result in sharper increases in transaction costs than extensions with a limited number of large emitters. The fact that average transaction costs depends on the annual emissions of firms is clearly shown in Figure 12. For small emitters the transaction costs are relatively high (ca. € 1/tonne CO_2). At these levels of annual emissions doubling emissions may lead to a reduction of average transaction costs by almost 50%.
For emission levels larger than 25,000 tonne CO_2 per year, transaction costs converge to a relatively low level.

Figure 12 Average transaction costs per tonne of CO_2 of firms in the EU ETS in Germany



Source: Heindl, 2012.

The total transaction costs for downstream and some midstream regulated entities (particularly vehicle owners, but maybe also in case of filling stations) will be much higher than for upstream approaches because of the large number of small emitters at this level (see also Section C.2.1). This statement is confirmed by many other studies (e.g. CE Delft, 2006; Inregia AB, 2006; ITS Leeds, 2007; Öko-institut, 2002; PWC, 2002).

Transaction costs may be lower if emissions or fuels are currently already monitored, reported and verified. The transaction costs (both for participants and governments) will probably be relatively low for the tax warehouse keepers since at this level already monitoring and regulation mechanisms are available (Grayling et al., 2006). Also for refineries the transaction costs of including transport fuels may be relatively limited, since these entities already have experience with participating in an emission trading scheme. Due to the limited number of actors also the costs for the government will probably be low. At the level of raw material extractors/importers the large number of small biomass producers may increase transaction costs (both for participants and governments). Exempting small (biomass) producers may be an option to prevent high transaction costs at this level, although this decreases the emission coverage of the scheme. Another option to reduce the transaction costs of these entities may be to establish a trustee, which is responsible for submitting (and buying) the allowances for the entities joining the trustee. This may reduce the trading costs for these entities, but may still require significant MRV costs from them.

The large number of filling stations in the EU (about 134,000, see Section C.2.1) suggests that transaction costs will be high in case they are appointed as regulated entities. However, it should be noticed that many of these filling stations are owned by large oil companies, which may represent these filling stations on the trading market. This may reduce the transaction costs considerably. But there are still many independent filling stations or filling stations owned by small (fuel trading) companies; for example, Fifo (2005) estimates that in Germany about 35% of the filling stations are independent of large oil companies.

As mentioned before, the large number of small emitters at a downstream approach may result in a high transaction costs. However, there are some studies that suggest that by properly designing a downstream system at acceptable financial costs for participants could be developed (e.g. Raux, 2004; 2009). By implementing a smart card system and organising the exchange of allowances in a central way (through a stock exchange which would yield the daily value of allowances) instead of bilateral, the transaction costs of a downstream scheme could be restricted. The costs for governments of such systems, on the other hand, will be rather high. Another option to reduce the transaction costs of downstream regulated entities would be to establish trustees, which submits and trade in allowances on behalf of the individual vehicle owners.

At a downstream level the transaction costs could also be reduced by exempting some subsectors from participating in ETS. Particularly the exemption of passenger transport (many small emitters) may result in significant reductions in transaction costs, although the emission coverage of the scheme also significantly decrease (see Section 3.2.1). Exemption of some modes (rail, IWT) will only marginally affect the total transaction costs, since these transport modes only have a small market share compared to road transport.

Equity: impacts on disposable incomes

An emissions trading scheme that is covering the transport sector can in principal affect households' disposable incomes in two ways. On the one hand, it can have a direct effect on households in the sense that the price of the transport fuel that is purchased by the households may increase. On the other hand, it can have an indirect impact on households in the sense that some of the other goods that households consume could be transport-intensive and could therefore become more expensive.

Regarding the direct effect, i.e. a price increase of the transport fuel consumed by the households, the impact of the emissions trading scheme on the households will be comparable to the impact of an energy tax on transport fuel. This holds independent of whether a down-, mid- or an upstream approach is chosen.

There is an extended literature on the distributional effects of energy taxation. In a recent study commissioned by the European Commission (Kosonen, 2012), an overview is given on the empirical evidence regarding Europe and different European countries. The main findings (which probably also holds for an emission trading scheme) are as follows:

- There is empirical evidence that taxes on energy carriers that are used for heating and electricity have a regressive effect, i.e. impose a heavier burden on low-income households than on high-income households, since the former spend a larger share of their income on these goods.
- If total expenditure of households is used as a basis of calculation instead of disposable household income, environmental taxation often appear less regressive.
- Taxes on transport fuel are in general less regressive than energy taxes in the built environment. Moreover, transport fuel taxes do not necessarily have a regressive effect. In fact, there is evidence that the effect differs between the US and Europe and between European countries. For some European countries a regressive effect has been stated while in other countries the middle class can be expected to carry the heaviest burden. Even a progressive effect is conceivable for some countries. One explanation for the different impacts could be the difference in the quality

of public transport in the different European countries. The supply of good-quality public transport could make a private car more of a luxury good, the use of which would increase strongly with income level. Also high levels of vehicle taxes could have a similar effect. For example, Kosonen (2012) reports that transport fuel taxes in Denmark are more progressive than in other Nordic countries, which may be explained by the rather high registration tax in Denmark, which made private cars more like a luxury good than in the other Nordic countries.

- Taxes on transport fuel are in general less regressive than energy taxes in the built environment, i.e.
- The way in which tax revenue is recycled is crucial for the distributional effect of an emissions tax. With respect to ETS, this implies that the recycling of auctioning revenues is key. This is discussed in more detail in Section C.3.3.

If, for distributional reasons, one wanted to except certain household groups from the emissions trading scheme, this would certainly be easier under a downstream approach.

Regarding the possible indirect impact of an emissions trading scheme on households, i.e. the impact of the possible rise of the prices of other, transport intensive goods, the distributional effect on households depends on the nature of these goods. Only if these goods are necessary goods like for example food, a regressive effect comparable to the taxation of energy carriers that are used for heating and electricity can be expected. Again, no significant impact of the regulated entity chosen on the size of these impacts is expected.

Impact on market

The current EU ETS covers about 45% of the EU's GHG emissions, which is about 2,000 Mt (European Commission, 2013). By including the transport sector in the EU ETS the coverage of the scheme would increase by 886 Mt (see Section 3.2.1), which is ca. 45%. The actors on the transport market therefore potentially have a big impact on the market for allowances.

The market power of actors from the transport sector will be largest in case an upstream approach is applied. Particularly in case refineries or fuel blenders are appointed as regulated entities there will be some large oil companies with a significant share on the market for CO_2 allowances. For example, Shell would probably possess about 3% of the allowances in case transport would be included in the EU ETS (and allowances would be grandfathered).[61] Although this is a significant market share, no risk on market concentration is expected.

In case a midstream approach is applied the number of actors on the market of transport fuels increase and hence the market power of single actors reduces. However, it should be noticed that also at the midstream level there are still some large oil companies owning a significant number of the tax warehouses, fuel suppliers and filling stations.

Finally, in case the vehicle owners are appointed as regulated entities only small actors are introduced to the market for CO_2 allowances and hence there won't be any risk on market concentration.

61 The total refinery capacity in the EU is about 15,200 thousand barrels a day (BP, 2012). The refinery capacity of Shell is about 1,710 thousand barrels a day, which is ca. 11% of the total EU refinery capacity. In case transport is included in the EU ETS, the transport sector will be responsible for about 30% of the GHG emissions covered. This implies that Shell would require ca. 3% of the allowances (in case of grandfathering).

C.2.4 Assessment of technical feasibility

In this section we discuss the impact of the various possible regulated entities on the technical feasibility of including transport in the ETS. This discussion will be focussed on the possibilities to define clear boundaries for the various regulated entities. With respect to monitoring accuracy and sensitivity for fraud only the main conclusions are presented here; these issues are discussed in more detail in Section C.4.

Definition of installation boundaries

As was presented in Section 3.2.1 the total CO_2 emissions of the EU transport sector is equal to 886 Mt, which is about 19% of the total CO_2 emissions in the EU 27. If the entire transport sector would be included in the EU ETS (i.e. no subsectors are excluded) all these emissions would be covered by the scheme. This emission coverage is the same for all regulated entities that can be chosen, as in principle, only emission from transport related EU fuel consumption would be appointed to the regulated entities. Thereby, the entities have been defined in such a way that up to the point at which fuels leave the tax warehouses (and have to be consumed in EU Member States), importers of raw materials and/or fuels are regulated entities as well, enabling full coverage. For the same reasons exports or raw materials/fuels are excluded from the scheme at all levels of the supply chain.

Although in theory the boundaries of the various regulated entities could be clearly defined and hence full coverage of the relevant CO_2 emissions could be guaranteed, there may be some complicating issues. In this section these issues are discussed per type of regulated entity.

Boundaries at upstream approaches

There are three issues that may hamper a clear definition of the CO_2 emissions that should be allocated to upstream regulated entities:

- At this level in the supply chain it is still unclear in which sector the end product will be consumed and whether the fuel will be combusted or used as feedstock in the petrochemical industry. As was shown in Section 3.2.1 about half[62] of the fuels that could be used for transport purposes (petrol, gasoline, LPG, natural gas, biofuels) are actually be used for other purposes (e.g. in build environment or the industry). If other petroleum products like naphtha, heavy fuel oil and kerosene are included, the share of non-transport fuels is even higher. In case these entities are regulated, there is a risk of including non-transport related emissions therefore. This would result in covering more emissions than intended, which in turn may cause double counting.
- The correct amount of imports and exports of (transport) fuels in the full supply chain are not yet known at these levels of the supply chain. For example, transport fuels could be imported at the level of tax warehouse keepers and hence are not (automatically) taken into account if upstream entities are appointed as regulated entities. However, almost all transport fuels (except for natural gas) are subjected to the Excise Movement and Control System (EMCS), which provides the opportunity to control and follow the movements of excise goods for which no excise duties have been paid yet (see also 0). Since also the imports to and exports from the EU are recorded by this System, the inclusion/exclusion of these imports/exports in the EU ETS could be relatively easily organised.

[62] About one fifth if only liquid fuels are considered.

- At the level of extractors of raw materials and refineries it is not yet known which biofuels are blended to the final fuels and therefore also the exact carbon content of the fuels in not yet known. At the level of fuel blenders, biofuels are blended to the fossil fuels and hence at this level the exact carbon content of the fuels is known.

Next to the difficulties to clearly define the CO_2 emissions to be allocated to upstream regulated entities, there are also some issues with respect to the definition of the various transport sectors at this level. As mentioned before, at this level of the fuel production chain, it is still unclear which subsectors will consume the fuel, as some subsectors use the same fuel (e.g. diesel is consumed by both rail transport and inland shipping) (CE Delft, 2006).
As a consequence, it is not possible to exclude particular downstream subsectors (e.g. only freight transport, only road transport, etc.) with the current administrative procedures (Eckerhall, 2005; CE Delft, 2006).

Boundaries at midstream approaches

Many of the difficulties to define CO_2 emissions associated with upstream regulated entities do not hold for midstream entities. At this level of the supply chain it is known whether the fuels are consumed as transport fuels or not and also the export and import volumes are known. Additionally, in some EU countries (e.g. in the Netherlands) it is clear at this level which biofuel blends (the amount and type of biofuels blended with fossil fuels) are consumed, showing that at least it is technically feasible to determine this at the tax warehouse level. At the level of fuel suppliers and filling stations the biofuel blend is often not known, which is the consequence of intensive trading in trading fuels at these levels.

To prevent too high transaction costs (see Section C.2.3), it may be an option to implement a minimum participation threshold (e.g. based on the amount of transport fuels traded/sold). This may, for example, be an option in case fuel suppliers are appointed as regulated entities. Such a kind of threshold may, however, complicate the definition of boundaries of regulated entities (as well as the monitoring structures needed). Furthermore, it increases the risk on carbon leakage, since market actors are incentivized to split up existing entities in several separate entities or establish a new (small) entity in order to evade the ETS. Because of these disadvantages, we do not consider these kind of thresholds in more detail in this study.

At the level of midstream entities, a distinction between different transport sectors could often be made (or monitoring schemes could be easily implemented to make this distinction possible). As shown in Annex E, tax warehouse keepers are often also the excise duty point and since different fuel tax rates are often applied for road, rail and IWT transport (and also for agricultural and construction vehicles), it is (at least theoretically) possible to distinguish these subsectors. In case of separate excise duty points (not located at the level of the tax warehouse) additional monitoring schemes could be implemented.
A distinction between passenger and freight transport is not possible at a midstream level, since for road transport no separate fuel tank infrastructure exist for these two subsectors.

Boundaries at downstream approaches

At a downstream level the main problem to clearly define boundaries of entities is that at this point, it is unclear what biofuel blend has been consumed, making it difficult to cover the exact amount of emissions.

On the other hand, at this level it is possible to clearly define the various subsectors, including the distinction between passenger and freight transport.

Monitoring accuracy
In Section C.4.2 a detailed discussion on monitoring accuracy is presented. The main conclusions with respect to regulated entity are:
- At an upstream level it is not yet possible to identify markets on which the fuels are going to be used. Additional downstream monitoring schemes are therefore needed in this case.
- The type and amount of biofuels blended is difficult to monitor (with the exception of fuel blenders/tax warehouse keepers).
- At a downstream level, monitoring fuel use at a vehicle level requires a new monitoring scheme to be established.

Sensitivity for fraud
In Section C.4.3 a detailed discussion on the sensitivity for fraud is presented. The main conclusions with respect to regulated entity are:
- particularly at an upstream level there is a risk for fraud because of the difficulties to distinguish transport and 'other' fuels;
- risk on fraud due to difficulties to monitor the type and share of biofuels in the transport fuels at the lower levels of the fuel supply chain.

C.2.5 Assessment of legislative efficiency
In this section we consider the legislative interactions between the inclusion of transport in EU ETS and some other transport related Directives.
The discussion is focussed on the potential overlaps and synergies with respect to the defined regulated entity. Efficiencies that may be obtained from data that is already collected and monitored for these other directives are further described in Section C.4.4.
Four transport Directives have been identified that are likely to be subject to mutual interactions with the ETS, these are:
- The Fuel Quality Directive (FQD);
- Renewable Energy Directive (RED);
- CO_2 and Cars;
- Energy Taxation Directive (ETD), including the proposed amendment of this Directive.

The Fuel Quality Directive
The FQD regulates the fuel supplier, which is defined as 'the entity responsible for passing fuel or energy through an excise duty point (tax warehouse keeper) or, if no excise is due, any other relevant entity designated by a Member State'. The tax warehouse keeper is also an actor that may be regulated for the inclusion of transport in the ETS.

This may result in several practical efficiencies. Firstly, the boundaries for the regulated entity have already been defined and enforced. Additionally, the administrative reporting and auditing procedures are already in place, improving efficiency of the system.

The opportunity for Member States to appoint another regulated entity for the FQD may result in a varying pattern of regulated entities across Member States, which may reduce the potential efficiency gains by tuning the regulated entity for transport in ETS and for the FQD. Unfortunately, no overview of the regulated entities appointed by the Member States for the FQD is available.

The Renewable Energy Directive

The regulated entity in the RED are the Member States themselves. However, all Member States have appointed economic operators who have to demonstrate compliance with the criteria of the RED (see Table 42).

As becomes clear of Table 42 there is a wide range of actors in the various Member States that is appointed as regulated entity in the RED. Most often the fuel suppliers at the end of the supply chain or the fuel suppliers who supply fuels past the excise duty points were chosen. Since these actors may also be potential regulated entities in case transport is included in the EU ETS, there may be possibilities on efficiencies.

Table 42 Regulated entities in the RED in the various Member States

Country	Economic operators who have to demonstrate compliance with the criteria of the RED
Austria	Fuel suppliers at the end of the supply chain
Belgium	Fuel suppliers who supply fuels past the excise duty point
Bulgaria	Not yet determined
Cyprus	Fuel suppliers at the end of the supply chain
Czech Republic	Fuel suppliers at the end of the supply chain
Denmark	Fossil fuel refiners and importers who supply fuel to Danish transport market (which in fact are two types of fuel suppliers who bring fuels past the duty point)
Estonia	Not yet determined
Finland	Fuel suppliers
France	Fuel suppliers, who benefit from a tax reduction depending on the incorporation rate of biofuels
Germany	Fuel suppliers
Greece	Biofuel producers and wholesalers as well as parties who pay the fuel duty at the fuel duty point
Hungary	All parties in the biofuel supply chain
Ireland	Fuel suppliers at end of supply chain
Italy	During a transition period: operators at end of supply chain After transition period: all parties in the biofuel supply chain
Latvia	Fuel suppliers at the end of supply chain
Lithuania	Fuel suppliers who supply fuels past the duty point
Malta	Producers and/or importers of biofuels
The Netherlands	Fuel suppliers at the end of the supply chain
Portugal	Biofuel producers and importers of biofuels
Romania	Fuel suppliers at the end of supply chain
Slovakia	Fuel suppliers who pay fuel duties
Spain	All parties in the biofuel supply chain
Sweden	Fuel suppliers at the end of supply chain
UK	Fuel suppliers at the end of supply chain

Source: Ecofys and IEEP (2012).

Note: No information was available for Luxembourg, Poland and Slovenia.

CO_2 and Cars Directive
This Directive regulates car manufacturers in the EU, which is not one of the options that has been defined for the purpose of this study (see Section C.2.1)[63]. Hence, efficiencies as a result of choosing the same entity are not possible.

Energy Taxation Directive
Although also other (legal) persons could be appointed as excise duty point, in many European countries the majority of the excise duty points are organised by tax warehouse keepers. This entity is also a candidate as regulated entity in case transport is included in the EU ETS, providing opportunities for synergies (in terms of monitoring and reporting, defining the entity, etc.).

C.2.6 Summary assessment regulated entity

The main results of the assessment of the potential regulated entities are summarized in Table 43. As these results show the implementation of upstream approaches is hampered by the difficulties to draw clear boundaries, i.a. because at this level it is not yet clear which share of the fuels will be used in the transport sector. Additionally, it may be difficult to accurately monitor the biofuel content of the fuels at this level. At mid- and downstream levels defining and monitoring the boundaries of regulated entities is feasible. Another important difference between the various options for regulated entity are the transaction costs. These are very high in case a downstream approach is applied, while they are low to moderate in case a mid- or upstream approach is chosen. Finally, it should be mentioned that in case tax warehouse keepers are appointed as regulated entity there is a lot of positive interaction with the Fuel Quality Directive and (to a lesser extent) the RED, in which these actors could also be appointed as regulated entity.

63 The baseline-and-credit emission system falls outside the scope of the system. However, for such a system, car manufacturers would have been one of the options to be regulated and hence overlap could have occurred between the Directive and the ETS.

Table 43 Summary of assessment of regulated entity

Criterion	Sub-criterion	Indicator	Extractors/ biomass producers/ importers	Refineries/ biofuel producers/ importer	Biofuel blenders/ importers	Tax warehouse keepers	Fuel suppliers	Filling stations	Vehicle owners
Environmental impact	Incentive to reduce emissions	*Entity itself:* High, medium, low	Low	Low	Low	Low	Low	Low	High
		On other entities: Price	High	High	High	High	High	High	n/a
	Effect on longer-term (clean technology) innovation		Limited, but indirectly through price effect	Limited, but indirectly through price effect	Limited, but indirectly through price effect	Limited, but indirectly through price effect	Limited, but indirectly through price effect	Limited, but indirectly through price effect	Small effect
	Awareness raising		(Very) small effect	(Very) small effect	(Very) small effect	(Very) small effect	(Very) small effect	(Very) small effect	Increased awareness, impact larger as for other entities
	Risk of carbon leakage	*Entity itself* No, some, medium, much risk of leakage	No, but in case of minimum threshold some leakage is possible	No, but in case of minimum threshold some leakage is possible	No, but in case of minimum threshold some leakage is possible	No, but in case of minimum threshold some leakage is possible	No, but in case of minimum threshold some leakage is possible	No, but in case of minimum threshold some leakage is possible	Some
		Other entities: no, some, medium, much risk of leakage	Some, indirectly through price effects	Some, indirectly through price effects	Some, indirectly through price effects	Some, indirectly through price effects	Some, indirectly through price effects	Some, indirectly through price effects	n/a
		In case subsectors are excluded	Some	Some	Some	Some	Some	Some	Some

Criterion	Sub-criterion	Indicator	Extractors/ biomass producers/ importers	Refineries/ biofuel producers/ importer	Biofuel blenders/ importers	Tax warehouse keepers	Fuel suppliers	Filling stations	Vehicle owners
Economic impact	Impacts on competitiveness	Filing stations: no, small, significant	Small	Small	Small	Small	Small	Small	No
		Transport sector: no, small, significant	No	No	No	No	No	No	Possibly significant
	Transaction cost	Low, medium, high, very high	Medium	Low	Medium	Low	Medium	High	Very high
	Equity: impact on disposable income distribution		Different impacts for different Member States	Different impacts for different Member States	Different impacts for different Member States	Different impacts for different Member States	Different impacts for different Member States	Different impacts for different Member States	Different impacts for different Member States
	Impact on market	No, small, significant	No significant impact	No significant impact, but largest impact from all entities	No significant impact	No significant impact	No significant impact	No significant impact	No significant impact, smallest impact

Criterion	Sub-criterion	Indicator	Extractors/ biomass producers/ importers	Refineries/ biofuel producers/ importer	Biofuel blenders/ importers	Tax warehouse keepers	Fuel suppliers	Filling stations	Vehicle owners
Technical feasibility	Definition of boundaries	- difficult to draw clear boundaries + easy to draw clear boundaries	- due to export/import, distinction transport and other fuels, distinction type of biofuels, distinction of subsectors	- due to distinction transport and other fuels, distinction type of biofuels, distinction of subsectors	- due to distinction transport and other fuels, distinction type of biofuels, distinction of subsectors	+ although some additional arrangements may be needed to distinguish subsectors	+ although distinction of biofuels needs additional monitoring schemes	+ although distinction of biofuels needs additional monitoring schemes	+ although distinction of biofuels needs additional monitoring schemes
	Monitoring accuracy	Low/medium/ high	Low accuracy, due to exports, distinction transport and other fuels and distinction type of biofuels	Low accuracy, due to distinction transport and other fuels and distinction type of biofuels	Low accuracy, due to distinction transport and other fuels and distinction type of biofuels	High accuracy	Medium accuracy, due to uncertainty on type/amount of biofuels	Medium accuracy, due to uncertainty on type/amount of biofuels	Medium accuracy (due to uncertainty on type/amount of biofuels), although a complete new monitoring scheme needs to be implemented
	Sensitivity for fraud	Small, medium, large risk	Small	Small	Small	Small	Small	Small	Small
Legislative efficiency	Practical interaction		Possible positive interaction with RED in some Member States	Possible positive interaction with RED in some Member States	No interaction	Possible positive interaction with RED, FQD and ETD (in some Member States)	Possible positive interaction with RED in some Member States	No interaction	No interaction

C.3 Allowance allocation method

In this section we discuss the design option ‘allowances allocation method’. First we present the various options fro the allocation of allowances to the transport sector. Next, the allocation methods are assessed on several environmental, economic and technical feasibility criteria. In contrast to the design option ‘regulated entity’ the allowance allocation methods are not assessed on legislative criteria, mainly because there are no significant interactions between the type of allocation method applied and other EU transport directives.

