CHAPTER

4

# EXTENDING THE EU ETS TO THE ROAD TRANSPORT SECTOR

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## KEY MESSAGES

- ***Extension of EU ETS scope is not mentioned in the proposal for the revision of the EU ETS Directive*** - The possibility of extending the EU ETS scope to include road transport was considered in the European Commission's Communication on "A policy framework for climate and energy in the period from 2020 up to 2030". However, the proposal for a revised EU ETS directive, submitted July 2015, does not contain the prospect for the inclusion of new sectors.

- ***The potential impacts of including road transport in the EU ETS could disturb effort sharing and European Emission Allowances (EUAs) prices*** - Modeling results demonstrate that including the transport sector leads to two main consequences: (i) a shift in effort sharing between sectors included in the EU ETS which is supported largely by the power sector; (ii) an increase in the carbon price to $€_{2010}126/tCO_2$ in 2030, which would still remain too low to trigger structural abatements in the road transport sector.

- ***GHG emissions from road transport have already been included, using different compliance frameworks, in schemes beyond Europe*** - California, Québec and New Zealand have included road transport within the scope of their ETSs. However the strategic role of these ETSs and their compliance measures differ from the EU ETS. Analysis of these experiences suggests that high compliance costs for the road transport sector are mitigated with flexibility provisions of the use of carbon offsets.

- ***Several potential challenges should to be address if road transport is to be included in the EU ETS*** - If the EU Commission were to cover emissions from road transport, they would have to consider the following: defining the role of the EU ETS as a central or a complementary measure within the road transport policy mix; recalibrating the EU ETS emissions cap according to $CO_2e$ emissions from the road transport sector and also to complementary climate and energy policies; identifying the point of regulation; analyzing the effort sharing between sectors; and mitigating compliance costs though flexible mechanisms such as international or domestic offsets.

a. This chapter on the inclusion of the road transport sector is based on I4CE, IFPen & Enerdata expertise, on analysis developed in the workshop of the COPEC research program organized on December 16th 2014 and results from academic research. Thanks to IFPen for providing their valuable expertise on climate and energy policies for the transport sector. We thank also Patrick CRIQUI, Professor and Research Director - EDDEN - CNRS for his participation to this workshop and for his analysis of the economic tools for the decarbonisation of the road transport sector.

The road transport sector represents 20% of European GHG emissions. It is currently classified as a 'non-ETS' sector and is regulated by European $CO_2$ emissions standards, national taxes and other energy policies. One of the primary motivations behind extending the scope of the EU ETS to other sectors is largely due to the common idea that broader EU ETS coverage would help facilitate more cost-effective global carbon abatement and expand the pool of carbon abatement measures. Other ETS such as California, Québec and New Zealand, have already included road transport within their ETSs helping to build a case for its inclusion in the EU ETS.

In this chapter, section 1 introduces the current European debate on extending the EU ETS scope to include road transport and specific features of EU emissions from transport. Based on POLES modeling results, section 2 demonstrates the potential consequences of a scenario in which road transport emissions are included in the EU ETS and the impact of this inclusion on balancing supply and demand. Section 3 explores the features of other emissions trading schemes that have included emissions from the road transport sector in their programs. To conclude, section 4 examines the challenges that the EU Commission must investigate before extending EU ETS scope to include GHG emissions from the road transport sector.

# 1. EXPANDING EU ETS SCOPE TO INCLUDE ROAD TRANSPORT EMISSIONS

## Extending EU ETS scope: a long-standing discussion

Discussions regarding the extension of the EU ETS scope beyond energy and industry sectors have been taking place for some time now. The first proposal to extend the EU ETS to the transport sector began with including emissions from aviation in 2005. As a result of lengthy discussions, $CO_2e$ emissions from domestic European air transport were restricted through a semi-open emissions trading system linked with the EU ETS (Directive EC/2007/83) from the beginning of 2012 to 2020[b]. The EU Commission's current proposal for the review of the EU ETS Directive does not address issues relating to $CO_2e$ emissions from aviation. Adjustments to the Directive that apply to aviation activities are expected after an international agreement is reached within the ICAO Assembly in 2016 on a global-market based measure, to be implemented by 2020.

### European discussions on the inclusion of road transport: requesting further cost-benefit analysis

Initiated in the EU Commission's communication "*Building a global market*" [1], discussions on the issue of expanding the EU ETS have been ongoing since 2006. After a review process was initiated to assess a proposal for the inclusion of road transport in Phase III (2013-2020), the EU Commission noted that the "*extension of the EU ETS to other sectors and gases should be part of a comprehensive and coherent policy mix*".[2] Finally, the EU Commission resolved to exclude direct $CO_2e$ emissions from road transport due to high administrative costs.