C.3.1 Options for allowance allocation

In general, there are five approaches conceivable for the issuance of emission allowances:

1. The allowances can be issued for free, where the amount of allowances allocated is either:
   a A share of the regulated entity’s historic emissions (grandfathering).
   b Based on an activity benchmark applied to historic activity of the regulated entity.
   c Based on an activity benchmark applied to regulated entity’s activity in the according period.
2. The allowances can be auctioned. In this case no allocation mode has to be specified.
3. A hybrid approach could be applied with a share of the allowances issued for free (see one of the approaches 1a-1c) and the other share of the allowances auctioned.

The design of the benchmark in approaches 1b and 1c depends on the regulated entity appointed. With respect to the fully upstream approach the amount of raw materials extracted/imported (in tons) may seem the most reasonable activity benchmark and therefore we consider this one in this section. For other upstream and midstream (and even the downstream approach in case filling station are appointed as regulated entity) approaches a fuel-benchmark seems the most appropriate option, e.g. using the CO_2 per Joule of the most efficient fuel as the benchmark. For a fully downstream approach three benchmarks are possible:

- annual vehicle kilometres;
- annual tonne kilometres or passenger kilometres;
- annual fuel use;

In the remainder of this section we consider these three possible types of activity benchmarks.

The current EU ETS combines several allocation methods, although the role of auctioning has become more important over the years. For illustrative purposes a description of the allowance allocation methods applied under the existing EU ETS is given in the following textbox.

Allocation of allowances under the existing EU ETS

In the Revised EU ETS Directive (Directive 2009/29/EC), auctioning is determined as the basic principle for allocation since it is considered to

- be the simplest system;
- be the most economic efficient system;
- eliminate windfall profits;
- put new entrants and economies growing faster than average on the same competitive footing as existing installations.

For the power sector full auctioning is the rule from 2013 onwards, whereas for the other sectors a transitional approach currently holds, with a certain share of allowances still being allocated for free.

Regarding the manufacturing industry, in 2013 80% of 2005-2007 emissions are allocated for free; this share is reduced to 30% in 2020 and should be 0% in 2027. The amount of allowances that is allocated for free to incumbent is based on a product-specific output benchmark, historic activity levels and a correction factor to meet the emissions cap. Sectors that are deemed to be exposed to a significant risk of carbon leakage however receive a higher share of free allowances. It is assumed that a significant risk of carbon leakage is present if a sector is faced with relative high additional costs due to ETS and/or if a sector is exposed to relative strong competition from outside ETS.

Regarding the allocation of the allowances to the aviation sector, a hybrid approach is currently also applied. According to Directive 2008/101/EC, in 2012 85% of total allowances are allocated to the aviation sector free of charge and 15% are auctioned and in the period 2013-2020 82% are allocated free of charge, 15% are auctioned and 3% are reserved.

The allowances that are allocated free of charge are allocated to the aircraft operators on the basis of an EEA-wide tonne-kilometre benchmark and historic tonne-kilometres.

The free allocation options discussed above all assume that the regulated entity (the agent who have to surrender the allowances) is also the entity which initially receives the allowances. However, it may be possible to make a distinction between these two types of entities. Such a system is applied in California for a emission trading scheme covering energy use in the built environment. For example, with respect to electricity the generator/importer is appointed as entity who has to surrender the allowances while the electricity distributors receive the allowances (for free). The latter entity could sell the allowances and the revenues have to be used to protect end-users from price rises due to emission trading. In this way windfall profits and significant impacts on consumers' disposable incomes are avoided. With respect to the inclusion of transport in EU ETS it would be possible to appoint an upstream entity (e.g. refineries/importers) as regulated entity and vehicle owners as entity who receive allowances[64]. The main issues related to this allocation option and its main differences compared to the other allocation options in discussed in a text box in Section C.3.5.

[64] In contrast to the Californian system appointing the final supplier of fuels (in case of transport fuels the filling stations) as entity receiving allowances will not be effective. This allocation approach will only be effective in case the transfer of the revenues of the allowances to the end-users do not affect the variable costs (i.e. the fuel costs), because otherwise it will negatively affect the number/type of emission reduction measures taken by the end-user. In other words, the revenues of the allowances should be transferred as lump sump payments to the end-user in order to be effective. This will, however, not be the case if filling stations are appointed as the regulated entities receiving allowances since they could only transfer the revenues of the sales of allowances by lowering the fuel prices (and hence lowering the variable costs for end-users).

C.3.2 Assessment of environmental impacts

The impact of the allowance allocation method on the innovation effects and awareness raising capacity of EU ETS are discussed below.

Effects on innovation

The innovation effects of the inclusion of transport in the EU ETS depends on the allocation mechanism applied (Santos et al., 2010; Schleich and Betz, 2005). By appliance of more fuel-efficient technologies, the emission costs for the regulated entities decrease either since the freed-up allowances could be sold on the market or since less allowances need to be purchased at the auction. The reduced demand for allowances results in lower allowance prices. In case of auctioning regulated entities benefit from these lower allowance prices. However, in case of free allocation also the opportunity costs of the allowances are reduced and hence windfall profits; the benefits of lower allowance prices are therefore undone by lower windfall profits. Thus, where auctioning provides an incentive to apply innovative emission reduction measures to lower the average allowance prices, free allocation doesn't. Whether auctioning actually leads to lower allowance prices and hence innovation incentives depends on whether the regulator adjusts the target accordingly (Schleich and Betz, 2005). A reduction of the cap over time will counterbalance the impact of innovation up-take on the allowance price. In this case, the differences between free allocation and auctioning in terms of innovation vanish.

Auctioning of allowances also provides more transparency and clearer long-term price signals compared to grandfathering (Santos et al., 2010; Schleich and Betz, 2005). If (a small share of) the emissions allowances are auctioned prior to the start of a trading period this may generate robust price signals for the actual scarcity in the market, since participants base their bidding behaviour on their marginal abatement costs (Schleich and Betz, 2005). Therefore, auctioning of allowances may provide investors a clear and early price indicator on which they can base their investment decisions. In case a grandfathering approach is applied such an early price indicator is missing and hence less certainty on expected allowance price developments is available. As a consequence, investors will probably be less willing to invest in innovative reduction measures. Finally, it should be noticed that a robust price signal may also be provided by a hybrid allocation mechanism, provided off course by the fact that a substantial part of the emission allowances are auctioned.

Effects on awareness raising

The allowance allocation mechanism applied may affect the awareness raising capacity of the inclusion of transport in EU ETS. First of all, it should be noticed that most people are loss averse, i.e. they strongly prefer avoiding losses over acquiring gains (Kahneman and Tversky, 1979). Therefore, it may be expected that people are more affected by a loss of their free (unofficial) right to pollute (in case of auctioning) than by getting a (official) right to pollute (in case of free allocation) and hence people may be more incentivized to implement fuel-efficient measures in the former case. In other words, auctioning of allowances may have a bigger awareness raising effect than free allocation of allowances and hence may be more effective. This effect may be strengthen by the fact that the link between the inclusion of transport in EU ETS and the increase in transport costs is more direct (and hence clear) for transport users compared to free allocation of allowances and therefore may provide a bigger incentive to implement fuel-efficient measures.

With respect to the various options for free allocation of allowances the awareness raising capacity of grandfathering will probably be larger than of activity benchmarking, since the link between the policy instrument (EU ETS) and the target (reducing GHG emissions) is more clear for the former option.

C.3.3 Assessment of economic impacts

The choice of the allowance allocation method may affect some of the economic impacts of the inclusion of transport in EU ETS. These impacts of the allocation method on economic impacts are discussed in this section.
The following impacts are relevant in that respect: transaction costs, equity issues (impacts on disposable incomes and equal treatment of regulated entities), windfall profits, impacts on public finance and impacts on profits/incomes.

Transaction costs

An emissions trading system is associated with transaction costs for public administrations as well as for the regulated entities. The following transaction cost items are specific for the alternative allocation approaches and can therefore, depending on their level, be considered as a advantage/ disadvantage of a certain allocation method.

Table 44 Transaction cost items specific for alternative allocation approaches

Allocation approach	Specific transaction costs item	
	Public administrations	**Regulated entities**
1. Auctioning of allowances	Provide auctioning platform(s)	Participation in auction
2. Free allocation of allowances based on historic emissions ('Grandfathering')	Determination of allocation. Issuance of free allowances	Reporting and verification of historic emissions. Application for free allowances
3. Free allocation of allowances based on benchmarks and historic/actual activity levels ('Benchmark approach')	Determination of benchmarks. Determination of allocation. Issuance of free allowances	Reporting of historic emissions and activity levels by most efficient actors to determine benchmarks. Reporting and verification historic/actual activity levels to be applied to benchmarks. Application for free allowances

If the allowances were auctioned, the European Commission and the public administrations of the countries that are opting out, would have to provide an auctioning platform. However, since auction platforms have been assigned under EU ETS (currently EEX and ICE Futures Europe), there would be no need to start from scratch and incremental costs could expected to be minor.
The regulated entities would have to incur transaction costs for participating in the auction.

If the allowances were allocated for free based on historic emissions, the regulated entities would have to report their monitored and verified historic emissions. These latter costs could differ greatly between actors, depending on whether data has already been monitored for other purposes and depending on the degree to which the data can easily be verified (see also Section C.4 on MRV). Public administrations would have to determine the amount of free allowances that every actor would receive and in addition would have costs for issuing the free allowances. The regulated entities would have to apply for these allowances.

If the allowances were allocated for free based on benchmarks and actual/historic activity levels, the European Commission would have to determine the benchmarks in the first place. This could turn out to be a cumbersome and costly task, depending on the type of benchmark applied and the data already available from other reporting obligations of the regulated entity. In case a fuel benchmark is applied and the CO_2 content of the fuel with the lowest CO_2 content is used as benchmark, the transaction costs are very low. However, if – in case of a downstream scheme – an activity based benchmark is used (e.g. based on tonne kilometres or vehicle kilometres), transaction cost of determining the benchmark could be considerable; in this case the most efficient actors of the various subcategories would have to provide their historic emissions and activity levels or estimations would have to be made based on public available data, which both will result in significant transaction costs. Once benchmarks have been determined, the amount of allowances to be allocated for free to the different actors would have to be established as well. For this, the actors would have to report their monitored and verified historic/actual activity levels. Just as under the second approach, these costs could differ greatly between actors, depending on whether data is already being monitored for other purposes and depending on the degree to which the data can easily be verified. Public administrations would have costs for issuing the free allowances and the regulated entities would have to apply for these allowances.

Under each allocation approach the regulated entities would, in most cases, have to incur costs for buying/selling allowances on the market. Only if under an auctioning approach, the exact number of allowances was purchased in the first instance these costs would not accrue.

If a hybrid allocation approach was chosen, not only the transaction costs that accrue under auctioning but also the transaction costs that are specific for the according free allocation approach would have to be incurred.

From the above analysis we conclude that in general the ranking of allocation options regarding the expected transaction costs will be (starting with the option with the lowest expected costs):
1. Auctioning.
2. Grandfathering.
3. Benchmark approach.
4. Hybrid approach including benchmark approach.

However, in case tax warehouse keepers are appointed as regulated entities, the transaction costs of grandfathering and a benchmark approach (fuel benchmark) are very low as well, since all necessary data on historic emissions/fuel flows has already been reported by these entities. For this regulated entity we expect therefore no large differences in transaction costs between the various allocation approaches.

Finally, to give an indication of the level of the transaction costs, the transaction costs regarding the aviation sector are given in the following textbox.

Transaction costs of the inclusion of aviation in ETS
PwC, CE Delft and SQ Consult (2013) shows that for aviation small emitters compliance costs for an aircraft operator amounted on average to about € 22,000 and € 15,000 in 2010 and 2011 respectively. Since beginning of 2012, emissions from international aviation are included in EU ETS and the aircraft operators' costs incurred in 2010 and 2011 can therefore be seen as a small regulated entities' start up transaction costs of a benchmark allocation system.

The costs of 15 responding Member States for administering all aircraft operators was estimated to be around € 3 million in 2010 and € 1.2 million in 2011. For both the aircraft operators and the Member States, the costs incurred in 2012 have been estimated to be higher than the costs in 2011. Regarding the aircraft operators, registration costs thereby play a major role. For Member States the higher 2012 costs are also related to the registry handling but probably also related to 'Stopping the clock'. The allocation of free allowances consist a relative small share of 2012 transaction costs.

Equity: impacts on disposable incomes
The allowance allocation method applied do not directly affect the disposable incomes of final consumers. Although auctioning results in higher initial costs that may be passed on to the final consumers (or are borne directly by the final consumers in case of a fully downstream scheme) and hence lower their disposable incomes, the realisation of windfall profits by regulation entities by passing on the opportunity costs to final consumers may have the same impact on their disposable incomes. This reasoning do not completely hold for a fully downstream scheme, since then there is less potential for windfall profits (see below).

However, there is one important difference between auctioning and free allocation of allowances with respect to the impact on disposable incomes. In case of auctioning, the national governments receive revenues which they could use to compensate consumers for higher transportation costs. In this way the impacts on disposable incomes could be (partly) neutralised. Since free allocation of allowances do not result in additional revenues for governments, these types of schemes do not provide the opportunity to compensate final consumers for changes in their disposable incomes.

Equity: equal treatment of regulated entities
The allocation method should be chosen such that equity over time, equity between comparable actors within the system and equity between comparable actors in and outside the system is guaranteed as far as possible.

The allocation system should therefore be designed in such a way that:
- an early mover disadvantage should be avoided, i.e. that the adoption of a reduction measure that takes place under the regulation should not be rewarded stronger than the adoption of such a measure before the regulation entered into force;
- the terms at which a newcomer can enter the market does not differ from the terms that hold for a comparable established market participant;
- distortions due to windfall profits are avoided;
- a potential loss of market share to sectors not subject to a carbon regulation is minimized.

Early movers are rewarded if allowances are auctioned or if allowances are allocated for free on the basis of a benchmark, whereas early movers are penalized if allowances are allocated for free on the basis of historic emissions. Under auctioning, the early mover has to buy less allowances at the auction than the other actors in the market. Under a benchmark approach, the early mover has to buy less allowances on top of the allowances that are allocated for free than the other actors in the market or could even sell some of the allowances received for free. If the allowances are allocated for free on the basis of historic emissions, the early mover would receive less allowances compared to the other actors since his historic emissions are relatively low.

Under auctioning an established market actor and a newcomer are treated the same way in the sense that both can participate on equal terms in an auctioning, at least if the auctioning is carried out periodically. If the newcomer enters the market in between two auctions, the newcomer can buy allowances on the secondary market and thereby has comparable direct EU ETS costs to the incumbent company, at least if primary and secondary allowance prices do not differ significantly. If allowances are allocated for free, newcomers and incumbents can only be treated equally if a sufficient amount of free allowances are reserved for newcomers.

As explained in greater detail below, the free issuance of allowances can, under certain circumstances, lead to the generation of windfall profits. Windfall profits may not only lead to a distortion between actors in and outside the system but also to a distortion within the system. A distortion within the system could for example occur if certain vehicles were exempted from the system due to a size threshold and would end up having a disadvantage of not receiving free allowances or if for example under a downstream approach non-vehicle owners have a disadvantage over vehicle owners by not receiving free allowances.

In order to prevent a loss of market share to sectors not subject to a carbon regulation, the EU ETS regulation foresees a higher allocation of free allowances to those sectors that are exposed to a significant risk of carbon leakage. In order to prevent distortions due to windfall profits, two indicators have been developed to determine whether a sector is exposed to a significant risk of carbon leakage. As explained in Section C.2.2 we do not expect the transport sector to be exposed to a significant risk of carbon leakage.

Potential for windfall profits

The potential for windfall profits exists in case emission allowances are allocated for free to the regulated entities (ITS Leeds, 2007; PWC, 2002; Santos et al., 2010). Companies receiving allowances for free may pass through the opportunity costs of these allowances and hence obtain windfall profits. The potential for windfall profits depends on the extent by which regulated entities are able to pass through their costs to the final consumers.

As discussed in Section C.2.2 the potential for passing on costs to final consumers depends on the elasticity of the demand and supply curves and the market structure. According to Sijm et al. (2009), the more competitive the market, the larger the potential to pass on costs and hence the larger windfall profits (theoretically; under the monopoly companies are able to pass through 50% of the (opportunity) costs of ETS, while under perfect competition up to 100% pass through of costs could be realised (CE Delft, 2010a). In the latter situation companies are incentivized to pass through all their (opportunity) costs in the consumer prices, while in case of a monopoly it may be economically rational to pass through only part of the opportunity costs (to maximize profits).

The potential for windfall profits doesn't depend on the type of free allocation mechanism (grandfathering vs. activity benchmarking). In case allowances are auctioned there are no opportunity costs of allowances that regulated entities could pass on and hence there is no potential to realise windfall profits.

The potential for windfall profits may also depend on the regulated entities chosen. No large differences in the potential for windfall profits are expected for entities at up- and midstream levels, since they will probably all pass on the opportunity costs to the final consumers (Kågeson, 2008; Öko-institut, 2002), also because they are not experiencing (significant) negative impacts on their competitiveness compared to non-EU companies. For downstream approaches, a distinction should be made between private passenger transport, public passenger transport and freight transport. For the latter category it may be expected that they will pass on the opportunity costs to shippers and hence there will be windfall profits[65]. For private passenger transport no potential for windfall profits exists, since the regulated entities are the final consumers in this case. Finally, with respect to public passenger transport the potential for windfall profits depends on the market structure; in case the public transport companies operate in a competitive market windfall profits may be expected, but if they are operating in a regulated market, these kinds of profits will probably not exist.

Impact on public finance

Inclusion of transport in EU ETS may impact national government revenues in two ways:
- by gathering revenues from the auctioning of allowances;
- by changes in other tax revenues.

Revenues from auctioning CO_2 emission allowances

By auctioning emission allowances the government may gather additional revenues. These revenues could be used to finance the operational costs of the scheme, to reduce other transport taxes (to compensate transport users), to invest in CO_2 mitigation measures or they could be used to fund the general accounts. The size of these revenues do depend on the number of allowances allocated and hence exempting some subsectors from the ETS may reduce the revenues.

In case of free allocation there are no revenues for the government, while in case of a hybrid system only revenues are gathered for the 'auctioning part' of the system.

Impact on other tax revenues

The inclusion of transport in EU ETS may affect other tax revenues in several ways. First of all, governments may decide to eliminate or reduce existing fuel or carbon taxes to avoid doubling financial burdens on the sector. This political decision may depend on the type of regulated entity chosen. In case a downstream approach is applied it will be clear for all transport users that there is a direct link between the increasing transport costs and the inclusion of transport in ETS. However, if a mid- or upstream regulated entity is appointed this link is more indirect and hence there may be less public pressure to reduce existing fuel taxes.

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65 Since transport companies are often relatively small companies it may be expected that on average they will act less rational (in economic terms) that the large companies further upstream in the fuel supply chain. Therefore, it may be possible that not all opportunity costs are passed on by these organisations resulting in lower windfall profits. However, there is no empirical evidence proving this reasoning.

Changes in transport behaviour of households and companies may also affect tax revenues. The revenues of excise duties on transport fuels may decrease in case vehicle owners decide to buy/use more fuel efficient vehicles, drive more fuel-efficient, increase the logistical efficiency of their transport or travel/transport less (see Section 3.2.3 for a complete overview of possible fuel reduction measures). Also changes in the fuel mix may affect fuel tax revenues, in case the excise duty rates differ on the various types of fuels. Since the CO_2 emissions per kilometre are in general lower for diesel vehicles as for petrol vehicles the costs per kilometre will increase more for the latter vehicles in case transport is included in EU ETS and hence a (modest) shift from petrol to diesel vehicles may be expected. Since in general the current taxes on diesel are lower than the ones on petrol, this shift will result in lower tax revenues. Finally, a (modest) shift from road transport to rail or IWT may be expected, since the CO_2 emissions per tonne or passenger kilometre are lower for the latter modes. Also this transport effect results in a reduction in fuel tax revenues.

As was discussed in Section C.2.2, the incentive to reduce fuel use within the transport sector doesn't differ much between the various possible regulated entities and hence also the impact on transport tax revenues will not significantly differ between the various regulated entities. Also the choice of allowance allocation mechanism will probably not have a significant impact on the type and size of fuel efficient measures applied by transport users and hence on the changes in revenues of transport taxes.

Next to the direct effects on tax revenues discussed above there may also be some indirect effects on tax revenues; e.g. the revenues of taxes on profits may decrease if the relative competitiveness of EU companies deteriorates. However, it is expected that these impacts are small and could be marginalised by designing the scheme in a proper way. Therefore we will not discuss them here in more detail.

Impact on income/profit

By including transport in the EU ETS the (production) costs for the regulated entity will increase with the price of allowances that need to be bought. Which actors are actually bearing these cost increases depends on the extent by which the additional costs could be passed on through the fuel supply chain. As mentioned in Section C.2.2, in this study we apply the working assumption that actors could pass on 100% of the additional costs to the final consumers (the vehicle owners). In this case the inclusion of transport in the ETS results in a reduction of the average incomes. However, if the various actors are not able to pass on all the additional costs also the profits of various actors in the fuel supply chain may be affected.