The subject was raised again in March 2007 at the first meeting of the working group on the European Climate Change Programme (ECCP) which concluded that the possibility to include road transport merited further analyzes.[3]

### Can including road transport help tackle the growing EU ETS structural supply-demand unbalance?

To address the growing EU ETS allowance surplus, in November 2012, the EU Commission released its communication on *The state of the European carbon market in 2012*.[4] The communication highlighted six potential options to help manage the growing surplus. Of these, "*Option d*" presented the possibility of extending the EU ETS's scope to include $CO_2e$ emissions directly related to fossil fuel consumption. From December 2012 to February 2013, a public consultation was held and resulted in general agreement. The main recommendation was a call for further investigation and in-depth impact assessments for the possible inclusion of road transport emissions. It was agreed that while "*Option d*" may take time to implement, it may well be a viable option for post 2020 strategy.[5]

### Can the EU ETS act as a complementary policy to the road transport policy mix leading to 2030?

A structural review of the EU ETS for the post-2020 period has been under discussion since the release of the EU Commission's Communication "*A policy framework for climate and energy in the period from 2020 up to 2030*" [6] in 2014. The Impact

b. For more details, see Alberola E. and B. Solier, 2012, I4CE–Institute for Climate Economics Report « *Including international aviation in the EU ETS: a first step towards a global scheme* » Climate Report n°34, August 2012.

Assessment in Annex 7.8 [7] provides a qualitative and quantitative assessment on the extension of the EU ETS's scope to include all energy-related emissions. While this Communication does not specifically state an intention to include the road transport sector, it does consider expanding the scope of the EU ETS in general, stating it to be "*especially important within the 2030 context*".[8]

The EU Commission considers the inclusion of road transport in the EU ETS as a complementary measure to further develop and support existing policies on energy efficiency, renewable energy and other standards. The EC reckons that without these other policies, the decrease in price elasticity of energy demand could lead to unnecessarily high carbon prices.[9] Thus, overlapping policies and the complexity of regulatory approaches need to be "carefully" analyzed in future assessments.

After the release of the EU Commission's Communication on the 2030 Climate and Energy Package in early 2014, Denmark became the first Member State, to formally express its interest to include emissions from road transport in its national ETS target. In preparation for the 2030 Climate and Energy framework, the European Council disclosed their conclusions in October 2014.[10] The EU Council recalled that under the EU ETS Directive (Art.24)[11], Member States can opt to include the transport sector within the EU ETS.

On June 18th 2015, the EU Commission held a high-level conference on road decarbonisation.[12] There, it was announced that a communication on the subject be released in the first half of 2016.[13] For the time-being, the EU Commission is not considering including road transport in the EU ETS.

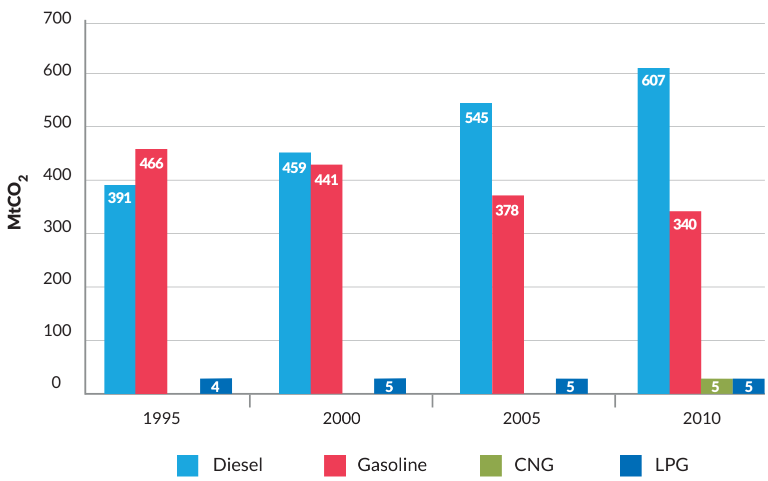
If road transport was to be included, it would likely be positioned as a complementary policy to the current policies regulating the sector, rather than replace them.

## Road transport constitutes one fifth of the EU GHG emissions profile

In 2012, the EU-28 emitted a total of 4,544.2 million tonnes of carbon dioxide equivalent ($MtCO_2e$) down 19.2% since 1990.[14] In 2012, the most important sector by far is energy (i.e. combustion and fugitive emissions), accounting for 79% of total EU-28 emissions within this, 20% derive from the road transport sector.[15] Between 1990 and 2012, the transport sector has been the only sector whose GHG emissions have increased, by 123 $MtCO_2e$.[16] However, since 2008, emissions from road transport have been decreasing.[17]

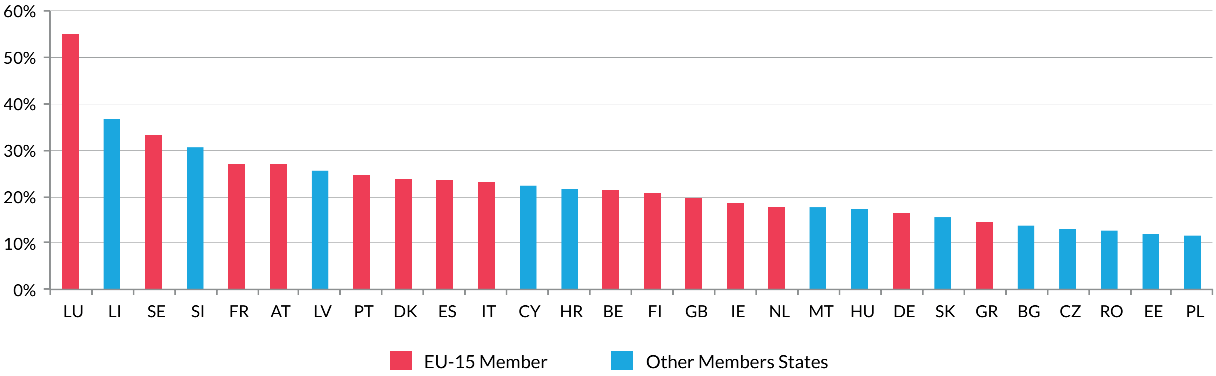
The majority of GHG emissions are derived from the use of gasoline and diesel in the road transport sector. GHG emissions from compressed natural gas (CNG) and liquefied petroleum gas (LPG) constitute a negligible share (Figure 1). Since the year 2000, the relative share of GHG emissions from gasoline and diesel has been reversed, and for the first time, GHG emissions related to diesel combustion have dominated the emissions profile. This growing share of diesel GHG emissions is due to an increased share of diesel cars in European car parks combined with an increase in kilometers traveled. This trend is growing fast: in 2012, GHG emissions from diesel were twice as high as those related to gasoline (570.6 $MtCO_2$ and 244.6 $MtCO_2$ respectively).[18]

**Figure 1 - GHG emissions by fuel type in Europe (including all vehicle types in road transport).**




*Source: Tremove, the Economic Transport and Emissions Model developed by K.U.Leuven and DRI for DG TREN, 2015. Available at: www.tremove.org*

**Figure 2 - Share of GHG emissions from road transport in Member States based on 2012 fuel sales.**




Note: percentages are calculated based on fuel sales in each Member State and do not take into account the boarder effect. Luxemburg and Liechtenstein are small countries compared to France or Deutschland, the boarder effect is therefore significantly higher.

*Source: IFPen, based on 2014 data from the European Environment Agency, 2015.*

The majority of GHG emissions among the automotive sector emanate from passenger transportation. For instance, in 2012 GHG emissions from light vehicles were over two times higher (around 680 $MtCO_2e$) than emissions from freight transportation vehicles (around 270 $MtCO_2e$).[19]

It is important to consider, when ascertaining the viability of including road transport in the EU ETS, that GHG emissions profiles vary from country to country. In 2012, GHG emissions from road transport emitted by the EU-15 countries[c] constituted 86% of total EU-28 road transport emissions. This difference is mainly due to the higher number of vehicles in EU-15. Furthermore, 15 out of the EU-28 countries exceeded the European average of a 21% share of GHG emissions from road transport in their registered national emissions[d], four of which have exceeded the average by 30% (Figure 2).