The impact on profits/incomes depends on the allocation approach applied. In case auctioning is applied, the impacts on profits/incomes is highest since actors have to pay for the initial allocated allowances. In case of free allocation these costs are lacking and hence the impacts on profits/incomes are lower. It should, however, be mentioned that in case of auctioning the government could decide to use the auctioning revenues to compensate the various actors affected by the EU ETS.

Notice that in this section we discussed the impacts of the allocation approach on the total profit/income levels. The impacts on the income levels of specific groups of actors may be different; for example, if the potential for windfall profits is fully realised by the regulated entity (i.e. the opportunity costs of the allowances are fully passed on to the final consumers) the impacts on the disposable incomes of vehicle owners are the same for free allocation and auctioning. This is discussed in more detail above (equity: impacts on disposable incomes).

C.3.4 Assessment of technical feasibility

In this section we discuss the technical feasibility of the various allowance allocation methods, based on one criterion: feasibility of allocation.

Feasibility of allocation

An important aspect with respect to the feasibility of free allocation is whether it is possible to accurately determine historic emission levels (grandfathering) or the benchmark (benchmark approach) against reasonable costs. With respect to grandfathering this may be doubted in case a downstream approach is applied, because it may be a very complex process to determine the historic emission levels for all individual vehicle owners (Fifo, 2005; ITS Leeds, 2007; Santos et al., 2010). This will even be more problematic in case an emission level averaged over some (historic) years is used. Also in case of some midstream approaches (e.g. filling stations as regulated entities), determining the historic emissions for all involved actors may not be practically feasible. However, for the more upstream approaches this shouldn't be a problem. With respect to the fuel benchmark approach exactly the same feasibility issues are relevant. Benchmarks based on passenger/tonne kilometres or vehicle kilometres are even more problematic from a technical feasibility objective, since currently no reliable monitoring schemes for vehicle kilometres or passenger/tonne kilometres exists for all European countries (this issue will be discussed in more detail in Section C.4.2).

With respect to auctioning no benchmark should be determined and hence the problems discussed above for free allocation are not relevant for auctioning allowances. Therefore, at least in case a downstream regulated entity is appointed, it seems more appropriate from a feasibility perspective to implement an auctioning scheme than a scheme based on free allocation of allowances (Fifo, 2005; ITS Leeds, 2007; PWC, 2002). However, as is mentioned by e.g. Santos et al. (2010), also applying an auctioning approach in combination with a downstream approach may not be practically feasible due to the large number of individuals who have to be involved.

C.3.5 Assessment of the legislative efficiency

In the Revised EU ETS Directive (Directive 2009/29/EC), auctioning is determined as the basic principle for allocation since it is considered to

- be the simplest system;
- be the most economic efficient system;
- eliminate windfall profits;
- put new entrants and economies growing faster than average on the same competitive footing as existing installations.

For the power sector full auctioning is the rule from 2013 onwards, whereas for the other sectors a transitional approach currently holds, with a certain share of allowances still being allocated for free.

Regarding the manufacturing industry, in 2013 80% of 2005-2007 emissions are allocated for free; this share is reduced to 30% in 2020 and should be 0% in 2027. The amount of allowances that is allocated for free to incumbent is based on a product-specific output benchmark, historic activity levels and a correction factor to meet the emissions cap. Sectors that are deemed to be exposed to a significant risk of carbon leakage however receive a higher share of free allowances. It is assumed that a significant risk of carbon leakage is present if a sector is faced with relative high additional costs due to ETS and/or if a sector is exposed to relative strong competition from outside ETS.

Regarding the allocation of the allowances to the aviation sector, a hybrid approach is currently also applied. According to Directive 2008/101/EC, in 2012 85% of total allowances are allocated to the aviation sector free of charge and 15% are auctioned and in the period 2013-2020 82% are allocated free of charge, 15% are auctioned and 3% are reserved. The allowances that are allocated free of charge are allocated to the aircraft operators on the basis of an EEA-wide tonne-kilometre benchmark and historic tonne-kilometres.

Options for issuing/allocating emission allowances to the transport sector

The arguments in favour of auctioning as mentioned in 2009/29/EC also hold for issuing/allocating emission allowances to the transport sector:
- Auctioning of the allowances is simpler than free allocation since no allocation mode (such as e.g. benchmarking) has to be determined.
- Auctioning of the allowances is more efficient than free allocation since allocation modes that would have to be applied under free allocation could trigger unwanted strategic behaviour.
- Auctioning of the allowances does eliminate windfall profits. Under free allocation of allowances windfall profits can occur and political acceptability of the system could therefore be lower. Note that this holds for an upstream approach (e.g. windfall profits of refineries) but could also be an issue under a downstream approach (e.g. windfall profits of dispatchers).
- New market entrants and existing market actors are treated equally under auctioning.

The question is then: is there a risk of carbon leakage that would constitute an argument for free allocation and/or should there be a transitional hybrid system of free and auctioned allowances?

The current ETS directive has set explicit criteria for assessing this risk. For a *manufacturing* sector, the risk of carbon leakage is expected to be high if a sector is faced with relative high additional costs due to ETS and/or if the sector is exposed to relative strong competition from outside the ETS.
The following two indicators have therefore been developed for determining whether sectors are exposed to a risk of carbon leakage:
1. The *production cost indicator* is determined by the direct and indirect additional costs due to the ETS as a proportion of the gross value added of the sector under consideration. The direct additional costs are the costs for buying emissions allowances and the indirect additional costs are the ETS related additional electricity costs.
2. The *trade intensity indicator* is defined as the ratio between the sum of the value of exports to third countries and the value of imports from third countries and the total market size of the sector in the Community measured by the sum of the annual turnover and the total imports from third countries.

According to Revised EU ETS Directive, a (sub)sector is deemed to be exposed to a significant risk of carbon leakage:

1. If the production cost indicator has a value of at least 5% and, at the same time, the trade intensity indicator has a value of above 10%.
2. Or if the production cost indicator has a value of above 30%.
3. Or if the trade intensity indicator has a value of above 30%.[66]

As to the *transport* sector, the two carbon leakage indicators developed for the manufacturing industry can naturally only be determined for the commercial transport sector. Quantification of the *trade intensity indicator* for the commercial freight sector however is difficult since there is a lack of data regarding the value of imports of transport from third countries.

Quantification of the *production cost indicator* however is possible for the commercial freight sector: For 2009, the additional direct ETS costs for the commercial EU 27 road freight sector would have amounted to approximately € 8 billion, if for 75% of the 268 Mt CO_2 emissions[67] allowances had to be bought at an allowance price of € 30.[68] With a value added of the sector of around € 94 billion in 2009 (Eurostat, 2013), the value of the *production cost indicator* amounts to around 9% for the commercial road freight sector.
The second carbon leakage criteria thus does not apply. Hence, the commercial road freight sector would only qualify for free allocation if its trade intensity was higher than 10%. As already mentioned, there is not sufficient data available for the quantification of this trade intensity but since market penetration of road freight suppliers from non-ETS countries is not fully liberalized we expect the trade intensity to be rather low. Access of hauliers from non-ETS countries to ETS countries is laid down in bilateral agreements as well as in a multilateral (ECMT) agreement. The transport work that has been carried out by EU 27 hauliers in third countries in 2010 accounted for only 8% of their total transport work measured in tonne-kilometres, with 6% being exports to third countries and 2% being imports from third countries (EC, 2011). This suggests, assuming that the bi-/multilateral agreements do not favour third country hauliers, that market penetration of hauliers from third countries is rather low. Furthermore, the comparative advantage of the dispatcher from the non-ETS country is restricted if he has to refuel against the higher fuel price in an EU ETS country. This would restrict carbon leakage if third country hauliers could nonetheless gain some market share.

Note that under a downstream approach, a possible comparative advantage of non-EU ETS dispatchers can better be foreclosed by including every vehicle, independent of its provenance, into ETS.

Regarding the commercial freight sector, a potential second type of carbon leakage is conceivable that cannot be captured by the two carbon leakage indicators as developed for the manufacturing sectors: Carbon leakage may also occur if the raised freight transport costs lead to a loss of market share of

[66] Next to these three criteria Directive 2009/29/EC further allows for a complementary assessment taking the (sub)sectors options for reducing emissions and/or electricity consumption into account as well as current and projected market characteristics and profit margins.

[67] The 268 Mt CO_2 emissions of the road freight sector is based on the Statistical Pocketbook 'EU transport in figures' and on Eurostat. We assume that these emissions are related to the transport work carried out by vehicles registered in the EU. If emissions from third country vehicles were captured here as well, the production cost indicator would even be lower.

[68] See SEC(2009) 1710 for the quantification of the carbon leakage indicators.

certain transport-intensive (non-transport) sectors. As a result, CO_2 emissions of manufacturing installations could shift to outside the ETS and, depending on where the demand is located, transport emissions outside the system could rise too. Since dispatchers do work for different sectors it would be costly to differentiate between transport work that has been carried out for sectors that are exposed to a carbon leakage risk and those that are not, in order to determine a certain share of allowances to be allocated for free. It therefore seems more sensible to expand the carbon leakage criterion for the manufacturing sectors by not only taking the additional ETS related electricity costs but also the additional ETS related transport costs into account.

Finally, there is a third type of carbon leakage conceivable which is not specific for the commercial freight transport sector. If, due to the ETS, the fuel price within the ETS was higher than outside the system 'tank tourism', i.e. filling up the vehicle tank outside the system, could occur.

If carbon leakage due to 'tank tourism' occurs, it can mainly be expected to occur in the ETS boarder countries since detours in order to tank outside the system are only efficient up to a certain detour distance.

Full elimination of this avoidance mechanism is actually possible by choosing a downstream approach where all transport emissions within the geographic scope of the ETS are fully covered by the ETS, whereas partial elimination can be reached by choosing for a downstream approach and allocating the allowances for free to the vehicle owners. This however could raise equity issues, since non-vehicle owners may not accept the windfall profit that some vehicle owners may make. Under an upstream approach 'tank tourism' cannot be prevented by a free allocation of allowances. It could only be limited by mechanisms comparable to the once that are in place in some Member States regarding the fuel tax. In Germany e.g. only a certain amount of fuel is allowed to be transported in extra fuel tanks of trucks without having to pay the local energy tax.

Note that other unwanted avoidance of the ETS can be prevented by a good policy design. If for instance all transport modes were covered on equal terms, no unwanted modal shift would occur or if e.g. filling stations were assigned as regulated entity, in-company filling stations would have to be incorporated as well or if e.g. refineries were assigned as regulated entity, only the fuel to vehicle owners within the system should fall under ETS and fuel imports to be sold within the system should be treated equally, for the refineries, associated with process CO_2 emissions, not to relocate, etc.

Another reason for deviating from the basic rule of full auctioning of the allowances is the level playing field that should be given with the aviation sector. This is a valid argument and would plead for the application of a transitional hybrid allocation approach for the non-aviation transport sector where a share of the allowances would be auctioned and the other would be allocated for free. However, if for the aviation sector full auctioning was established after 2020, a transitional hybrid allocation approach would neither be necessary for the non-aviation transport sector.

Conclusion
Auctioning emission allowances has several advantages compared to free allocation of allowances. The default way to allocate emission allowances in the EU ETS is therefore auctioning. A deviation from this rule is possible if there is a significant risk of carbon leakage.
For the road freight sector we do not expect significant carbon leakage due to a loss of market share to actors from outside ETS:
the impact of the EU ETS on transport costs is, related to the sector's value added, 9%, which is well below the 30% threshold. The sector would, according to the Revised EU ETS Directive, then only qualify for free allocation if its trade intensity was higher than 10% which is unlikely to be the case, although there are no accurate estimates.
Other forms of carbon leakage are conceivable (e.g. 'tank tourism') but free allocation of allowances is not the best solution here. Hence, in order to be consistent with the ETS directive, all allowances for the transport sector should be auctioned. A transitional hybrid allocation approach should only be considered if full auctioning was not established for the aviation sector after 2020.

C.3.6 Summary assessment allowance allocation methods

The main results of the assessment of the various allowance allocation methods are summarized in Table 45. From the assessment it follows that auctioning is the most efficient/effective allocating approach, which could also be easily implemented. In contrast to free allocation of allowances auction doesn't provide barriers for new entrants and risks on windfall profits. Additionally, auctioning of allowances awards early action of actors, while grandfathering doesn't (notice that early action is also awarded by benchmarking). Finally, auctioning is also expected to result in the lowest transaction costs. A potential disadvantage of auctioning is that it results in the highest (negative) impacts on the profits/incomes of actors in the transport market. This effect could be (partly) neutralised by using the revenues of the auctioning of allowances to compensate the harmed agents.

In case a free allocation method is chosen, grandfathering or fuel benchmarking seems most easily be implemented from a feasibility perspective. Benchmarking based on vehicle kilometres or tonne/passenger kilometres could theoretically be applied for a downstream approach, but since no data is available (or could be easily gathered) for these variables these approaches seem difficult to implement.

As mentioned in Section C.3.1 an alternative free allocation option is to make a distinction between the regulated entity (the entity which has to surrender the allowances) and the entity which initially receives the allowances.
In the following text box the main differences of this allocation option with the other potential allocation mechanisms are discussed.

Alternative allocation option: allocation downstream of the regulated entity

An alternative option to freely allocate the allowances is by allocating them to another entity than the regulated entity. As discussed in Section C.3.1 an interesting option for the transport sector could be to allocate the allowances to the vehicle owners (end-users), while an upstream regulated entity (e.g. refinery/importer) is appointed. In comparison to the other allocation option the main differences are:

- **Windfall profits**: since the upstream entities have to buy the allowances there is no risk on windfall profits (in contrast to the other free allocation options).
- **Incentive for emission reduction measures**: theoretically the incentive to implement emission reduction measures only depends on the variable costs of transport. However, there may be an (indirect) income effect as a result of the revenues end-users receive for the allowances, which may negatively affect the willingness to implement reduction measures.
- **Effect on clean technology innovation**: as is discussed in Section C.3.2 investment in clean technology innovation are hampered by free allocation of allowances, because in this case the implementation of innovative reduction measures result in lower allowance prices and hence lower windfall profits, which undo the direct benefits of the lower allowance prices. Since this alternative allocation option do not result in windfall profits, the investments in clean technology innovation are – as is also the case for auctioning - not negatively affected.
- **Transaction costs**: compared to the options where the allowances are allocated to the regulated entity the transaction costs are higher. This is due to the fact that monitoring should take place at two levels in the fuel supply chain. Furthermore, as is mentioned in Section C.3.3, the transaction costs of trading at a downstream level are very high anyway.
- **Impacts on income levels**: by allocating the allowances to the vehicle owners negative effects on their incomes could be compensated. However, it should be noticed that this could also be realised by allocating (some of) the auctioning revenues to these people/entities.

Table 45 Summary of assessment of allocation approach

Criterion	Sub-criterion	Indicator	Grandfathering	Benchmarking: historic activity	Benchmarking: activity in according period	Auctioning	Hybrid approach
Environmental impact	Effect on clean technology innovation		Limited	Limited	Limited	Significant effect, at least larger as for other options	Depends on the actual design, size effect between effect of grandfathering and auctioning
	Awareness raising		(very) small impact	Awareness raising impact is smaller as for grandfathering	Awareness raising impact is smaller as for grandfathering	Increased awareness, impact larger as for other options	Increased awareness, impact smaller as for auctioning
Economic impact	Transaction costs		Higher than auctioning but lower than benchmarking. In case tax warehouse keeper appointed as regulated entity, no big differences in transaction costs between allocation methods.	Higher than auctioning and grandfathering. In case tax warehouse keeper appointed as regulated entity, no big differences in transaction costs between allocation methods.	Higher than auctioning and grandfathering. In case tax warehouse keeper appointed as regulated entity, no big differences in transaction costs between allocation methods.	Lowest. In case tax warehouse keeper appointed as regulated entity, no big differences in transaction costs between allocation methods.	Including benchmarking: highest. Including grandfathering: unclear. In case tax warehouse keeper appointed as regulated entity, no big differences in transaction costs between allocation methods.
	Equity: impacts on disposable incomes		(Small) impact on disposable incomes	(Small) impact on disposable incomes	(Small) impact on disposable incomes	(Small) impact on disposable incomes, but could be (partly) compensated by use of auctioning revenues	(Small) impact on disposable incomes, but could be (partly) compensated by auctioning revenues
	Equity: early action and new entrants	Early action awarded: yes, no	No	Yes	Yes	Yes	Yes, partly
		Barriers for new entrants: yes, no	Yes	Yes	Yes	No	Yes, partly
	Potential for windfall profits	Yes, no	Yes	Yes	Yes	No	Yes, but smaller potential as for grandfathering and benchmarking
	Impact on public finance	Allocation of allowances: Yes, no	No	No	No	Yes	Yes, but smaller as for auctioning
		Other tax revenues:	Yes	Yes	Yes	Yes	Yes

Criterion	Sub-criterion	Indicator	Grandfathering	Benchmarking: historic activity	Benchmarking: activity in according period	Auctioning	Hybrid approach
		Yes, no					
	Impact on income/profit	Impact on overall income/profit level: yes, no	No	No	No	Yes	Yes, partly
Technical feasibility	Feasibility of allocation	Feasible, not feasible	Feasible, but very difficult to implement for downstream approaches	Feasible, but only for a fuel benchmark	Feasible, but only for a fuel benchmark	Feasible, but also difficult to implement for downstream approaches (but easier as for grandfathering)	Feasible, but difficult to implement for downstream approaches

C.4 MRV: data to be monitored

The data to be monitored in the EU ETS is one of the design options we distinguish in this study. In this section we first briefly discuss the options for the data to be monitored. Next, the various options are assessed based on the following criteria: monitoring accuracy, sensitivity for fraud and legislative efficiency.

C.4.1 Monitoring options

With respect to the monitoring of the CO_2 emissions ultimately be released from burning transport fuels actually one feasible option could be distinguished: based on the total amount of fuels produced/consumed the total CO_2 emissions are estimated by multiplying these amounts of fuels with an (average) emission figure for the respective fuel type (Flachsland et al., 2011). This monitoring option thus only requires that the total amount of fuels (differentiated to the various fuel types) produced or consumed by the appointed regulated entity are monitored. With respect to the emission figures to be used it should be taken into account that these could change over time and hence these figures should be checked regularly. Additionally, the carbon content of biofuels may be uncertain, particularly at lower levels of the supply chain. However, in the Fuel Quality Directive average default values are used for different types of biofuels and it seems appropriate to use the same values for ETS.

In case of a downstream approach, an alternative monitoring approach could be applied based on standardized CO_2 emission figures (g CO_2 per kilometre) for vehicles. Combined with information on the annual mileages of vehicles the annual CO_2 emissions of a vehicle could be determined. However, currently only official CO_2 emission figures per kilometre are available for passenger cars and vans (because of the CO_2 vehicle standards that are in place for these vehicles) based on test cycle measurements. Similar CO_2 emission figures are currently not available for heavy duty vehicles as well as for the non-transport modes. Additionally, it should be mentioned that these test cycle CO_2 emission figures deviate from real-world CO_2 emissions and hence the CO_2 emissions monitored in this approach are not equal to the actual CO_2 emissions emitted by the vehicle user. Finally, not all reduction measures applied will be taken into account in case this monitoring approach is applied; e.g. applying a fuel-efficient driving style does not result in less CO_2 emissions monitored. For these reasons we don't consider this monitoring approach a feasible option and therefore we don't discuss it in any more detail in this report.

Monitoring options for activity benchmarks

Depending on the allowances allocation method applied also data on the allocation benchmark should be monitored. With respect to the historic emissions the same approach as described above could be applied. However, for the activity based benchmarks alternative monitoring options should be considered (see Table 46). In case of a fully upstream approach, the amount of raw materials extracted/imported could be used as an activity benchmark. Monitoring of this benchmark could be easily done by checking the accounts of the extractor/importer. For most of the regulated entities a fuel benchmark is a relevant option, which could be based on data on actual consumed/ produced/processed/sold fuels (differentiated to fuel type).
In case of a downstream approach, the number of vehicle kilometres or the number of passenger/tonne kilometres are possible activity based benchmarks.

Theoretically, these indicators could be measured directly. However, they may also be estimated based on other indicators; the various options are presented in Table 46.

Table 46 **Monitoring options for various activity benchmarks**

Regulated entity	Activity benchmark	Possible monitoring option
Extractor/importer of raw materials	Amount of raw materials extracted/imported	Directly from the accounts of extractors/imported
All entities (except for extractor/ importer of raw materials)	Amount of fuel	Based on actual amount of fuel consumed/produced/processed/ sold (differentiated to type of fuel)
Vehicle owners	Number of vehicle kilometres	Based on actual vkm Based on characteristics of vehicle owner (e.g. family size)
	Number of passenger kilometres or tonne kilometres	Based on actual pkm or tkm Based on actual vkm and average occupancy rates/load factors Based on characteristics of vehicle owner (e.g. family size)

C.4.2 Monitoring accuracy

An effective ETS system requires an accurate monitoring scheme. In this paragraph we discuss three issues related to monitoring accuracy:
- the possibility to accurately monitor total CO_2 emissions of transport fuels;
- the possibility to accurately monitor the various potential activity based benchmarks for allocating allowances;
- the possibilities to exempt some subsectors from a monitoring perspective.

Monitoring total CO_2 emissions of transport fuels

As mentioned above the amount of CO_2 emissions that will ultimately be released from burning transport fuels can be (readily) calculated by multiplying the total amount of fuels produced/consumed with (average) emission figures for the respective fuel type.

At the level of up- and midstream entities the total amount of fuels produced/traded could relatively easy be monitored. Depending on the regulated entity selected, monitoring imported/exported fuels (or raw materials) may be require some additional monitoring activities, particularly in case import/export volumes at different points in the supply chain are needed. However, almost all transport fuels (except for natural gas) are subjected to the Excise Movement and Control System (EMCS), which provides the opportunity to control and follow the movements of excise goods for which no excise duties have been paid yet (see also Annex E). Since also the imports to and exports from the EU are recorded by this System, the inclusion/ exclusion of these imports/exports in the EU ETS could be relatively easily organised.

Monitoring CO_2 emissions from imported materials/fuels becomes more complicated if also upstream emissions have to be accounted for (Flachsland et al., 2011), since then also the process emissions of the extraction of raw materials should be taken into account. This could, however, be overcome by using a default emission factor (per fuel type) for upstream emissions. Currently, no agreements on such a default value are made on an European level, although it is intended to include such a value in the Fuel Quality Directive. It seems appropriate to use the same value as soon as it becomes available.

Another issue with respect to upstream (and not or to a much lesser extent to mid- and downstream entities) is the impossibility to identify the markets on which the fuels are going to be used (see also Section C.2.4). To overcome this problem additional monitoring of fuel use further down in the supply chain are needed, resulting in more complex monitoring systems and hence higher transaction costs.

Also mentioned before are the difficulties to monitor the type and amount of biofuels blended to fossil fuels for most of the potential regulated entities. At the level of fuel blenders/tax warehouse keepers, however, this information is often available. For the regulated entities for which this information is not available additional monitoring structures should be implemented.

At a downstream level (vehicle owner), the fuel used per year by a specific vehicle is currently not regularly monitored nor reported (IVL, 2006). Therefore, a system would need to be set up to monitor the fuel use per vehicle. Most studies on this issue (ITS Leeds, 2007; PWC, 2002; Raux, 2005; 2010) recommend the implementation of some kind of smart card system. On these smart cards the emissions rights are held and by using these cards the rights could be debited (or purchased at the current rate) when buying fuel. By applying such a system the monitoring of relevant emissions is rather reliable, although the implementation/transaction costs may be considerable (see Section C.2.3).

Monitoring activity based benchmarks for allocating allowances

In case the amount of raw materials extracted/imported is used as activity benchmark for the allocation of allowances in an upstream scheme monitoring could be done relatively easy based on the accounts of the extractors and importers. Also in this case the export of raw materials should be considered, which requires additional monitoring efforts.

In case of a fuel benchmark the monitoring seems not to be a big problem as well. In case of up- or midstream schemes the amounts of fuels produced/processed could be based on the accounts of the refineries or fuel blenders, while corrections for imported and exported fuels could be made based on the data provided by the EMCS. At a downstream approach (vehicle owners) monitoring will become more problematic, since the amount of fuels consumed is not regularly monitored nor reported. As mentioned above, a smartcard system could be used to monitor the fuel consumption of these actors, but this may result in significant transaction costs.

In case an benchmark based on tkm/pkm or vkm is applied for a downstream approach, accurately monitoring would become even more challenging. Currently no complete EU wide database is available on the number of vehicle, passenger of tonne kilometres driven per vehicle. The number of vehicle kilometres could maybe be gathered during regular vehicle inspections, based on information from the vehicle's milometer. However, this requires the implementation of a rather extensive monitoring scheme. Directly monitoring the number of passenger or tonne kilometres or the number of passengers/freight transported per vehicle is hardly possible in a reliable way, since it requires that vehicle owners accurately register the number of kilometres travelled including the respective occupancy or loading rate of their vehicle. Instead it seems more feasible to estimate the passenger or tonne kilometres based on actual vehicle kilometres travelled and indicators for the average occupancy/loading rate of vehicles (the latter preferably differentiated to characteristics of the vehicle). However, in this case vehicle owners with an initially high occupancy rate/load factor are not rewarded by getting more allowances, which may be regarded as unfair from an equity perspective. Finally, it is also possible to estimate both the vehicle and passenger/tonne kilometres based on characteristics of the vehicle owner (size of the family, type of firm, etc.) which strongly correlates with the number of kilometres. Although this option is relatively easy monitored, it may be considered unfair from an equity perspective (e.g. why should large families living in urban areas get more allowances than small families in rural areas?). For this reason, this option would probably lack public (and political) support.

Possibilities for exempting subsectors from a monitoring perspective
As mentioned above it is currently not feasible at upstream levels to determine the market at which fuels will be used. At the level of extractors/importers of raw materials, refineries and fuel blenders it is therefore not possible to monitor the emissions/fuel consumption of several subsectors (road, rail, IWT, agricultural/construction vehicles; passenger vs. freight transport) without implementing a monitoring system at a lower level in the supply chain.

At lower levels in the supply chains these possibilities often do exist for different types of modes, as is illustrated by the fact that different excise duty rates hold for these modes. Distinguishing passenger and freight transport in the monitoring process at these levels is harder, mainly because these types of transport partly use the same filling stations. In some European countries (i.e. Belgium, France, Spain, Italy and Slovenia) current diesel excise duties are lower for freight transport than for passenger transport. This is operationalized by tax refund schemes; truck owners have the opportunity to partly reimburse the fuel taxes paid. A comparable approach is used in the current ETS to compensate the most electro-intensive sectors for increases in electricity costs resulting from the ETS; these sectors may be supported by state aid schemes, as long as these schemes conform the EU state aid rules and are approved by the Commission. Such kind of a scheme may be an option to 'exclude' passenger or freight transport from the ETS.

C.4.3 Sensitivity for fraud

The sensitivity for fraud of including transport in ETS strongly depends on the monitoring and reporting system to be implemented. In case a complete and reliable monitoring and enforcement system is implemented, the risks on fraud could be minimalized (Flachsland et al., 2011; Raux, 2009). At downstream levels, however, there are a large number of entities and hence more extended enforcement measures are needed to prevent fraud.

More specific, there may be three main potential sources for fraud:

- The difficulties to distinguish transport and 'other' fuels at upstream entities may provide possibilities to fraud; this would be the case if fuels that were indicated to be used for non-transport purposes and hence for which no allowances are submitted are used for transport purposes.
  This potential source of fraud may also harm the effective allocation of allowances in case they are (partly) allocated on historic emissions.
  As discussed before this possibility to fraud could be overcome if fuel use is monitored further down the chain too. Also further down the fuel chain this option to fraud exists. However, at these levels monitoring and enforcement mechanisms already exist, in order to prevent fraud with (differences in) excise duties. These mechanisms could also be used to prevent fraud with emission allowances.
- Exempting some subsectors (e.g. agricultural vehicles, rail transport, IWT) may also provide options to fraud, which are closely related to the options discussed above. This implies that vehicles which emissions are accounted for in the ETS have the opportunity to use transport fuels that are meant for vehicles not included in the ETS, in this way evading the scheme.
  This option to fraud exists for all types of regulated entity, but more downstream of the chain monitoring and enforcement mechanisms already exist to prevent this type of fraud.
- The difficulties to monitor the type and share of biofuels in the transport fuels at the lower levels of the fuel supply chain may provide some opportunities to fraud; e.g. fuel suppliers may argue that their fuels contain more biofuels than they actually do to decrease the number of allowances they have to submit. A reliable monitoring and enforcement system is needed to prevent this type of fraud.
- In case a benchmark approach is used for the allocation of allowances, potential opportunities for fraud are available with respect to the benchmark applied. Particularly with respect to the benchmark options for downstream approaches (vkm, tkm, pkm) vehicle owners have the opportunity to fraud, e.g. by manipulating their milometer. In case the benchmarks are indirectly estimated based on characteristics of the vehicle owner, the opportunities for fraud will probably decline, but at the same time the effectiveness and equity of the benchmark will deteriorate.

C.4.4 Legislative efficiency

Because of the other transport related EU Directives, various actors in the fuel supply chain already monitor/gather data that may be relevant with respect to the inclusion of transport in the EU ETS. Therefore, we discuss in this section the possible efficiencies that could be realised by aligning the data to be monitored in case transport is included in the EU ETS and the data monitored because of other EU Directives.

Fuel Quality Directive

The FQD obliges the reporting of:

- the total volume of each type of fuel or energy supplied, indicating where purchased and its origin; the scope of the FQD is limited to fuels used for road transport, IWT and non-road mobile machinery.
- life-cycle greenhouse gas emissions per unit of energy; life cycle GHG emissions means all net emissions of CO_2, CH_4 and N_2O that can be assigned to the fuel (including any blended components) or energy supplied[69].

[69] This includes all relevant stages from extraction or cultivation, including land-use changes, transport and distribution, processing and combustion, irrespective of where those emissions occur.

The methodology for the calculation of life-cycle GHG emissions from biofuels is explicitly described in this Directive; the calculation of these emissions could be based on:
- a default value for GHG savings for the biofuel production pathway as laid down in the Annex of the Directive (in case the annualised emissions from carbon stock changes caused by land use change are equal to or less than zero);
- the actual value of GHG savings;
- a combination of default values and actual values.

The default values may only be used for biofuels cultivated outside the EU or for biofuels cultivated in areas within the EU for which Member States have proven that the GHG emissions of the cultivation of agricultural raw material are lower than the default values mentioned in the Directive or for biofuels based on waste or residues other than agricultural, aquaculture and fisheries residues. In all other cases actual values should be used. No general GHG calculation method for fossil fuels is provided yet, but the Commission is preparing a directive in which this issue will be covered.

Next to these calculation rules for the GHG savings realised by biofuels, the Directive defines also some sustainability criteria for biofuels. The biofuels should meet these criteria to be taken into account in the calculations. These are criteria like: the GHG emission saving from the use of biofuels should at least be 35%, the biofuels shall not be made from raw materials obtained from land with high biodiversity value or land with high carbon stock, etc. To verify whether these criteria are met, Member States should require economic operators to show that the sustainability criteria are met, i.a. by reporting information on the various sustainability characteristics of the biofuels used.

All these data that should be monitored by economic operators according to the FQD could also be used for monitoring objectives in case transport is included in the EU ETS. Although the scope of both instruments differ (the FQD is focussed on WTT emissions, while the ETS is focussed on TTW emission) the data on the total amount of fuels supplied gathered to meet the FQD requirements is also very useful for monitoring purposes with respect to the inclusion of transport in ETS. Additionally, the definition and calculation method of GHG savings from biofuels as presented in the FQD could be useful for an extended ETS. However, it should be mentioned that the FQD considers life-cycle emissions, while the current EU ETS only considers direct emissions. Finally, to be able to use the monitoring data gathered for the FQD the same regulated entity for the inclusion of transport in ETS should be appointed as was done in the FQD (i.e. often the tax warehouse keeper).

Renewable Energy Directive

In the RED it is mentioned that Member States should report on:
- the total amount of petrol, diesel, biofuels and electricity consumed in road and rail transport;
- the amount of energy from renewable sources consumed in transport, taking into account all types of energy from renewable sources consumed in all forms of transport;
- the contribution from electricity produced from renewable sources and consumed in all types of electric vehicles.

Additionally, the RED also presents the same calculation rules and criteria with respect to the GHG emission savings and sustainability of biofuels. Comparable reporting obligation hold with respect to these issues as in the FQD.

The FQD and RED largely overlap with respect to the data to be monitored. The interaction with respect to this issue between the inclusion of transport in ETS and the RED is therefore comparable to the interaction discussed for the FQD.

Cars and CO_2

The Cars and CO_2 directive requires that each Member state gather for each manufacturer data on:

- the total number of new passenger cars registered in its territory;
- the average specific emissions of CO_2 (sum of specific CO_2 emissions per car divided by the number of new passenger cars);
- the average mass of cars;
- the data mentioned at the first three bullets, but then for each version of each variant of each type of new passenger car.

All the data that Member States are required to gather according to the CO_2 and Cars Directive is not directly useful with respect to the monitoring needs of the inclusion of transport in the EU ETS. Therefore, we are not considering this in any more detail here.

Energy Taxation Directive

The ETD does set minimum excise duty rates for the various transport fuels, but does not oblige Member States or other actors in the fuel supply chain to gather any data (although it should be monitored that the minimum fuel taxes set by this Directive are actually implemented). The proposed amendment of the ETD refers to standardised default CO_2 emissions to be used for the potential CO_2 component of the 'new' excise duties. Alignment could be realised by using the same CO_2 emission figures in EU ETS.

As is discussed extensively in Annex E.3 the practical implementation of the ETD is regulated in Directive 2008/118/EC. This Directive defines some of the responsibilities and requirements for the regulated entities in the ETD.

C.5 Enforcement

For the current ETS each Member State has appointed an emission authority which is responsible for monitoring and enforcing the requirements of the participants in the ETS. In case transport is included in the EU ETS the same emission authority could be appointed for monitoring and enforcement tasks, but also a new authority could be created or cooperation could be sought with existing authorities that already has authority over the regulated entity.

The way to organize enforcement may depend on the choice of the regulated entity:

- Upstream approaches; many of the actors in upstream approaches are already part of the current ETS system and hence it is rather straightforward to made enforcement of these regulated entities be part of the responsibilities of the emission authority currently authorizing the ETS participants. With respect to the import and export of fuels (or raw materials) these authorities could cooperate with custom offices, which currently already monitor the import and export of these goods.

- Tax warehouse keeper; there are two logical options to organize enforcement at the level of tax warehouse keepers. As shown in Annex E tax warehouses in EU Member States are currently often monitored by tax and/or custom authorities; these authorities are therefore appropriate organisations to be responsible for the enforcement responsibilities with respect to the inclusion of transport in EU ETS. Another option would be to appoint the authority that monitor and enforce the reporting requirements with respect to the FQD (which is also often organised at the level of tax warehouse keepers) as the responsible agent to enforce the requirements with respect to the inclusion of transport in EU ETS. The latter authority may be the same one as the authority currently monitoring and enforcing the EU ETS (as is the case for the Netherlands). Cooperation between the tax authority and the emission authority could be useful.
- Fuel supplier; enlarging the responsibilities of the emission authorities currently enforcing the EU ETS in order to cover also fuel suppliers seems the most appropriate option to organize enforcement in case these entities are appointed as regulated entities. Since many of these entities are known by the tax authorities through the excise duty system, close cooperation of the emissions authority with the tax authorities will be useful.
- Vehicle owners; because of the large number of entities the creation of a dedicated emission authority for these entities should be considered. Depending on the actual design of a possible downstream scheme cooperation with other national or local authorities that hold relevant information for enforcement purposes could be sought, like for example the authority registering all (new) vehicles in a Member State.
  The institutional set-up will possible be different for each Member State, depending on the available sources of information that could be used.

Annex D Evaluation of design parameters built environment

D.1 Introduction

In this annex we assess the following design parameters for the inclusion of the built environment in ETS: regulated entity (Section C.2), allowance allocation method (Section C.3), MRV (Section C.4), geographical scope (Section D.5) and enforcement (Section C.5). For the assessment of these parameters, the same criteria (or a subset of them) as for the evaluation of the inclusion variants are used (see Section 1.4 for an overview of the criteria).

The results of the analyses presented in this Annex are used to choose and define the inclusion variants for the built environment as presented in Chapter 2. Furthermore, some of these results are used for the evaluation of the inclusion variants for transport, as carried out in Chapter 4.

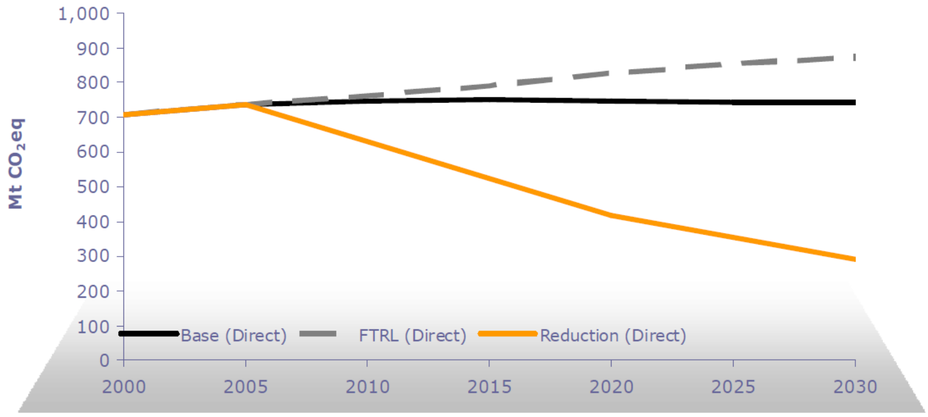
D.2 Reduction potential in the built environment

A study by Ecofys (2009)[70] identified an abatement potential for *direct emissions* in the built environment of 61% in 2030, compared to Frozen Reference Technology scenario, and a ~53% against the PRIMES baseline scenario (Figure 13). Total identified absolute potential against a frozen efficiency baseline in 2020 for the residential sector was ~300 Mton and ~100 Mton for the non-residential sector.
Table 47 provides an overview on the relative contribution of different measures in total identified emission reduction potential in 2020. It must be noted that this study did not look into the potential for behavioural changes and fuel switching from coal/oil to natural gas and biogas.
A study by CE Delft (2012) [71]focuses specifically on reduction potential for behavioural change in housing and the non residential sector. Measures include lowering room temperature, optimising use of thermostats and optimised use of ventilation. The report shows that the overall reduction potential (against a Primes baseline) for all measures sums up to 98 Mt in 2020 (2°C reduction; 75 Mt for a 1°C reduction). For 2050 this amount is slightly lower due to a more efficient building stock. Nevertheless the value is still 78 Mt for the 2°C and 62 Mt for the 1°C scenario

[70] Ecofys (2009) Sectoral Emission Reduction Potentials and Economic Costs for Climate Change (SERPEC-CC). Residential buildings and service sector. Ecofys, October 2009.

[71] CE Delft (2012), Behavioural Climate Change Mitigation Options, Domain Report Housing. CE Delft, January 2012.

Figure 13 **Direct CO_2 emission for the built environment sector in the EU 27 (residential and non-residential), showing the Frozen Technology Reference development (FTRL), the PRIMES baseline and the abatement potential**



Source: Ecofys, 2009.

Table 47 **Relative share of different types of measures in total identified emission reduction potential for the residential and non-residential sector.**

Measures	% of total potential in 2020
Residential	
Wall insulation	23%
Roof insulation	16%
Ground insulation	13%
Glazing	10%
Improved regulation & heat distribution	7%
High efficiency condensing boilers	6%
Heat pumps	6%
Biomass boilers	6%
Other	13%
Non-residential sector	
Glazing	20%
High efficiency condensing boilers	15%
Roof insulation	14%
Wall insulation	13%
Ground insulation	10%
Heat pumps	9%
Biomass boilers	9%
Others	10%

Source: Ecofys, 2009.

A study by Fraunhofer (Fraunhofer et al, 2009)[72] identified a technical savings potential in 2030 for the *residential sector* of 45% against an autonomous baseline scenario (i.e. that already included some savings). It must be noted that this study looked into final energy use including electricity as well as fossil fuels and assessed most of the measure listed in Table 47 with exception of the behavioural measures. This study identified a 52% savings potential against an autonomous baseline scenario for the *non-residential sector*, and

72 Eichhammer, W., T. Fleiter, B. Schlomann, S. Faberi, M. Fioretto, N. Piccioni, S. Lechtenböhmer, A. Schüring, G. Resch (2009): Study on the Energy Savings Potentials in EU Member States, Candidate Countries and EEA Countries.

found a potential in the residential sector which is ~2.5 times the potential in the non-residential sector.

BPIE analysed the potential for CO_2 reduction by renovating the European building stock (BPIE, 2011)[73]. In a ‘Deep renovation’ scenario they identified a CO_2 savings potential between 16-35% in 2020 and 71-90% in 2050. against a baseline scenario assuming continuation of current renovation rates. It must be noted that this includes savings on direct as well as indirect CO_2 emissions.

The Ecofys (2009) study showed that the reduction potential for direct emission in the built environment in 2020 is about 10% of total identified potential in 2020 and 2030 (see Table 48). In the study by Fraunhofer (2009) the reduction potential for the household sector (indirect and direct emissions) included about 30% of total identified energy savings potential in 2020. However it must be noted that this study only looked energy savings potential and not into GHG emissions and can therefore not be compared with the Ecofys study.

Table 48 Sector overview of baseline development and emissions levels and reduction potentials for 2020 and 2030

		2005	2020		2030	
Sector	Level	Baseline	Baseline[1]	Reduced	Baseline	Reduced
Built environment	Total	1,436	1,760	1,168	1,830	1,024
	- of which direct	738	748	416	743	290
Transport (road, rail)	Total	920	1,015	863	1,028	810
	- of which direct[2]	887	976	805	986	695
Transport (passenger aviation)[3]	Total	147	218	224	255	269
Industry and refineries[4]	Total	1,551	1,831	1,253	1,912	1,276
	- of which direct	907	975	596	981	571
Agriculture	Total	501	487	326	487	328
Waste (landfilling)	Total	132	84	69	61	27
Fluorinated greenhouse gases	Total	72	78	53	78	55
Fugitive emissions (energy sector)	Total	106	78	61	68	35
Energy sector - power supply	Total	1,375	1,483	1,041	1,463	537
Total[5]		4,982	5,321	3,779	5,395	3,025

D.3 Regulated entity

In this section we analyse the design option ‘regulated entity’ for the built environment. First, we define the various types of regulated entities that could be applied for transport. Next, these options are assessed based on environmental, economic, technical feasibility and legislative criteria.

D.3.1 Options for regulated entities

One of the main design parameters for an emissions trading system is the regulated entity, the entity that has the obligation to hand over emission allowances to cover the CO_2 emitted by the built environment. There are several groups of entities in the different value chains that deliver fuels to the built environment that in principle could be designated as regulated entity. The different types of fuels used in the built environment have different value chains. Especially the supply chain for natural gas differs from the other fuels (coal, heating oil, LPG) because it is distributed from producer to end-user by

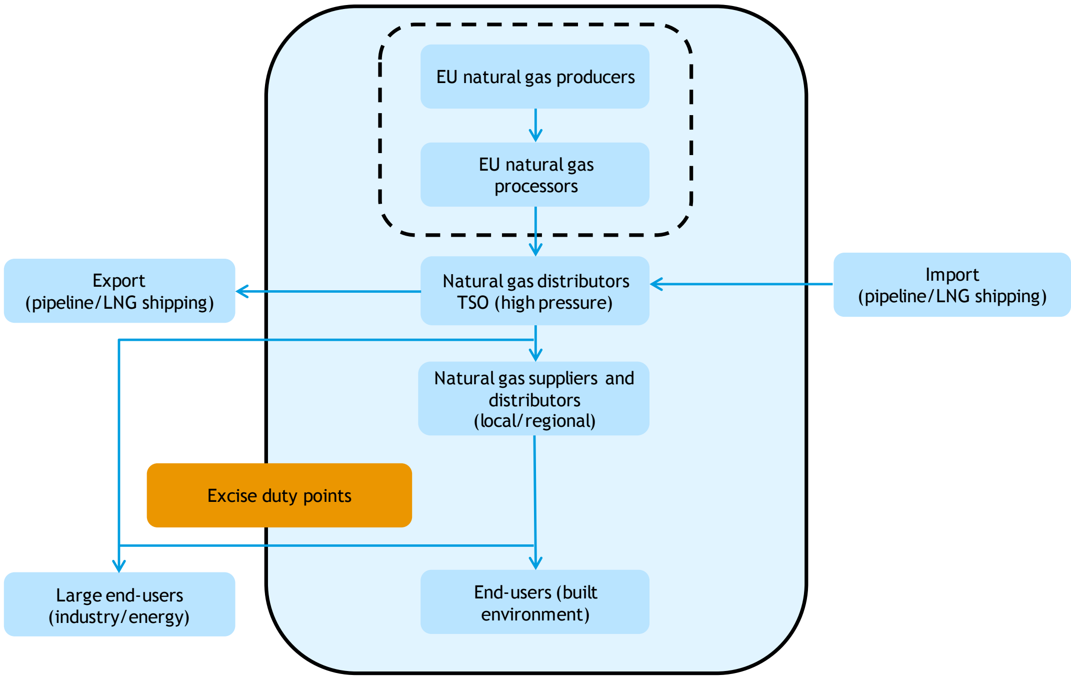
[73] BPIE (2011) Europe’s buildings under the microscope A country-by-country review of the energy performance of buildings. Buildings Performance Institute Europe (BPIE).

pipelines. Because it is distributed by pipelines, the distribution to the end-user is carried out by organisations with a regional monopoly, which is strictly regulated by national and European regulations.

In this paragraph the tax warehouse keepers are addressed a separate possible regulated entity. All coal, mineral oil and natural gas delivered in the EU fall under the Energy Taxation Directive (ETD). These fuels are eligible for excise duty and therefore have to pass an excise duty collection point. For oil products, to control import and export of these goods the tax warehouse system has been implemented. Goods can be moved between these tax warehouses without paying excise duty. All movements between warehouses have to be registered in the EMCS (Excise Movement and Control System). For products that leave the warehouse and enter the market, excise duty has to be paid. A such, the tax warehouse keeper is a central point available in all Member States where robust data on supply of oil products by source is available covering all sectors of the EU economy. Therefore, it is considered in this study as one of the possible regulated entities.

Options for regulated entities for natural gas

Figure 14 Supply chain for natural gas



- *Producers, processors, and importers of natural gas*; all organisations that produce, process and/or mix natural gas within EU or import natural gas from outside the EU are considered as regulated entities, i.e. all entities that feed into the European transmission network. Note that production, processing and mixing are often combined, making it difficult to separate these processes as two separate entities.
- *Transporters of natural gas;* in each EU country transmission system operators (TSO) have been appointed that carry out gas transport over the high-pressure gas network. The TSOs keep an administration of all (trans-)national transport, including import and export for each country.

In the supply chains of heating oil, coal and LPG there are no equivalent entities, comparable to the TSO. The choice of the TSO as regulated entity would lead to a differentiated approach for the different fuels used in the built environment.

- *Natural gas suppliers and distributors*; supply and regional/local distribution companies that sell and distribute natural gas to end-users (last step before the end-user). In some countries, natural gas suppliers and distributors are separate legal entities (e.g. in the Netherlands) whereas in other countries these functions are carried out within one company. This means that, for the entity at this level, the choice will have to be made whether the regulated entity is the supplier (who sells natural gas to the end-user) or the distributor (who maintains the natural gas networks and who is responsible for the physical delivery).
- *End-users;* owners or tenants of residential and non-residential buildings.

For natural gas the function of tax warehouse keeper does not exist. Natural gas falls under the excise duty for energy products but many countries have exempted natural gas from excise duty.

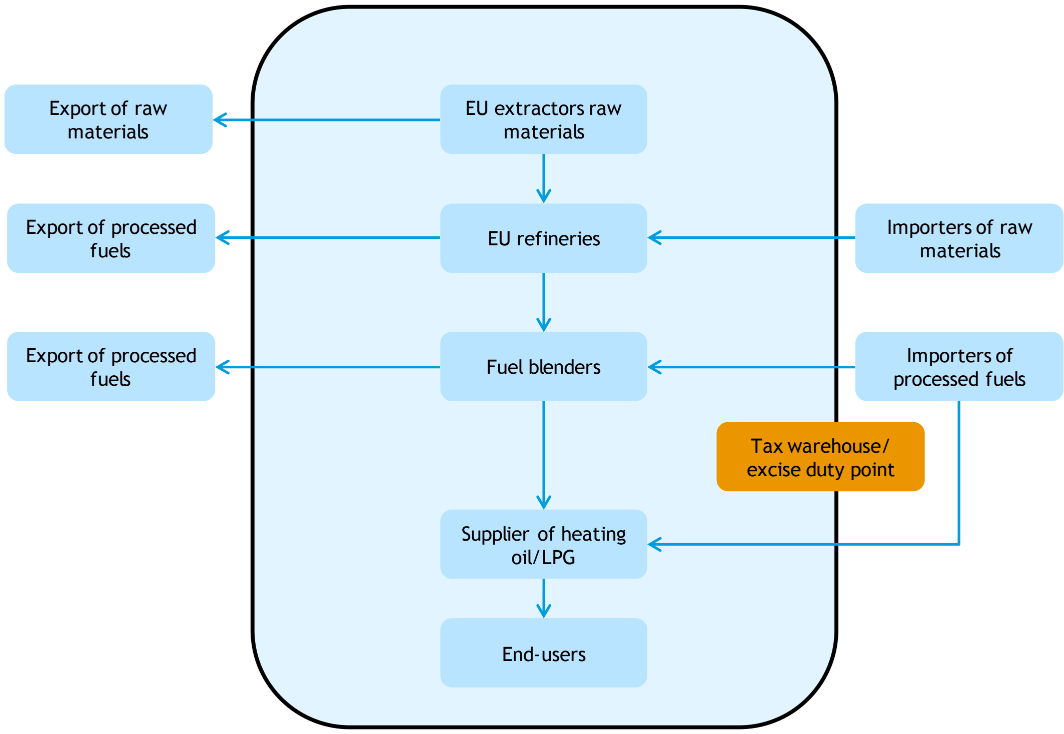
Regulated entities for heating oil, LPG and coal

The supply chains for oil products is very similar to the supply chain for transport fuels.
For coal, a difference is that refineries play no role in the supply chain. Coal with different qualities can be mixed to get a consistent quality.
Another difference is that for coal the function of tax warehouse keeper does not exist. Coal falls under the excise duty for energy products but many countries have exempted coal from excise duty.
The main difference for heating oil, LPG and coal, compared to transport fuels is the distribution to the end-user, which does not take place through filling stations, but through delivery by trucks from stock holders and (for LPG) through sale of smaller gas cylinders (through filling stations or home delivery). The end-users are both residential and non-residential buildings (owner or tenant).
To summarize, for coal, heating oil and LPG the following entities are considered as options for regulated entities:

- *Producers, refineries, processors, and importers of fuels;* all organisations that extract, process, refine and/or mix coal within Europe or import coal from outside the EU, including major stock holders and tax warehouses.
- *Final fuel suppliers*: trading companies that sell directly to end-users among others in the built environment.
- *tax warehouse keeper (oil products only)*[74]; the owner of an authorised place where oil products are charged with excise duty. These tax warehouses are administrative institutions and the function is assigned one of the entities in the supply chain.
- *End-users;* owners or tenants of residential and non-residential buildings.

74 Different colour in the figure, because the excised duty point is a function, not an physical entity.

Figure 15 Supply chain for heating oil and LPG



Overview of possible regulated entities

The following type of entities are used to discuss the criteria related to the choice of the regulated entity.

Table 49 Overview of possible regulated entities in the built environment, per type of fuel

Regulated entity option	Description	Natural gas	Heating oil, LPG,	Coal
Producers/importers (incl. processing)	The point of origination: either production in EU or import into EU	- EU production - LNG shipping terminals - LNG pipelines into EU	- Import of heating oil/LPG to EU - Heating oil/LPG refined in EU from crude extracted in EU - Heating oil/LPG refined in EU from crude imported into EU - Fuel blenders - Stock holders	- Import into EU - Production in EU - Stock holders
Transmission System Operators (TSO)	Highest level of distribution after origination	- Bulk pipeline transport of natural gas	n.a.	n.a.
Suppliers and distributors of coal, natural gas, heating oil	Lowest level of distribution: supply to end-users	- Natural gas regional suppliers/ distributors to end-users through local grid	- Distributors to end-users, typically by truck	- Distributors to end-users, typically by truck

Regulated entity option	Description	Natural gas	Heating oil, LPG,	Coal
Tax warehouse keeper	Point in supply chain when excise duty becomes chargeable when product is released for the market	n.a.	Typically the entity that holds fuels in stock before distribution to the end-user	n.a.
End-users (owner or tenant)	- Residential: home owners and tenants - Non-residential: building owners and tenants			

Conclusion
The supply chain and the type of entities involved for natural gas differ from the other fuels (coal, heating oil, LPG). Because natural gas is transported by pipeline from the producer to the end-user, with regional monopolies for transport, energy regulators keep a close eye on this market. The TSO, is an entity that does not exist for other fuels, has physical control over all natural gas that passes in and out of a country and on to large end-users and all distributors in a country. Also the excise duty point differs from the other fuel types.

For coal and natural gas the function of tax warehouse keeper does not exist. Both type of products falls under the excise duty for energy products but many countries have exempted coal and/or natural gas from excise duty, making it difficult to use the excise duty system for a harmonised expansion of ETS in the built environment.

For coal products the markets are less regulated. Trade of raw, intermediate en final products take place between producers, and blenders which will complicate monitoring and determining clear system boundaries (in case of an upstream system). Also distribution to the end-user takes place in a less transparent way (compared to natural gas).

For oil products the same type of trade of crude oil, intermediate en final products takes place between producers, refineries and blenders. Through the tax warehouse system a clear point can be identified when a products enters the market for final consumption.

D.3.2 Number and size of entities
The groups of possible entities, as described above differ strongly in the number and size of entities that would need to be regulated across Europe. This influences the impacts of certain design choices, e.g. in terms of the complexity of the system, the administration costs on the side of the government and the cost-efficiency related to MRV and market participation on the side of the candidate ETS participants.

Table 50 Number and size of entities

Regulated entity	Range (estimate)	Number of entities	Source
Producers/importers (incl. processing)	500-1,000	– About 310 producers of crude oil and natural gas – 22 LNG import terminals + 7 under construction, inter-EU pipelines unknown – Number of importers of coal, crude oil, heating oil is unknown	Eurostat (2013) GIE (2003)
Transmission System Operators	~62		Energy markets in the European Union 2011
Suppliers and distributors of coal, natural gas, heating oil	Coal: 4,000 - 8,000 Gas: 1,000- 1,500 Heating oil/ LPG: 10,000 - 20,000	- Coal: exact numbers unknown, own estimate based on the extrapolation of the Dutch and Czech Republic situation - Gas: exact numbers unknown, extrapolation of 7 Member StatesHeating oil/ LPG: EU ~10.000 based on 10 MS	Coal: info from national excise duty contact s Eurofuel (2013) Gas: : Energy markets in the European Union 2011
Suppliers and distributors of coal, natural gas, heating oil	Coal: 1,500-3,000 Gas: 1,000-1,500 Heating oil/LPG: 10,000–20,000	– Coal: exact numbers unknown, own estimate based on the extrapolation of the Dutch situation as minimum number – Gas: exact numbers unknown, extrapolation of 7 Member StatesHeating oil/LPG: EU ~10,000 based on 10 MS	Eurofuel (2013)
Tax warehouse keepers (oil products)	Maximum number of entities comparable to the oil suppliers: 5,000–10,000	– Exact numbers unknown	
End-users (owner or tenant)	200-300 million, of which 10-15 million non-residential entities	– 213,572,400 households in 2012 (EU-27+HR) – 13,642,569 office buildings (2011)	Eurostat (2013) JRC (2011)

Conclusion

In general, there are fewer entities covered if an upstream system is implemented, moreover many of these entities will already have experience with emission trading. The suppliers or excise duty points as regulated entities would add a number of entities that is in the same order of magnitude as the entities covered in the current ETS. Most of these entities will be new to emissions trading. The end-user as regulated entity will add millions of entities to the ETS. This could be reduced by a factor 10 if residential entities would be excluded.

D.3.3 Assessment of environmental impact

Incentive to reduce emissions
In Section 4.2.3 a number of different types of emission reduction measures was identified.
Regulated entities differ in opportunities they have to take reduction measures themselves In other words: including different regulated entities into the EU ETS may incentivise different measures impacting emissions in the built environment. Of course, in addition to measures the regulated entities can implement themselves, the costs associated with their action/inaction can also incentivise additional emission measures further downstream. The latter, however, will only differ significantly between different entities where the mitigation cost differ strongly between entities, or the allocation approach results in significantly different stringency in allocation between entities.

Upstream
As a direct measure, some of upstream entities can reduce emissions in the built environment by increasing the share of biofuels/biogas supplied to the end-user. This would provide these regulated entities with a cost advantage because they do not need to hand in allowances for biofuels[75].
Another direct measure that emission trading could incentivise is a switch from coal to gas. The system could provide an incentive to fuel suppliers as regulated entity to become involved in helping end-users to switch from coal to natural gas.
As an indirect measure the regulated entities will most likely pass on the costs of allowances by increasing the price of their product or service. This will result in a price signal that will be passed on to end-users in the build environment.

Tax warehouse keeper (oil products)
For the tax warehouse keeper as regulated entity for oil products, setting a carbon price will result in a price signal that will be passed on to end-users to reduce direct CO_2 emissions. The tax warehouse keeper will possibly be part of one of the upstream entities, which have the above described direct reduction incentives.

Downstream approach – Owner or tenant
Making the owner or tenant the regulated entity will pass on a price signal to implement emission reduction measures as the introduction of the ETS will increase his energy costs in case he/she does not implement measures.
This price incentive is similar to the price signal if the regulated entity lays more upstream, but (in principle) the end-user is in the best position to judge which measures are cost effective in his specific situation. Of course, many small end-users, will not have the know-how or ability to make this judgement.

The ETS could be set up in such a way that energy service organisations play an intermediate role, representing groups of end-users for allocation, monitoring and compliance, and assisting groups of end-users in taking emission reduction measures which are(partially) financed through the value of the (avoided) emissions.

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75 Depending on boundary setting and monitoring rules the upstream entities in the gas supply chain could also get an incentive to reduce emissions due to distribution losses in the gas transport and distribution system. However, this does not affect the direct emissions in the built environment.

It can be assumed that the price incentive will be more effective in owner/user situations than in an owner/tenant situation, because if the owner and user of a building are the same entity, investments in emission reductions can directly result in a reduced energy bill.
In case buildings are rented the regulated entity could either be the owner or the tenant. The owner has different reduction options, compared to the tenant. The owner can take measures to improve the building shell (isolation, glazing) and invest in more efficient energy conversion installations or installations that use low carbon or no carbon fuels. The tenant can take behaviour measures. Normally the tenant is the one that pays the energy bill. Appointing the owner as the regulated entity, also in a rent situation, will give the owner a financial incentive to improve the energy performance of the building, even if he does not have to pay the energy bill. However, in owner/tenant situations, this could complicate monitoring (as discussed under monitoring accuracy).

Conclusion
The price signal is the main incentive for end-users to take emission reduction measures. This price signal can be introduced by all the possible regulated entities, but will be felt most directly if the end-user is the regulated entity. The price signal is less effective in owner/tenant situations. The system can provide upstream regulated entities an incentive to increase the share of biofuels/biogas supplied to the end-users in the built environment.
Fuel suppliers as regulated entity can get an incentive through the system to assist end-users to switch from coal to other fuels.

Effect on longer term (clean technology) innovation
Assessing the criterion requires not only knowledge of the regulated entity and the incentives it has to take reduction measures but also of the allocation methodology, how the cap is set and for what period of time cap and regulations are known. Therefore it is not possible to assess this criterion based on the regulated entity alone.

Awareness raising

Upstream
The upstream entities (producer/importer, TSO) have little possibilities to create awareness for emission reductions in the built environment, because they are not in direct contact with the end-users.

Suppliers of coal, natural gas, heating oil and LPG
Because the energy suppliers are in direct contact with their end-users, they have more possibilities to create awareness, compared to the further upstream entities. Appointing suppliers as regulated entity could be an incentive to become more active in their communication and services to create awareness for CO_2 emission reductions with their customers. In some white certificate systems in different countries (France, Italy, Denmark) natural gas suppliers have taken this role[76].
Some awareness can be created through explicitly adding carbon costs to the bills that end-users will receive.

[76] See for instance: Energy saving obligations and tradable white certificates, JRC, 2009.

Tax warehouse keeper (oil products)
As the Tax warehouse keeper is an administrative function, it is unlikely that it will take an active role in awareness raising. In most cases the excise duty will be part of one of the upstream entities which have the above described possibilities for awareness raising.

Downstream approach – Owner or tenant
Appointing end-users as regulated entity is the most direct way to increase attention for the implementation of CO_2 emission reduction measures with the end-user. The price incentive will be similar to the price signal if the regulated entity lays more upstream but it can be assumed that the effect of awareness raising that comes with being a regulated entity will be bigger. The price effect is more explicit and the regulated entity will be 'confronted with his emission 'behaviour, at least once a year to carry out his monitoring, reporting and surrendering obligations.
The effect on awareness will be bigger if the owner is also the user of a building, because the owner/user can take (or plan for) direct action.

Conclusion
Awareness will be highest if the end-user is the regulated entity. Also the fuel suppliers can take an active role to create awareness at their end-users. Appointing entities further upstream will have a very limited effect on awareness raising.

Risk of carbon leakage

Leakage to outside EU
The ETS Directive gives a definition for carbon leakage related to loss of competitiveness. Because of the nature of the built environment, there is no risk for end-users in the sector for loss of competitiveness.

Leakage to sectors/entities or fuels not covered by the EU ETS
Depending on the details related to system boundaries, minimum thresholds and monitoring, leakage could occur.
For example:
– Introduction of a minimum threshold for the fuel suppliers (in terms of the amount of fuel supplied to the built environment) could lead to growth of smaller fuel suppliers that stay below the threshold.
– Larger installations producing heat for district heating systems will fall under the current ETS, smaller installations are not covered under the current ETS. Specific boundary and monitoring rules will be required to identify heat used in the built environment that is not covered under the current ETS.
– So far, we have excluded peat from this analysis, as it is used very locally. If not covered, use of peat could increase in order to evade the system. The same is valid for any other non commercial fuels or any waste products which could be sold as fuel.

D.3.4 Assessment of enforcement and technical feasibility

Definition of boundaries
In this sector we look at two types of boundary issues :
– the possibility to distinguish between fuels supplied to the built environment and other sectors;
– the possibility to distinguish between residential and non-residential use.

Split between built environment and other sectors
In general, **upstream regulated entities** (producers, importers and TSO) have no direct knowledge by which end-users their fuels are used. Only in case of some large industrial customers there is a direct relationship. This means that at this level it is currently difficult to make a clear distinction between fuels that will results in emissions in the built environment and fuels that will result in emissions elsewhere. In case an upstream system would be implemented the share of fuels related to emissions in the built environment needs to be monitored further downstream. This could be addressed through requiring the customers of the upstream entities to monitor the fuels downstream and report back the volume that is passed on to end-users in the built environment. For coal, heating oil and LPG, intermediate trade between entities and import and export further downstream will complicate such monitoring. Examples exist to solve this type of difficulties (for example the use of renewable energy certificates). For natural gas intermediate trade is not an issue because the natural gas can be traced through the distribution network.

Appointing producers/processors/imports or the TSOs as the regulated entities introduces an important difficulty to clearly distinguish between fuels that will be used in the built environment and fuels that will be used in other sectors (transport, agriculture and industry not covered by the current EU ETS). Monitoring of fuel stream further downstream could solve this but will certainly make implementation of the system more difficult

Energy suppliers as regulated entity deliver directly to the end-user.
They can clearly separate supply to end-users in the built environment from supply to other end-users. Overlap can exist with emissions covered under the current ETS, such as emissions from, some hospitals, for which boundary rules will have to be established.

A specific boundary issue at the level of the fuel supplier as regulated entity is district heating.
According to the current ETS regulation, larger installations where heat is generated will fall under the current ETS, but smaller installations will not be covered under the current ETS. Suppliers that supply heat from smaller installations should be covered as regulated entity otherwise leakage could occur.
Another option (not in line with the current ETS) could be to decide that all district heating in principle will fall under the built environment. The heat distributors should then be considered as regulated entity. Specific boundary rules would be required in case of cogeneration.

In case of a **downstream system** (owner or tenant) a clear distinction between use in the built environment and other sectors is possible. Boundary rules will have to be established for emissions already covered under the current ETS, such as emissions from some hospitals. Some end-users will also be supplied with heat from cogeneration or district heating. Heat from larger installations will already be covered under the current ETS, but heat supplied from smaller installations will need to be covered by the system.
Specific boundary rules would be required in case of cogeneration.

When the t**ax warehouse keeper (oil products)** is the regulated entity, it can make use of the tariff differentiation that exists under the Energy Taxation Directive. The ETD sets minimum tariffs for fuels and differentiates between use for 'heating' and use as 'propellant'. This differentiation could be used to differentiate between fuel use in the built environment and use in other

sectors.
However, implementation of the excise duty differs per Member State. Not all countries make the same tariff differentiation and some countries use the same tariffs for different fuel usage, without making any administrative differentiation.

Split between residential and non-residential use

Upstream regulated entity:
The same issues are valid to distinguish between fuels supplied to the built environment and other sectors.

At the level of **the energy suppliers** as regulated entity it is in general possible to distinguish between residential and non-residential use.

- Coal, heating oil and LPG are supplied through private deliveries. The administration of these suppliers should in principle be able to distinguish between residential and non-residential use. However, this distinction is in most cases currently not required and will take some effort to implement.
- Natural gas is supplied through regional and local distribution companies. The administration of these companies will in most cases also be able to distinguish between residential and non-residential use. However, there are situations where this may be more difficult, such as mixed use situations (offices and apartments in one building). The same issues apply for district heating, if not covered under the current ETS.

Tax warehouse keeper (oil products)

As discussed earlier, the ETD sets minimum tariffs for energy used in the built environment and it allows for differentiation between business and non-business use. This differentiation could be used to distinguish between fuel use for residential and non-residential purposes.
However, as noted earlier, implementation of the excise duty differs per member state. Not all countries make the same tariff differentiation.
The tax warehouse keeper will require additional monitoring information from downstream fuel suppliers to be able to identify fuels intended for business use in the built environment or administrative requirement for the tax warehouses should be adapted to include such differentiation.

In a **downstream system**, the actual emitter is appointed as the regulated entity. In the case of the built environment this can either be the owner or the tenant of a building. In general it is possible to distinguish between residential and non-residential use, but in specific situations it can be difficult to make this distinction (mixed use buildings).

Conclusion

Boundaries can be defined most clearly in a system where the end-user is the regulated entity. Also for the fuel supplier as regulated entity it is possible to draw clear system boundaries. A special boundary issue for both type of systems are the emissions from district heating, which are currently mostly covered under the current ETS apart from emissions from smaller installations.
Appointing producers/processors/imports or the TSOs as the regulated entities introduces an important difficulty to clearly distinguish between sectors or subsectors.by monitoring further downstream this could be resolved, but this will make the system more complex.
The tax warehouse keeper (oil products)can make use of the differentiation in energy taxation tariffs to define system boundaries, but the differentiation that is actually used will not be the same in each country, making a uniform approach difficult at this moment.

Monitoring accuracy

Possibility of accurately monitoring CO_2 emissions at the entity level
Producer/importer of natural gas, coal, heating oil and LPG
All entities will have an administration of quantities and qualities of outgoing fuels. Many entities, such as large producers and refineries are already covered under the current ETS and the current MRV for ETS could be used to monitor fuel streams, with the same kind of accuracy. Activity data to determine whether the fuels will be used in the built environment, will probably have to come from other entities further downstream. The accuracy of these activity data will mostly determine the possible accuracy of the monitoring at of the producer/importer.
Importers (into the EU, but also from Member State to Member state) will have to monitor the fuel which they import. It will be important to be able to verify whether the importer reports the correct activity data For control of movement of goods that fall under an excise duty an European computer system has been developed, EMCS (Excise Movement and Control System), through which movements of excise goods, for which no excise duties have yet been paid, can be followed on real-time basis. This system could in principle be used as source of monitoring information by the reporting entity or by verifiers, in order to check whether importers have included all their imported fuels in their monitoring.

TSO
The TSO keeps an administration of incoming and outgoing gas volumes and calorific value for each trading entity that is regarded as accurate. TSO's publish a daily average for the calorific value that is transported. As with the producers, the accuracy of the activity data used to determine which share of the fuels is used in the built environment will mostly determine the possible accuracy of the monitoring at of the producer/importer.

Suppliers of coal, natural gas, heating oil and LPG
The fuel suppliers keep an administration of sales volumes per end-user.
Fuel quality and calorific values of natural gas, LPG and heating oil used in the built environment will be known, making accurate monitoring for ETS purposes possible (as is already currently done by existing ETS participants).
The activity data and quality data (emission factor, calorific value, ash content) required for monitoring could be based on the administration of these entities, by using information on sales data, actual delivery data or on the excise duty paid.

Tax warehouse keeper (oil products)
The tax warehouse keeper keeps an administration for taxation purposes of all fuels entering the market for final consumption. This should make an accurate monitoring for ETS purposes possible.
Because of the value of these excise duties and the fiscal requirements this administration will be subject to financial assurance and other checks required by the tax authorities.

Downstream approach – Owner or tenant
The monitoring approach for downstream entities would be to monitor the direct emissions with the end-user. Accurate monitoring could be based on the billing information (activity data) that each entity receives from its energy supplier. Standard emission factors could be used. Because of the large number of individual entities, monitoring could be simplified by collecting the required information from the fuel suppliers or through the excise duty

collection point. N.B. This might lead to privacy issues (see legislative efficiency).

Another approach could be to estimate energy use and CO_2 emissions for individual buildings, based on a calculation method (for instance based on square meters, number of users/occupants, energy label[77], type of building, region, country, weather data). The annual monitoring could then be reduced to reporting major changes to these parameters (for instance change in energy label and/or number of users/occupants).This type of monitoring will be less accurate for the individual entities.
Monitoring could be complicated in an owner/tenant situation, in case the owner is the regulated entity and the tenant is the entity that holds a contract with the fuel supplier (which is normally the situation). This could be solved by appointing the tenant as regulated entity is such situations, or by introducing an joint responsibility for monitoring (which is the case in the ETS introduced in Tokyo).

Conclusion
The administrations of both the tax warehouse keeper (oil products)and of the fuel suppliers make an accurate monitoring possible. Also at the end-user level accurate monitoring is possible.
For the producers/importers the accuracy of the activity data is uncertain because this data will probably depend on other entities further downstream.

Sensitivity for fraud

Fraud related to monitoring
The sensitivity for fraud of including the built environment in ETS strongly depends on the monitoring and reporting system to be implemented. In case a complete and reliable monitoring and enforcement system is implemented, the risks on fraud could be minimalized (Flachsland et al., 2011; Raux, 2010).
Potential sources for fraud are:
- Import of fuels could provide possibilities for fraud, for instance if not all importers are known to the emissions authority. Use of the European Excise Movement and Control System (ECSM), as implemented for oil products, for enforcement purposes can probably prevent this type of fraud.
- For downstream entities, two different monitoring approaches have been described (see monitoring accuracy).
  - For monitoring based on billing information the sensitivity for fraud depends on the way the monitoring and reporting is organized and whether automated checks are possible. It starts with the assumption that the billing information is correct. That is not always the case. End-users can be creative in bypassing metering devices and especially in case of delivery by truck (coal, heating oil, LPG) it is possible that not all delivered fuel is administrated.
    If entities have to report their own monitoring data, sensitivity for fraud is very big. Because of the large number of entities, likelihood

77 The Energy Performance of Buildings Directive introduces an obligatory energy performance certificate (energy label) for buildings throughout Europe, which classifies the energy performance of a buildings in to several categories. The label includes 'standardised' data on energy use per square meter and CO_2 emission per square meter, which gives an indication of the energy use of a building as it is designed. Actual energy consumption data for individual buildings can differ considerably. More on the energy label under the design parameter MRV - legislative efficiency.

that fraud can be discovered and followed up for each individual case is small.
- For monitoring based on estimates: If the estimate can be based on information from other registers (municipal registration, energy label database, land registry, etc.) sensitivity for fraud will depend on these registers. For determining such an estimate, the energy label could become an important factor. The certification system through which the energy labels are issued could be sensitive to fraud. Again, due to the large number of entities, the likelihood that fraud can be discovered and followed up for each individual case is small.

Fraud related to evasion of the system

The difficulties to distinguish fuels that will be used in the built environment and fuels that are supplied to other sectors at upstream entities may provide possibilities to fraud. This would be the case if fuels that were indicated to be used for by other sectors and hence for which no allowances are submitted are used in the built environment. For example, if a coal suppliers that usually supplies industrial customers resells coal to suppliers or end-users in the built environment. This possibility for fraud could be overcome if fuel use is monitored further down the supply chain too.

Fraud related to the share of biofuels

Monitoring of the type and share of biofuels (biogas) in fuels in the built environment at the lower levels of the fuel supply chain may provide opportunities to fraud; e.g. fuel suppliers may argue that their fuels contain more biofuels (biogas) than they actually do to decrease the number of allowances they have to submit. The Renewable Energy Directive contains requirements to develop verification systems that enable verification of the sustainability criteria set under the RED and requires economic operators to trace biomass content through the use of mass balances. These requirements should assist in preventing this type of fraud.

D.3.5 Feasibility of allocation

The feasibility of allocation depends to a large extend on the combination of regulated entity and allocation method. These combinations are discussed under the chapter allocation methodology.
Some aspects of allocation, related to the regulated entity only, are summarised here.

Producer/importer of natural gas, coal, heating oil and LPG

As discussed under ‘definition of boundaries’, the difficulty to clearly separate fuels that will be used in the built environment or in other sectors, also affects the allocation feasibility. To determine the share of emissions that is used in the built environment it is necessary to gather information from entities further down the supply chain on fuel volumes sold to in the built environment. For auctioning, participants in the auctioning will be responsible to do their own market intelligence). For grandfathering and benchmarking this will be much more complicated as the Competent Authority will require detailed information for each individual regulated entity.

End-users (owner/tenant)

The feasibility of allocation to the end-users as regulated entity depends on the details of the allocation rules and the way the allocation process can be organised for such a large group of entities (estimate: 200-300 million for the whole sector, 10-15 million if residential energy use would be excluded).
It will be required to develop a largely automated process to collect and

process information required for the allocation and to carry out the actual allocation or auctioning.
The number of actors in the process could be reduced if intermediate organisations can represent groups of end-users. This could be for instance municipalities, energy suppliers or energy service companies.

Alternative: allocation downstream of the regulated entity

In the previous parts it is assumed that the regulated entity (entity with a reporting obligation, that surrenders allowances) is also the entity that receives free allocation (if any). This is the approach currently used in EU ETS. For electricity supply to the built environment under the Californian ETS, the producers are the regulated entity, but free allocation is disbursed to the suppliers of the end-users. Free allocation to the suppliers is based on a calculation which includes CO_2 emissions per kWh and market share of each supplier. This approach could be considered in Europe as well, and is especially useful if the market is dominated by local distribution monopolies, as is often the case for natural gas. If auctioning is used as the only allocation method, this alternative approach does not apply because no allowances are allocated. Allocating to a non-regulated entity causes the following effects for benchmarking or grandfathering:

- One of the main reasons to implement such a system, would be to place the windfall profits at the fuel supplier. In California ETS combines allocation to energy suppliers, which operate in a regulated, regional monopoly, with ‘earmarking’ the earnings from the sale of allowances. The energy suppliers are supposed to take efforts to reduce the impact of price effects due to the carbon price on the end-user. At the same time, this approach takes away the possibility for the producer/importer to make any windfall profits.
- Having fewer, larger regulated entities that are more equipped to handle the required administration and trading on the market is an advantage, both for technical feasibility and transaction costs, and it is also easier to calculate the allocation a bit further downstream, at the supplier level. Allocating to a non-regulated entity combines both benefits.
- Changing to an ETS system that allocates allowances to a non-regulated entity implies a large legislative change.

D.3.6 Assessment of economic impacts

Impact on competitiveness

The impact on competitiveness is, for the built environment, not a very relevant criterion. If we look at either the producers/importers, TSO’s or fuel suppliers as regulated entities, the products that are put on the market by the different entity levels are covered through the system and no impact on competitiveness is expected, other than the (intended) effect that fuels with a higher CO_2 content per kJ will have a disadvantage in the market.

For end-users, a very high carbon price could theoretically influence a location choice, moving outside of the EU or moving to locations within the EU with more efficient buildings, use of fuel types with less carbon content or just a nicer climate. However, such a location choice will only marginally be influenced by a carbon price.

Transaction costs
In general, the total transaction costs for downstream regulated entities in the built environment (building owners and/or tenants) will be much higher than for upstream approaches because of the large number of small emitters at this level. For transport, this statement is confirmed by many other studies (e.g. CE Delft, 2006; Inregia AB, 2006; ITS Leeds, 2007; Öko-institut, 2002; PWC, 2002). Less studies exist for the built environment, but the same result can be expected.

Producer-importer
Additional to the general remark above, transaction costs will be lower if emissions or fuels are currently already reported and verified. For many of the producers, which are already covered under the current ETS, the additional costs of monitoring fuels and participating in trade will be marginal. However, this is not valid for most importers and for smaller producers. Organising monitoring further down the supply chain to determine the share of fuels supplied to the built environment could increase transaction costs for the producer/importers considerably.

Due to the relative limited number of actors the costs for the government of expanding the system will probably be lower, compared to a downstream system. At the level of raw material extractors/importers the large number of small biomass producers may increase transaction costs (both for participants and governments). Exempting small (biomass) producers through the use of a threshold may be an option to prevent high transaction costs at this level, although this decreases the emission coverage of the scheme.

TSO
For natural gas, use of the TSO's as regulated entity would probably lead to the lowest transaction costs and costs to the government because only few (app. 50 entities are involved), each covering a large share of the natural gas market.

Suppliers of coal, natural gas, heating oil and LPG
Involving the natural gas suppliers as regulated entity will result in relatively low transaction costs as this is a very regulated market with relatively large suppliers.
Transaction costs in case suppliers of coal, heating oil and LPG are the regulated entities, will be higher. These markets are less organised, involving many smaller players, with no experience in the current ETS.
*Tax warehouse keeper (oil products)*Transaction costs (both for participants and governments) will probably be relatively low for the tax warehouse keepers since at this level already monitoring and regulation mechanisms are available (Grayling et al., 2006).

Downstream entities, owner or tenant
As mentioned before, the large number of small emitters at a downstream approach may result in high transaction costs. Transaction costs for the entities involved could be reduced if allocation, monitoring and compliance could be automated, for instance by making use of the billing information provided by the energy suppliers or by developing an automated system that provides an estimate energy use for each building that can be used for allocation, monitoring and compliance. However costs (and risks) associated to the development of such automated systems can be very high.

Another option to reduce the trade part of the transaction costs of downstream regulated entities would be to establish trustees, which surrender and trade allowances on behalf of the individual building owners.

At a downstream level the transaction costs could be a reason to consider to exempt all residential end-users from the system. This would reduce the number of entities involved by a factor 10 and the emissions covered in the built environment by two third.

Impact on market concentration

The current EU ETS covers about 45% of the EU's GHG emissions, which is ca. 2,000 Mt (European Commission, 2013). By including the built environment in the EU ETS the coverage of the scheme would increase by 751 Mt (see Section 3.2.13), which is ca. 38%. The actors on the built environment market therefore potentially have a big impact on the market for allowances.

The market power of actors from the built environment sector will be largest in case an upstream approach is applied. Over 55% of the emissions in the sector are related to natural gas, therefore the largest market power for emission trading will probably be concentrated in the largest gas producers and in the TSO's. Because the natural gas market is predominantly organised along national companies, there is not one organisation that dominated the European gas market Although there are companies with a significant market share, no risk on market concentration is expected.

In case the fuel suppliers or tax warehouse keeper (oil products)are considered as regulated entity, the number of actors supplying fuels to the built environment increase and hence the market power of single actors reduces. However, it should be noticed that also at the midstream level there are still some large oil and natural gas suppliers with a significant market share.

Finally, in case the end-users are appointed as regulated entities only small actors are introduced to the market for CO_2 allowances and hence there won't be any risk for market concentration.

D.3.7 Assessment of legislative efficiency

The assessment for legislative efficiency has been included in the main report (see Chapter 4).

D.3.8 Conclusions per regulated entity

Producer/importers

The difficulty to clearly distinguish what part of the fuels produced/ imported by these entities is intended for use in the built environment, complicates monitoring, allocation and boundary setting in such a way that it is questionable whether a robust ETS can be developed. A solution could be found in monitoring the fuel streams further downstream by other entities, but this is complicated because of trade that takes place between entities at the same level in the supply chain. Also, the monitoring by the regulated entity would rely for a large part on activity data collected by other entities, which would make the quality of the monitoring uncertain.

This problem would disappear if the aim was not to cover one single sector, but to cover all fuels that are supplied to end-users, regardless of the sector in which they operate. Appointing the producer/importer as a regulated entity and covering all fuels that are either produced or imported by these entities, could provide an emission trading system that is comparable in complexity to

the current ETS. It would provide an reduction incentive to end-users based on a carbon price, in the built environment and in other sectors.
A system like this would also cover activities under the current ETS (except for installations with process emissions). It could be implemented parallel to the current ETS, but then special attention would be needed to prevent double counting of fuels used by installations that are already covered under the current ETS.

TSO
The same difficulty (to distinguish what part of the fuels will be used in the built environment) applies to the TSO as a regulated entity, but this could be easier to solve for natural gas alone.
Because natural gas is transported by pipe from producer to end-user, a not too complex monitoring system can be envisaged that enables monitoring of fuel use further downstream. If this difficulty can be solved, the TSO as regulated entity could provide for a system that covers natural gas only, with low transaction costs and few entities involved. For a complete system, covering all fuels used in the built environment, other type of regulated entities will have to be chosen to cover coal, heating oil and LPG.
Developing an ETS for natural gas only does not make sense, it would lead to large differences between countries and would make fuels with a higher carbon content (coal) more attractive.

Fuel suppliers
Appointing the fuels suppliers as regulated entities could provide the basis for a robust emission trading system that is no more complex than the current ETS and which would provide emission reduction incentives in different ways. Not only by passing on a carbon price to the end-users as is the case with further upstream options, but it would also give incentives to fuel suppliers to take measures themselves, by assisting end-users in taking emission reduction measures and by increasing the biomass content of fuels supplied to the end-users.
Tax warehouse keeper (oil products)The tax warehouse keeper as regulated entity for oil products can form the basis for a well administered trading system that is already checked by financial control systems, allowing for good quality data that can be used for allocation and monitoring.

It is not possible to use the tax warehouse system for other fuels used in the built environment (coal, natural gas) as it is not applicable to these fuels.

End-users
Apart from the very large number of entities that have to be dealt with, the end-user as regulated entity could provide the basis for a functional emission trading system. The very large number of entities is a very important bottleneck. Organising allocation, monitoring, compliance and enforcement for 200 to 300 million end-users across all Member States will be a very complex process with very high transaction costs. To reduce the number of entities covered it could be considered to exempt all residential end-users from the system. This would reduce the number of entities involved by a factor 10 and the emissions covered in the built environment by two third.

The main incentive for end-users to take emission reduction efforts would be the carbon price (similar to further upstream options), but because of his position as regulated entity, the end-user will be confronted more explicitly with the carbon price.

However, unlike the current ETS, where end-users are, in principle, in the best position to judge what reduction measures can be taken in their processes, most end-users in the built environment will have insufficient knowledge to make this judgement and face several barriers that are not easily removed by the price signal alone.
Some barriers could be reduced by introducing energy service organisations (fuel suppliers, ESCO's) that could play an intermediate role in allocation, monitoring and compliance, representing groups of end-users. These energy service organisations could also assist end-users in providing knowledge and developing emission reduction measures which are(partially) financed through the value of the (avoided) emissions.

D.3.9 Summary assessment regulated entity

Scores: - - = Prohibitively difficult, bad - = Difficult/negative/bad, 0 = Neutral, + = Easy/positive/ good, + + = Very positive, very good

Criterion	Sub-criterion	Comments	Producer/importer	TSO	Fuel supplier	Tax warehouse keeper (oil products)	End-user
Special remarks				Natural gas only, other fuels would require a differentiated approach			
General	**Number and size of entities**		**500-1,000**	**62**	**Coal: 4,000 - 8,000, oil products 10,000 - 20,000** **Natural gas: 1,000 - 2,000**	**Maximum: 5,000 - 10,000**	**200-300 million**
Environmental impact	Incentive to reduce emissions with built environment	E.g. technical efficiency measures only, including fuel switch, behavioural change	**0/+**	**0/+**	**+**	**0**	**++**
			Incentive to increase biomass share	Incentive to increase biomass share	Incentive to improve end-user energy efficiency, increase biomass share	Depends on relation of tax warehouse keeper with other entities	Direct prise incentive
	Effect on awareness raising with built environment	Degree to which option leads to increased awareness regarding the importance of emission reductions, potentially leading to an indirect effect on emissions	**0**	**0**	**+**	**0**	**++**
					Incentive to create awareness at end-users		Direct impact due to price effect. Role of regulated entity underlines responsibility
	Risk of carbon leakage	Leakage to outside EU	**0**				
		Leakage to sectors/entities or fuels	**-**				
			Some leakage could occur, details related to for instance system boundaries, minimum thresholds and monitoring				
Enforcement & technical feasibility	Definition of boundaries	Is it feasible to delineate which emissions are included and which are not?	**- -**	**- -**	**++**	**+**	**++**
			Delineation will need to rely on monitoring further downstream	Delineation will need to rely on monitoring further downstream	Special attention required for district heating	Many differences in application of excise duty tariffs	Special attention required for district heating
		Possible to distinguish residential, non residential fuel use?	**- -**	**- -**	**++**	**+**	**++**
			Delineation will need to rely on monitoring further downstream	Delineation will need to rely on monitoring further downstream		Many differences in application of excise duty tariffs	
		Double-counting provisions	Depends on monitoring	Depends on monitoring	Yes, for entities in	Yes, for entities in	Yes, for entities in built

Criterion	Sub-criterion	Comments	Producer/importer	TSO	Fuel supplier	Tax warehouse keeper (oil products)	End-user
		needed?	provisions further downstream	provisions further downstream	built environment already covered under ETS	built environment already covered under ETS	environment already covered under ETS
	Monitoring accuracy	Availability and quality of data to monitor emission/fuels at the regulated entity	-	-	++	++	+
			Accuracy depends on accuracy of data from downstream entities	Accuracy depends on accuracy of data from downstream entities			Accurate monitoring is possible, but due to the large number of entities, less accurate monitoring methods might be preferred
	Sensitivity for fraud		**0**	++	**0**	++	-
			Fraud related to import, export and biofuels might be an issue	Strongly regulated entities, strong financial control	Especially for coal, heating oil, LPG	Strongly regulated entities, strong financial control	Due to the large number of entities, fraud will be difficult to discover and follow up
	Feasibility of allocation	Is allocation of auctioning possible, independent of method	--	--	+	+	_ _
			Depends on information availability further downstream	Depends on information availability further downstream			Complexity due to large number of entities
Economic impact	Impact on competitiveness	Does inclusion have an impact on competitiveness among entities covered or (sub)-sectors	0	0	0	0	0
	Transaction cost	Participants: MRV, trading. Total system costs for BE, compared to current ETS	0	+	0	0	- -
			Closely related to number of entities				
		Government: compliance, permitting. Total system costs for BE, compared to current ETS	0	+	0	0	_ _
			Closely related to number of entities				
	Market concentration	Can large entities influence carbon market	0	0	0	0	0
Legislative efficiency	Interaction with other legislative frameworks?	Covered by other legislative frameworks?	ETD (excise duty movements) RES (biomass tracing and monitoring)	ETD (excise duty movements) Energy regulations	EED (emission reduction obligation)	ETD (energy taxation)	EPBD (energy label)

D.4 Allowance allocation method

In this section we discuss the design option 'allowances allocation method' for the built environment. First we present the various options for the allocation of allowances to the built environment. Next, the allocation methods are assessed on the following criteria, which are relevant for the allocation options are analysed:
- feasibility of allocation;
- treatment of early action;
- potential for windfall profits;
- impact on public finance;
- impact on profits/income;
- impact on disposable income;
- transaction cost;
- clean technology and innovation;
- legislative efficiency;
- legislative changes;
- sensitivity for fraud.

D.4.1 Options for allowance allocation

The built environment is a sector for which the risk of carbon leakage due to international competition is minimal. The current ETS rules could be interpreted in this case to mean that auctioning should be used as the default allocation method. However, given the very different nature of the building sector (and the different types of potential economic impacts of certain allocation choices in the sector), benchmarking and grandfathering are also analyzed.

In the EU ETS, it is the regulated entity (i.e. the party with the surrender obligation) is the party that participates in auctioning, buys allowances on the market or receives allowances for free based on benchmarking. In the Californian ETS, allowances to cover for the emissions that take place in the built environment are not allocated to the regulated entity (in this case the producer), but allowances are handed out for free to other, downstream entities based on the market share of these entities (form of grandfathering). We will also consider this option.

For each criterion, the three different design options for allocation are analysed:
1. Auctioning: No allowances are allocated for free in this option; entities have to acquire all their allowances at auctions or on the market.
2. Grandfathering: Entities receive allowances through free allocation, based on direct emissions in the built environment for which this entity is held responsible, emitted during (a selection of) previous years.
3. Benchmarking: Entities receive allowances through free allocation, based on a performance measure.

Note that a combination of auctioning with partial free allocation grandfathering or benchmarking is also possible. In this chapter it is assumed that one design option is dominant.

An overview of the score of each combination of options is shown in Section 4.4.13.

D.4.2 Feasibility of allocation

Issues which are discussed here:

- Are reliable data for allocation (benchmarking, grandfathering) available?
- Can a reasonable performance measure be set for benchmarking?
- Is allocation practically feasible (for instance taking into account the number of entities)?

The feasibility of upstream entities to distinguish which part of the energy carrier they sell leads to direct GHG emissions in the built environment also affects the feasibility of allocation, this topic is discussed in section 'regulated entity - definition of boundaries'. The feasibility of an auctioning methodology is directly dependent on the choice of regulated entity; therefore all relevant options are discussed below.

Auctioning

This design option requires the regulated entity to acquire all allowances through auctions or on the market. Regulating this, ensuring thorough understanding by the entities and guaranteeing equal access becomes more challenging the more regulated entities there are. Smaller entities are more likely to experience difficulties or lack the capacity and expertise for acquiring and trading allowances. The data requirement for allocation is low to none.

- Producers/importers and TSO: No difficulties are expected for these entities with respect to participating in auctions. Entities are relatively few in number and typically large corporations. Such factors reduce the risk that the auctioning procedure is overly complicated or labour intensive for the entities.
- Suppliers of coal, natural gas, heating oil and LPG: No specific difficulties are expected, however the larger amount and smaller size of the entities could lead to the issues mentioned above.
- tax warehouse keeper (oil products): No difficulties are expected because the amount of entities involved is relatively low, and tax warehouse keepers are experienced in handling complex legal and administrative requirements.
- Downstream: Owner or tenant: a downstream approach will involve 200-300 millions of entities (households, offices) throughout Europe, making the practical implications of organizing auctions for all these entities very complicated. A possible route to simplify the auctioning could be to allow intermediate organisations (for instance banks, trading offices, energy suppliers energy service companies) to participate in the auctions.

Grandfathering

- Producers/importers and TSO: The primary bottleneck is that because the energy carrier may be traded several times before reaching the end-user, at this point in the beginning of the supply chain, the entity has no direct insight in what share of the energy carrier it sells to its direct clients is eventually used in the built environment or in other sectors. For grandfathering, this data is essential for calculating how much free allowances should be allocated. Possible solutions could be developed to collect this information, by requesting information from downstream energy suppliers. Information flow along the supply chain is common practice for other supply chains, such as food and biofuels.
- Suppliers of coal, natural gas, heating oil and LPG: The energy suppliers are in direct contact with end-users, and the data required for grandfathering could possibly derived from sales data. It would have to be verified that this data is readily available in a comparable format throughout the EU (even in remote areas), that there are no legal or privacy issues and that verifiable, historical data is available. Extra rules

will need to be developed to deal with trade between end-users and handle cases where a natural gas connection or fuel end-user covers both built environment and non-built environment uses, e.g. a farm with housing and agricultural function combined. It should be noted that district heating installations not already included in ETS will also require extra rules, because they supply heat to the end-user instead of fuel.
- Tax warehouse keeper (oil products): Tariff differentiation between fuels used for heating and fuels used as propellant could make it possible to distinguish between fuels used in the built environment and other fuels. Based on this information it is possible to set up a grandfathering system.
- Downstream; Owner or tenant: Data on energy use, thus indirectly on CO_2 emitted, is in principle available for each downstream entity through the invoices of the energy suppliers. Collecting this data could provide more difficult in an owner tenant situation if the owner is the regulated entity and the tenant has the contract with the energy supplier. Data on energy use would have to be collected for each individual entity, or it must be made legally possible for their suppliers to share this information with the Competent authority directly. The extra rules mentioned under the previous bullet are needed here too.

Benchmarking

The benchmarking design option has the same data availability issues for the different regulated entity options regarding activity data as described for the grandfathering design option above.

In addition, a performance measure has to be developed that can be used as a benchmark. Typically, an ETS benchmark is expressed in allowances per unit of activity. The current ETS system prefers a product benchmark if possible, with a heat benchmark as the first fall-back option, and a fuel benchmark as a second fall-back option.

For the built environment sector, a product benchmark could give an indication of the efficiency of energy use at the end-user (e.g. allowances per heated square or cubic meter, energy use per number of people in a household). It would be necessary to take climate differences into account, given the large regional differences in Europe. Gathering the required data is prone to suffer great difficulties, e.g. effective floor space data for each building, and besides for space heating, the fuels may also be used for water heating or cooking. The benchmark value has to be only set once for the whole EU, but allocation must be calculated over the benchmark for each building and recalculated of there are significant changes to the building, therefore the unit over which is allocated (e.g. occupants, degree-days, square of cubic meters space) should be chosen wisely.

A possible heat benchmark could be allowances per TJ calorific value. This way free allowances would be received based on the amount of heat that is consumed by the end-user, which stimulates the switch to fuels with a lower emission intensity per TJ. In this case, the data requirement is restricted to type and amount of fuel consumed by the built environment end-user, and for upstream entities the share of their product used in the built environment.

Another possible way to develop a community-wide benchmark for the built environment is to use the European energy labelling system for buildings. Though the EPBD requirements all buildings in Europe will hold an energy efficiency certificate, which gives an indication of the energy performance of the building and includes 'standardised' data on energy use per square meter and CO_2 emission per square meter of a building, as it is designed[78].

The energy label, combined with information on floor space and the number of

[78] Actual energy consumption data could differ considerably.

users/occupants of a building could form the basis to set the benchmark value for the sector. However, the same difficulties apply to collect such data as discussed above. Calculation rules and label categories for the energy certification system are defined at national level, taking into account different climate conditions and building practises. Therefore the system could be used to develop national benchmarks.
The EPBD aims to develop a more harmonised approach, but this is proving to be very difficult. Again here for upstream entities it cannot be directly determined what the built environment emissions of the energy carrier they sell are.
Conclusion is that there are different options to develop a product benchmark, but there is not yet a well defined uniform Europe wide system on which such a benchmark could be based. The energy performance certificate system introduced by the EPBD could perhaps provide a basis for such a benchmark, but actual energy consumption could differ considerably from the indications based upon the energy label.

D.4.3 Treatment of early action

The equity criterion analyses the impact on entities that took early action (investment in emission reduction measures before inclusion into ETS).
Early action should not be penalized by a design option for allocation; instead ideally it should be rewarded. Secondly, past inaction should not be rewarded.

Entity-independent considerations

1. Auctioning: Any early action taken directly reduces the amount of allowances that needs to be bought (through auction or on the market). Hence early action therefore is rewarded under this design option for allocation, because it provides a competitive edge.
2. Grandfathering: Grandfathering is allocation based on emissions in the past. If early action was taken in the past, past emissions thus allocation may be lower, therefore early action can negatively impact the amount of allowances allocated.
3. Benchmarking: Also benchmarking is usually based on activity data from previous years. For the free allocation to industrial sectors in phase three, the 10% best performers in a sector are used as the benchmark. Therefore early action of one entity can reduce the allocation to the whole sector. This is negative for the whole sector except the entity that took early action. This entity will get fewer free allowances due to its early action, but the reduction in free allowances is stronger for its competitors (but also for the other entities owned by the same owner).

Allocation design option independent considerations

- Producers/importers and TSO: The potential for early action is limited for the producers/importers and for the TSO's, thus no effect is expected here.
- Suppliers of coal, natural gas, heating oil and LPG: Suppliers are in direct contact with end-users and therefore have more potential to influence or assist end-users to reduce emissions. Therefore the potential for early action is larger, thus the effects of the different allocation options is stronger.
- Tax warehouse keeper (oil products): The potential for early action is limited, no effect is expected.
  Downstream: Owner or tenant: Auctioning rewards early action. Possible negative effects of early action are largest for the downstream entities under the grandfathering option. Allocation rules for grandfathering might give an incentive to end-users to postpone reduction measures. Individual

entities that took early action are too small to impact any sector-wide benchmark, so no effect can be attributed here.

D.4.4 Potential for windfall profits

Windfall profits can occur in situations where the regulated entity is able to pass on (a large part of) the carbon price down the supply chain as opportunity costs, while at the same time receiving free allowances. This situation occurs when entities on an open market can pass on the opportunity costs to their clients.

Auctioning
All entities (either upstream or downstream) have to buy their allowances either through auctioning or on the market, therefore there is no risk for windfall profits.

Grandfathering or benchmarking
Both free allocation based on grandfathering and benchmarking are susceptible to windfall profits.
- Producers/importers: Markets for coal, gas, heating oil and LPG are competitive; therefore it is likely that suppliers will try to the value of the allowances in the marginal costs as opportunity costs, creating windfall profits.
- TSOs have a regional or national monopoly that is strictly regulated. Monopolies typically already ask the optimal price in their market, paying for or receiving free allowances would not affect this. A regulator could take measures to prefund windfall profits.
- Suppliers of coal, natural gas, heating oil and LPG: Suppliers of natural gas have, in most countries; a regional monopoly, based on regulation, the same issues apply as described for TSOs. Markets for coal and heating oil are much more competitive, causing windfall profits as explained for producers/importers.
- Tax warehouse keeper (oil products): Markets for oil products are competitive; therefore it is likely that suppliers will try to the value of the allowances in the marginal costs as opportunity costs, creating windfall profits.
- Downstream; Owner or tenant: Windfall profits are not an issue at the level of the end-user.

D.4.5 Impact on public finance

The main factor impacting public finance is the revenue generated by the sale of allowances by governments (costs of carrying out the allocation are discussed in the section on transaction costs). This criterion is independent of the type of regulated entity.

Auctioning as an allocation method
All revenues from the auctioning go to the government; therefore the positive impact on public finance is at its maximum with this allocation method.

Grandfathering or benchmarking as an allocation method
No government revenues for the share of allocation that is handed out for free. Part of the allowances will still have to be bought on the market if emissions are higher than free allocation. As long as the total free allocation (+ carbon credits) is lower than the total emissions and lower than the cap, the government has to auction some allowances.

If there is under-allocation in the built environment sector, but over-supply of free allowances in another sector, this surplus can flow to the built environment, reducing the auctioning potential, unless this exchange of allowances between sectors is not permitted.

D.4.6 Economic impact: impact on profits/income

When an ETS system is introduced, the production cost (or product purchase cost) increases with the price of allowances that need to be bought.
The effect of this rise in production cost on an entities profits or income depend on its ability to pass on these extra allowance costs to its client, except for the end-user, who cannot pass on the extra cost.

If auctioning is chosen as the design option for allocation, the increase in production cost, and therefore the potential impact on profits or income is highest. Allocating free allowances trough grandfathering or benchmarking reduces the amount of allowances that need to be purchased. Compared to grandfathering, free allocation through benchmarking gives an advantage to entities that have a good emission efficiency, because they need to buy relatively fewer allowances on the market.

Entities on a competing market can typically pass on at least part of the allowance price to their customers, a generalized prediction on how much cannot be made. Entities in a natural monopoly such as regional natural gas supplies may not be able to pass on the extra costs of allowances, see Section 4.4.4. The effect of increased fuel cost on low income end-users is discussed in Section 4.4.7.

D.4.7 Impact on disposable income

Introducing an ETS system increases costs, thus can affect the disposable income starting at the regulated entity down to the end-user. This price signal is an intended effect of ETS, although it may have a disproportionally strong negative effect on low income households suffering from fuel poverty, see section on 'regulated entities – impact on disposable income'

D.4.8 Transaction costs

The set-up and operation of an ETS system involves various administrative costs. Some of these are independent of the design option for allocation; such as personnel costs at the competent authorities and at the regulated entities, costs for MRV and hiring third party verifiers, and in some member states there are one-off or annual registration fees or fees for requesting free allocation, while the government should provide sufficient guidance and training.
Even when auctioning is not the main method of allocation, some allowances will need to be auctioned, so an auctioning platform is need, and fees may be charged for participation in auctioning. In case the regulated entity is downstream, or a large group of small suppliers, they may need to get organised, acquire knowledge, or hire someone else to handle auctioning and trading. As grandfathering or benchmarking do not fully replace the need for some auctioning, these considerations also apply to systems with free allocations, albeit on a smaller scale. Any system with free allocation is likely to get involved in legal challenges of the allocated amount of free allowances, so legal fees will be incurred.

– For individual entities, if auctioning is used as the only allocation method, it is likely that many entities will want to directly participate in auctions, which may involve a fee.

If grandfathering is applied, entities will have to carry the cost of preparing a report on their emission data for the baseline period of each ETS phase, and having it independently verified.
In case of benchmarking, the same types of costs as for grandfathering apply, but instead of just emission data during the baseline period, activity data is needed. Secondly, the majority of the entities in a sector will have to supply activity and emission data needed to determine the benchmark value.

- For governments, if auctioning is used as the only allocation method, an auctioning platform that ensures equal access and is fraud resistant needs to be set up and operated. In ETS phase three, an EU wide auctioning platform has been set up (with UK, DE and PL having opted out in favour of a national platform), which would need to be expanded for the built environment sector.
  If grandfathering is applied, the government needs to set up a system for applying for free allocation, for checking the applications and for tracking changes to allocations during an ETS phase.
  On top of that, for benchmarking the government is responsible for organising a large data gathering exercise, and using that data to calculated adequate

D.4.9 Clean technology and innovation

Auctioning as the design option for allocation provides a simple and direct stimulus, which is at the core of the emission trading concept; each entity tries to find an optimum between investing in emission reduction or buying allowances on the market if that is cheaper. Grandfathering is based on the same principle but has the downside that emission reduction efforts made before or during the baseline period will penalize the entity by reducing the amount of free allocation that an installation will receive, see Section 4.4.3.

Benchmarking as a design option for allocation is commonly seen as a strong stimulus for innovation and switching to cleaner technology. On top of the financial stimulus described for auctioning, benchmarking requires mapping the performance of a peer group, which exposes the differences between competitors, and what level for improvement is practically possible.
A benchmark based target will stimulate laggards to remain closer to the set benchmark level. In addition, reduction of the benchmark over time ensures further development and implementation of cleaner technologies.

D.4.10 Legislative efficiency

Including the built environment into ETS will stimulate energy efficiency in the sector, which is also the target of the EPDB, however there are no large differences between the three allocation methods considered in this chapter.

There is an important aspect of the EPDB that could be of importance if benchmarking is chosen as the allocation method; the usage of energy labels in determining the benchmark value. See also the benchmarking section of Section 4.4.2.

D.4.11 Legislative changes

Any form of allocation upstream from the place of the direct emissions (the end-user) is not in line with the currently applicable ETS rules, and would mean amendment of the ETS directive.

The currently active phase three of EU ETS uses auctioning as the primary form of allocation, with benchmarking as the alternative option where it can't be avoided for economic reasons. In case it turns out that this approach is either not feasible or not desirable for the built environment, legislative changes to the ETS directive or CIMs[79] may be required to accommodate a different choice for prioritizing allocation methods.

Within the current benchmarking methodology, there is a defined preference for a product benchmark, if that is not feasible the first fall-back option is a heat benchmark, and in the last case a fuel benchmark. As in the built environment a fuel benchmark may be much easier to implement than the other options, legislative changes may be needed to accommodate this.

D.4.12 Sensitivity for fraud

If entities do not receive free allowances, such as when auctioning is used as the design option for allocation, there is no possibility to commit fraud with allocation specifically. For the allocation option of grandfathering, there is a requirement of data, to be supplied by the regulated entity. The amount and range of data that needs to be supplied is significantly larger under a benchmarking system. The data supplied by the entities has to be verified by an external auditor, but even so, it is possible for entities to submit inaccurate data. If not noticed in checks by the Competent Authority and the Commission, this may lead to more free allocation than actually entitled to. If in any of these checks inaccurate data is found, it is very hard to determine with certainty whether this was accidental or maliciously, thus with the objective to commit fraud.

D.4.13 Conclusions allowance allocation method

D.4.14 Summary of allocation option built environment

Table 51 provides an overview of the score of all analysed combinations of criterion with design option for allocation.

It can be concluded that when considering only the selection of allocation method, auctioning is more simple to implement, as it does not require a system to calculate (and update) the amount of free allowances per regulated entity. Downside is that the impact of auctioning is strongest felt in low income groups, which may not have the financial means to invest in emission reduction measures. In case the end-user is chosen as the regulated entity, auctioning is likely to have other important downsides, most prominently related to technical feasibility of including such a large group of end-users. As long as less than 100% of the cap is allocated for free, an auctioning system must be in operation, so the negative effects of auctioning count for all allocation methods.

79 Community-wide Implementing Measures (CIMs), Commission Decision of 27 April 2011 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council.

Allocating free allowances adds significant difficulties, independent of the method; for large entities, at the beginning of the supply chain it cannot be known which part of their energy product will eventually be consumed in the built environment, there is a large risk of wind-fall profits and more data is needed from the regulated entity to determine its allocation share, as compared to auctioning.

Grandfathering has the additional problem that end-users and their suppliers that take early action receive less free allocation thus have an undesirable disadvantage compared to their peers. As grandfathering is no longer used in EU ETS, it would also imply an important legislative change. Furthermore, it stimulates clean technology and innovation less than the other allocation methods.

For all allocation methods, the complexity of a system with the downstream owner or tenant is a concern. Benchmarking is administratively and technically the most complex alternative, but alleviates the specific issues related to grandfathering in the previous paragraph. Furthermore, benchmarking is able to stimulate clean technologies and innovation much stronger than the other allocation methods.

D.4.15 Summary of allocation option built environmnent

Table 51 Score of each combination of criterion, allocation method and regulated entity

Scores: - - = Prohibitively difficult, - = Difficult/negative, 0 = Neutral, + = Easy/positive, + + = Very positive

Criterion		Sub-criterion	Comments	Auctioning	Grandfathering	Benchmarking
Enforcement & technical feasibility	4.4.2	Feasibility of allocation	To upstream entities (producer, importer, TSO, supplier, excise duty point)	+	-	-
				No major issues, lower amount of participants	Problematic to separate built environment from other sectors	Problematic to separate built environment from other sectors
			To downstream entities (building owners and tenants)	-	- -	- -
				Number of participants is a concern	Data collection difficult, number of participants a concern	Data collection difficult, number of participants a concern
Economic impact	4.4.3	Treatment of early action	Effect on regulated entities that have taken early action	+	- -	**+ / 0**
				Early action rewarded	Early action penalized	Early action rewarded/no effect if downstream entity is regulated
	4.4.4	Potential for windfall profits	Is the participant able to pass on the price of allowances it got for free to its clients?	+ +	**- / 0**	
				Windfall profits fully prevented	Significant risk of windfall profits/no effect if downstream entity is regulated	
	4.4.5	Impact on public finance	Proceeds (auctioning, taxes)	+ +	**0**	
				Maximum government revenue	Low government revenue from auctions	
	4.4.6	Impact on profits/income		-	-	+
				Allocation method with highest cost	Limited cost, but equal treatment bad and good performers	Limited cost and advantageous for good performers
	4.4.7	Impact on disposable income	Impact of increased cost on low income households in older buildings	- -	-	
				Highest cost = highest impact	Cost lower than for auctioning	
	4.4.8	Transaction cost	If regulated entity is upstream	+	-	-

Criterion		Sub-criterion	Comments	Auctioning	Grandfathering	Benchmarking
			(scoring only cost dependant on allocation method)	Only auction registration fees may play a role	Some cost for verified emission data for allocation calculation	Some cost for verified emission and activity data, little higher than grandfathering
			If regulated entity is downstream (scoring only cost dependant on allocation method)	-	- -	- -
				Costs for organizing themselves or paying someone to handle auctioning	Cost for verified emission data high relative to allocation	Cost for verified emission and activity data high relative to allocation
			Government (scoring only cost dependant on allocation method)	+	-	-
				Auction platform needed, currently exits for current ETS and will still be needed if another allocation method is chosen	Elaborated system for allocating free allowances is needed	Elaborated system for allocating free allowances is needed, also a one-off effort to determine benchmark values
Environmental impact	4.4.9	Clean technology and innovation	(treatment of early action included above, not considered here)	+		+ +
				Cost of the allowances that need to be bought stimulates emission reduction, if cheaper		More direct link with technologies and reduction potential, greater awareness of potential measures

Criterion		Sub-criterion	Comments	Auctioning	Grandfathering	Benchmarking
Legislative impact	4.4.10	Legislative efficiency		**0**		**0 / +**
				No relevant synergies with other legislation		Small synergy with EPDB energy labels is an option
	4.4.11	Legislative changes	If regulated entity is upstream	- -		
				Large legal changes are needed if the regulated entity is not the entity with direct emissions		
			If regulated entity is downstream	+ +	- -	-
				Auctioning as primary allocation method is in line with current ETS	Grandfathering not an option under current ETS	ETS has target to be auctioning-only by 2027
	4.4.12	Sensitivity for fraud		+	-	
				No possibility for fraud with allocation	Fraud through supplying incorrect data for the allocation calculation could be found through checks by verifier, CA or Commission, but is not impossible	

D.5 MRV

Most relevant aspects of monitoring are directly related to the choice of the regulated entity and have been discussed in that chapter under 'monitoring accuracy. The institutional setting is discussed under enforcement.

Legislative efficiency

– Renewable Energy Directive[80] (RED)

An important assumption for monitoring under the current ETS system is that the CO_2 emission factor of biomass and other biofuels is set at zero if they comply with the sustainability criteria, otherwise they are regarded as fossil fuels.

The Renewable Energy Directive contains requirements to develop verification systems that enable verification of sustainability criteria set under the RED and requires economic operators to trace biomass content through the use of mass balances. In that was the biomass content of mixtures and blends of biofuels and fossil fuels can be traced.

The RES directive currently contains sustainability criteria for bio liquids that are used in heating or cooling, and a system to trace these sustainable fuels throughout their supply chain. Also for biogas these sustainability criteria exist, but only when consumed in its compressed form. These fossil fuel alternatives, when used under ETS, can be regarded as having zero emissions. Currently such an EU-level sustainability system is not yet available for solid biomass (and biogas used directly, without grid injection or other long range transport).

Any changes or tightening of the sustainability criteria under the RED, can also affect the biomass sources used in the built environment and the emission factor of these sources used for monitoring under ETS.

– Draft General data protection Regulation[81]

In case the end-user is the regulated entity, each end-user should in principle report its own energy use. Monitoring could be simplified if it was possible to use data directly from fuel suppliers or from the excise duty collection point However, due to privacy reasons, energy suppliers at the moment are in general not allowed to provide information to third parties on energy use of individual end-users.

There is a draft EU data protection regulation under discussion, which is also applicable to the use of energy data. The draft is based on the principle of 'explicit informed consent' meaning that in most cases consumers will explicitly have to agree to the use of personal (energy) data for other purposes. It is likely that an exemption to this principle is required to make it possible to use data on individual end-users for monitoring purposes.

80 Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

81 COM 2012/0011.

D.6 Geographical scope

Because of the nature of the built environment, the geographical scope of the system can be defined relatively easy. The focus of the system will be on direct emissions in the built environment, in all Member States of the European Union. These emissions are covered if either the direct emissions of all end-users are covered or if all fuels supplied to the built environment are covered. Any fuels imported to the European Union for use in the built environment will also have to be covered by the system.

There are limited possibilities for fraud or leakage due to the geographical scope. In some regions bordering non EU countries, private import of coal could occur to evade the system. Private import of other fuels will be more difficult (heating oil, LPG) because it would involve trans-border transport by tank trucks. Private import of natural gas is virtually impossible.

D.7 Enforcement

The enforcement cycle consists of permitting, annual monitoring and reporting and surrendering of emission allowances. For the current ETS each country has appointed an emissions authority that approves the monitoring plan of an entity through an emissions permit and checks whether the entity is in compliance with reporting obligations and surrendering of allowances.
For the built environment, either the existing emissions authority could be expanded to cover entities in the built environment as well, a new emissions authority for the built environment could be created, or cooperation could be sought with an existing authority that already has authority over the regulated entities. The way enforcement can be organised is strongly dependent on choice of the regulated entity.

– Producers/importers as regulated entity

Because of the type of activity, many producers will already be covered under the existing ETS and therefore known by the existing emission authorities. Not currently covered are the importers of fuels into the European Union. In principle these importers should be registered in the European EMCS (Excise Movement and Control System) through which movements of excise goods, for which no excise duties have yet been paid, is followed.
The producers that have to be covered will be known by the tax authorities through the excise duty system. Close cooperation of the emissions authority with the tax authorities will be useful. For enforcement of the importers involved, cooperation with the customs office and access to the EMCS will be useful.

– TSO as regulated entity

These entities are already strongly regulated through the national energy regulators. Enforcement of the ETS for these entities could be made part of the responsibility of the energy regulators. If organised otherwise, close cooperation with the energy regulators for enforcement will be useful.

– Suppliers of coal, natural gas, heating oil and LPG as regulated entity

Supply of natural gas is a regulated market were national regulators have oversight and companies need permits for the supply of natural gas to end-users. Permitting and enforcement could be made part of the responsibility of the energy regulators.
Markets for coal, heating oil and LPG are much less regulated and oversight will have to be established. The entities for oil products that have to be

covered will be known by the tax authorities through the excise duty system. The same applies for coal suppliers in countries were coal is not exempted from excise duty. Close cooperation of the emissions authority with the tax authorities will be useful.

– Tax warehouse keepers (oil products) as regulated entities

Existing tax authorities could play an active role in the compliance cycle.

– End-users as regulated entities.

Because of the large group of entities involved, it should be considered to create a dedicated emissions authority for these entities. Depending on the type of monitoring system (either through billing information or through calculated estimates) cooperation needs to be established with the national energy regulators (overseeing fuel suppliers) or with local and national authorities that hold relevant information for enforcement purposes, such as municipalities (addresses), the land register (type of building, square meters), and the energy label databank. The institutional setting will be different for each Member State, depending on the sources of information that can be used.

Legislative efficiency - Energy Taxation Directive.

Through the excise duty system, information is available on fuels streams that are being used in the built environment. This information could be used for enforcement purposes: to check whether all entities are covered and to cross check monitoring data. For regulated entities it might be possible to use data reported to the excise duty point or to the European EMCS (Excise Movement and Control System) as basis for ETS monitoring. Because of the differences in the national implementation of the excise duty system, the suitability of the excise duty system for this purpose will have to be looked at on a country-by-country basis.

Annex E Tax warehouses

E.1 Introduction

In this annex we discuss the (legislative) concept of tax warehouses and their potential role as regulated entity in case transport and/or built environment is included in the EU ETS. First, we define tax warehouses and discuss some of their characteristics in the various EU Member States (Section E.2). In Section E.3 the current role of tax warehouses in levying excise duties on energy products is discussed. The monitoring of movements of energy products between tax warehouses (and between EU Member States) is discussed in Section E.4. Finally, the potential role for tax warehouses as regulated entity in case transport and/or built environment is included in EU ETS is discussed in Section E.5.

The analysis in this appendix is based on the relevant regulations on the one hand, and on the results of a questionnaire amongst Member States on the other. In total, seven questionnaires have been filled out by relevant authorities in Austria, The Netherlands, France, Germany, Denmark, Poland, Sweden and Ireland.

E.2 Tax warehouses

Tax warehouses are places where excise goods are produced, processed, held, received or dispatched under duty suspensions arrangements (i.e. arrangements that suspend excise duty) by an authorised warehouse keeper (EC, 2008). The establishment and operation of tax warehouses is subject to the authorisation of the Member States. They should, however, respect the guidelines laid down in the Commission Recommendations 2000/789/EC. The national requirements to establish a tax warehouse differ widely, but are in general quite easy to meet; they include administrative (e.g. owning a VAT number), administrative (e.g. having the opportunity to keep records of the stocks of fuels), financial (e.g. providing of adequate financial security via bonds or guarantees) and/or physical (owning authorised storage room) requirements.

Tax warehouses are often owned by other entities in the fuel supply chain. The results of the questionnaire set out in some Member States show that refineries, fuel suppliers, fuel traders and fuel stock holders often act as tax warehouse keepers. Also independent tax warehouse keepers were reported. The total number of energy products related tax warehouses in the EU is unknown, but the estimate of 5,000 to 10,000 provided in Section C.2.1 seems reasonable[82]. In general it is argued that the number of tax warehouses is rather stable over time.

In general, tax warehouse keepers register the stock of excise goods at their warehouse. The results of the questionnaire show that in all countries the quantity of fuels is registered in tax warehouses, while in many of the Member States (6 out of 8 surveyed countries) also the biofuel content of the fuels is

[82] For the following countries the number of tax warehouses for energy products is known: Austria (79), Denmark (10), Germany (500-1000), Ireland* (192), The Netherlands (105), Poland* (436), Sweden* (265); * *tax warehouses for natural gas and coal excluded.*

registered. Fuel quality, on the other hand, is not registered in tax warehouses in any of the surveyed countries. The period during which tax warehouse keepers should keep this record varies between Member States but is in the range of 4 to 7 years. The registrations should be reported to tax authorities and/or custom agencies. In general, no standardised verification of the reported data by a third party is in place, although regular (and irregular) checks are used to monitor the reporting requirements of the tax warehouses.

Not all energy goods necessarily pass a tax warehouse. For natural gas and coal this is not obligatory and as a result, these energy goods do not pass tax warehouses in many Member States. However, all other energy goods do, in general, pass tax warehouses, even if they are exempted from excise duties by a Member State. Fuels used as raw material (e.g. in the chemical industry) on the other hand, do not pass tax warehouses (or at least are not reported by tax warehouses) in all surveyed EU Member States.

E.3 The role of tax warehouses in levying excise duty

The Energy Taxation Directive (ETD) sets minimum taxation rates for energy products and electricity in transport and the built environment. However, the ETD itself does not specify the responsibilities of different parties with respect to levying the excise duties on these goods. These responsibilities are laid down in other EU regulation, such as Directive 2008/118/EC on the general arrangements for excise duty.

According to Directive 2008/118/EC, excise duty shall become chargeable at the time (and in the Member State) of release of the (energy) good for consumption. Most often this is the case at the moment of the departure of the good from a duty suspension arrangement[83] or the import of the good into the EU in case the good is not placed under a duty suspension arrangement[84]. In general the person liable to pay the excise duty that has become chargeable shall be the authorised warehouse keeper, the registered consignee ('a natural or legal person authorised by the Member State of destination to receive excise goods moving under a duty suspension arrangement from another Member State') or any other person releasing the excise goods or on whose behalf the excise goods are released from the duty suspension arrangement.

Not for all energy goods the excise duty becomes chargeable at the time of releasing the good for consumption. The ETD states two exceptions:
- electricity and natural gas become chargeable at the time of supply by the distributor or redistributor;
- coal, coke and lignite shall become chargeable at the time of delivery by companies, which have to be registered for that purpose by the relevant authorities.

From the regulations described above it becomes clear that tax warehouse keepers are not the only persons liable for levying excise duties on energy products. In other words, the excise duty points for liquid fuels are often, but not always located in tax warehouses. However, it should be noted that many of the liquid fuels released for consumption by a registered consignee or

83 A tax arrangement applied to the production, processing, holding or movement of excise duty goods suspending the payment of excise duty.

84 Other situations that could be considered as releasing the good for consumption is when the good is produced or hold outside a duty suspension arrangement.

another authorised person are received by these persons from a tax warehouse. For natural gas and coal, tax warehouses are never appointed as the excise duty points.

Although the ETD sets minimum rates for different types of energy products and electricity, Member States do not necessarily have to apply these rates. They can apply for reduced rates or completely exempt a wide variety of products[85], such as:

- electricity from renewable sources;
- energy products and electricity used by rail, metro, tram and trolley bus;
- fuels used for navigation on inland waterways (excl. private pleasure craft);
- natural gas (if share of natural gas in Member State in final energy consumption was less than 15% in 2000;
- electricity, natural gas, coal and solid fuels used by households and/or by charity organisations;
- natural gas/LPG used as propellants.

Due to the exemption of excise duties, these energy products do not necessarily pass the excise duty point. However, they most often do pass the tax warehouse (with the exception of electricity, natural gas and coals).

E.4 Excise movement and control system (ECMS)

Excise goods may be moved under a duty suspension arrangement within the EU from a tax warehouse to another tax warehouse, a registered consignee or a place where the good leaves the EU. In addition, movement under duty suspension arrangement is also allowed from the place of importation of the good into the EU to the place where the good is released to consumers.

Excise duty goods moved under a duty suspension arrangement are subject to the Excise Movement and Control System (ECMS) and required electronic documents. The information that needs to be included in this document has been specified in Commission Regulation 684/2009 and includes, among other aspects:

- destination type code, journey time, transport arrangement, date and time, etc.;
- trader information, including trader consignor and trader place of dispatch, trader place of delivery and so on;
- the excise product code, CN code, quantity, gross/net weight.

This implies that for those products which are subject to the control and movement provisions, the country of origin, destination, CN codes (and hence fuel type) and quantities of imports and exports by different Member States are known. This also applies to excise goods that are imported into the EU, and ends when the excise duty goods are exported outside the EU.

Not all energy products covered by the ETD that are subject to excise duty payments are also subject to the EMCS, as is shown in Table 52. Natural gas, electricity, and coal are not covered by the EMCS system.

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[85] Member States differ in the (partial) exemptions they have determined (specified in Annex II of the ETD).

Table 52 Coverage of energy products by the ECMS

Energy products covered by the ETD	Subject to the control and movement provisions of Directive 92/12/EEC? (article 20 of the ETD)
Motor fuels	
Leaded petrol (2710 11 31, 2710 11 51, 2710 11 59)	Yes
Unleaded petrol (2710 11 31, 2710 11 41, 2710 11 45, 2710 11 49)	Yes
Gas oil (2710 19 41 to 2710 19 49)[a]	Yes
Kerosine (2710 19 21, 2710 19 25)[a]	Yes
LPG (2711 12 11 to 2711 19 00)[a]	Yes
Natural gas (2711 11 00, 2711 21 00)[a]	Currently not subject to control and monitoring provisions. Commission can decide upon monitoring and control provisions (article 20(2))
Heating fuels and electricity	
Gas oil (2710 19 41 to 2710 19 49)	Yes
Heavy fuel oil (2710 19 61 to 2710 19 69)	Yes
Kerosene (2710 19 21, 2710 19 25)	Yes
LPG (2711 12 11 to 2711 19 00)	Yes
Natural gas (2711 11 00, 2711 21 00)	Currently not subject to control and monitoring provisions. Commission can decide upon monitoring and control provisions (article 20(2))
Coal and coke (2701, 2702, 2704)	Currently not subject to control and monitoring provisions. Commission can decide upon monitoring and control provisions (article 20(2))
Electricity (2716)	Currently not subject to control and monitoring provisions. Commission can decide upon monitoring and control provisions (article 20(2))
Other[b]	
1507-1518 (if used as motor/heating fuel) Soya-bean oil and its fractions. Includes crude oils and other oils (e.g. olive oils, palm oils, Sunflower-seed)	Yes
2901 and 2902 Acyclic and cyclic hydrocarbons	Yes (2901 10, 2902 20, 2902 30, 2902 41 to 290244)
2905 11 00 (if used as motor/heating fuel) Methanol (methyl alcohol)	Yes
3403 Artificial waxes and prepared waxes of chemically modified lignite, poly(oxyethylene), and other waxes	Currently not subject to control and monitoring provisions. Commission can decide upon monitoring and control provisions (article 20(2))
3811 Anti-knock preparations, oxidation inhibitors, gum inhibitors, viscosity improvers, anti-corrosive preparations and other prepared additives, for mineral oils (including gasoline) or for other liquids used for the same purposes as mineral oils	Currently not subject to control and monitoring provisions. Commission can decide upon monitoring and control provisions (article 20(2))

Energy products covered by the ETD	Subject to the control and movement provisions of Directive 92/12/EEC? (article 20 of the ETD)
3817 Mixed alkylbenzenes and mixed alkylnaphthalenes, other than those of heading 2707 or 2902	Currently not subject to control and monitoring provisions. Commission can decide upon monitoring and control provisions (article 20(2))
3824 90 99 Prepared binders for foundry moulds or cores; chemical products and preparations of the chemical or allied industries (including those consisting of mixtures of natural products), not elsewhere specified or included	Yes, if used as heating or motor fuel
Other All other energy products that are intended to be used as motor fuel or for heating purposes (except peat).	Currently not subject to control and monitoring provisions. Commission can decide upon monitoring and control provisions (article 20(2))

[a] For these fuel types the ETD has set two different minimum energy taxation rates; one tax rate for regular purposes and one rate in case the fuel is used for agricultural, horticultural, piscicultural works and forestry, for stationary motors, for machinery used in construction, for civil engineering and public works, or for vehicles used off the public road.

[b] If used as motor fuel or for heating purposes, energy product has to be taxed at an equivalent rate as the comparable energy product for which a rate is specified.

Source: ETD and http://www.wcoomd.org.

E.5 Tax warehouse keeper as regualted entity in EU ETS

Three main conclusions can be drawn from the analyses presented in the previous sections:

- Tax warehouse keepers are not the only (legal) persons acting as excise duty points, also other persons may be authorised for this task. This is clearest for electricity, natural gas and coal, for which the ETD appoints other parties than the tax warehouse keepers in the fuel supply chain as excise duty point. As a consequence not all energy product necessarily pass a tax warehouse. However, from the survey applied in various EU Member States it became clear that at least all liquid energy products used in transport and the built environment do pass tax warehouses.
- The ETD provides Member States the possibility to exempt fuels from excise duties. Those fuels that have been exempted from excise duty in a particular Member State (e.g. coal, natural gas and electricity consumed by households, LPG/natural gas used as propellant, etc.) may not pass excise duty points. However, as discussed above all liquid fuels will pass tax warehouses.
- Not all fuels covered by the ETD are automatically monitored in the EMCS (i.e. natural gas, coal and electricity). Consequently, information on exports/imports and delivered quantities may not always be available for these fuels. For the fuels covered by the EMCS, all necessary data on exports/import is available.

Based on these general conclusions the following specific conclusions on the potential role of tax warehouse keepers as regulated entity in EU ETS can be drawn:

- For transport, almost all fuels are covered by the tax warehouses and the ECMS, and hence, tax warehouse keepers are a suitable option as regulated entity in case transport is included in EU ETS. A few notes should be made:
  - The only transport fuel currently not covered by tax warehouses and the EMCS is natural gas, but this is currently (and in the near future) only a niche fuel in the transport sector.
  - At the level of the tax warehouse keeper, it may currently not always be clear for which subsectors (road, rail, agricultural vehicles, etc.) the fuels will be used. However, since tax warehouse keepers are often assigned as excise duty point as well and since a differentiation between subsectors is often already made at this level in many EU Member States, it is clear that additional monitoring arrangements could be implemented (quite easily) to make this differentiation if necessary.
  - The biofuel content of fuels is not registered at the tax warehouse level in all Member States yet. However, as the majority of the Member States do register this data, the necessary arrangements should be easily transferable to those other Member States.
- For the built environment a large share of the fuels does not pass a tax warehouse and is not covered by the ECMS (i.e. natural gas and coals). Appointing tax warehouse keepers as the entity to be regulated would therefore not provide sufficient coverage for this sector. The coverage would be enlarged by regulating all authorised excise duty points. However, in the latter case, the coverage would still not be a hundred per cent, as most Member States have exempted some fuels in the built environment from excise duties. These exempted fuels may not pass such excise duty points. In these countries additional measures are required for exempted fuels in case tax warehouses (in combination with excise duty points) are appointed as regulated entity. Additional measures could be to widen the scope of the regulated entity and/or to adjust the EMCS regulations in order to also cover exempted fuels. These requirements will differ between Member States, as they will have granted different exemptions.

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Annex G List of emission trading schemes reviewed

G.1 Emission trading schemes

		System includes		
Country	Region/name	Built environment	Transport	System operational?
Australia		Yes	Yes	2012
Canada	Quebec	Yes	Yes	2012
Chile		Not clear yet	Not clear yet	Not clear yet
China	Beijing	Yes	No	Pilot
China	Chongqing	No	No	Pilot
China	Guangdong	Yes	Yes	Pilot
China	Hubei	No	No	Pilot
China	Shanghai	?	No	Pilot
China	Shenzhen	Yes?	No	Pilot
China	Tianjin	Yes?	No	Pilot
China	National	Not clear yet	Not clear yet	Planning: 2016
Japan	Tokyo	Yes	No	2010
Kazakstan		No	No	Pilot
New Zealand		No	Yes	2008
South Korea		No	No	2015
Switzerland		No	No	2007
Ukraine		No	No	2014?
USA	California	Yes	Yes	2013
USA	RGGI	No	No	2009
USA	Waxman-Markey	Yes	Yes	No

G.2 White certificate schemes

			System includes		
Country	Region/ name	Type of system	Built environment	Transport	System operational?
UK	CRC	EETS (Energy efficiency)	Yes	No	Yes, since 2008
UK	EEC/CERT/ ECO	EETS (Energy efficiency)	Yes	No	2002-2012
France	Certificats d'Économies d'Énergie (CEE)	White certificate	Yes	Yes, since 2011 (motor fuel use)	Yes, since July 2006
Italy	TEE	White certificate	Yes	Yes	Yes, since Jan 2005
Denmark	Energy saving agreement	EETS (Energy efficiency)	Yes	Yes, since 2013	Yes, since 2006
Belgium	Flanders	Energy efficiency obligation	Yes	No	Former system 2003-2011 closed; new system operational since 2012
Ireland	Energy Supplier Obligation and Energy Savings Credit System	White certificate	Yes	No	Yes, since 2011
Poland		White certificate	Yes	No	Planned to start 2013
India	PAT	White certificate	No	No	2011