## 2. INTRODUCING ROAD TRANSPORT TO THE EU ETS BY 2030: RESULTS BASED ON THE POLES MODEL

### Defining the scenario

The objective of this section is to analyze and assess the possible consequences of including road transport in Phase IV (2021-2030) of the EU ETS. To this end, two scenarios were developed[e]:

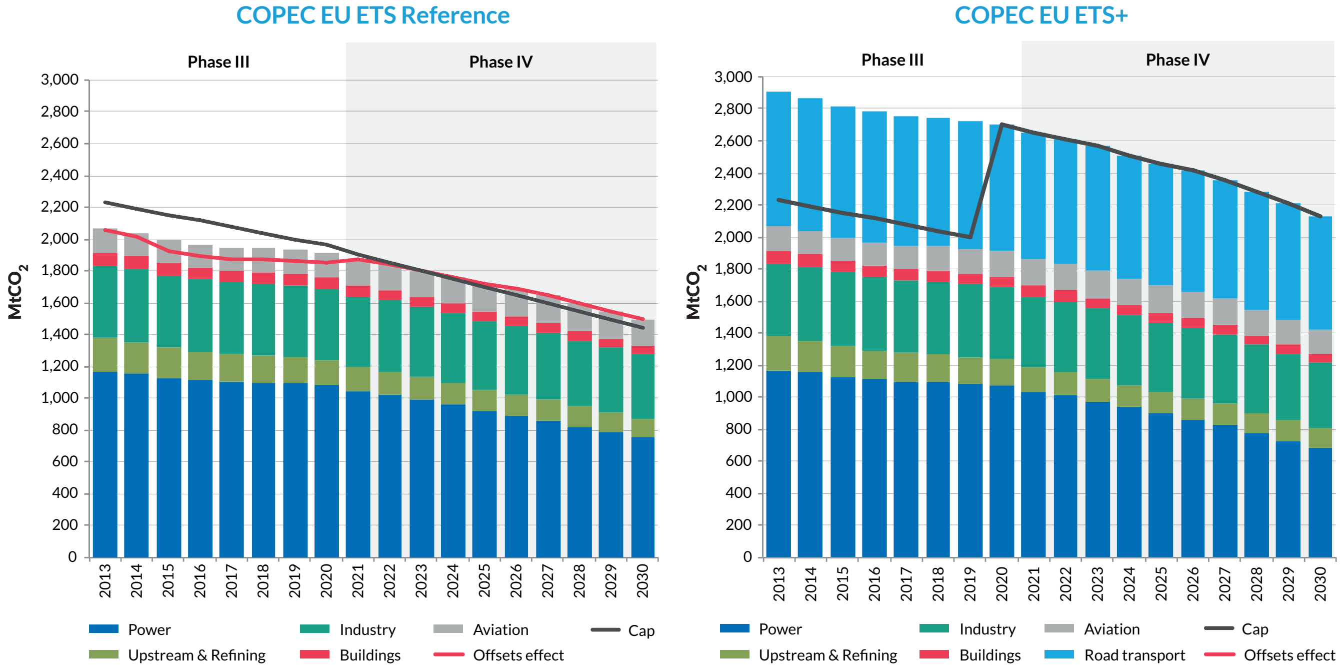
- **COPEC EU ETS Reference:** this scenario is equivalent to the reference scenario examined in Chapter 1. The level of surplus available is taken from the reference case (I4CE – Institute for Climate Economics, 2015 and the EU Commission, 2014, see Chapter 2 for more details) and the 2030 EU GHG emission reduction target is 40% compared to 1990 levels.
- **COPEC EU ETS+:** in this scenario, road transport is a new sector included as a whole (100% of its emissions) in the EU ETS from 2020. The new cap for this scenario is defined as total emissions from all sectors observed in the reference scenario substracting by emissions of the new non-ETS sector (i.e. excluding road transport).To assess the consequences of these assumptions on the extended EU ETS, the carbon value in non-ETS sectors is assumed unchanged in this scenario and the 2030 EU emission reduction target remains -40% vs. 1990 levels.

### Results

The inclusion of road transport in the EU-ETS is analyzed in terms of emission levels as illustrated comparatively in Figure 3, where in addition to the Reference case (left), emissions of road transport have been included in the ETS (right) from 2020 with the associated emission cap defined above. As observed, the integration of road transport primarily leads to an increase in GHG emission reduction effort from the power sector until 2030, with an additional reduction amounting to about 67 $MtCO_2e$ in 2030 compared to the Reference case. In this case, the effect of the inclusion on the emission reduction effort from industry is negligible.

c. The first 15 EU Member States.
d. Luxembourg, Lichtenstein, Sweden, Switzerland and Slovenia.
e. In both scenarios, the Market Stability Reserve (MSR) mechanism is not considered. In addition, both scenarios have the same assumptions with the exception of the inclusion or not of the road transport sector in the EU ETS. Thus, for the transport sector, the same assumptions are applied on vehicle $CO_2$ efficiency and biofuels subsidies.

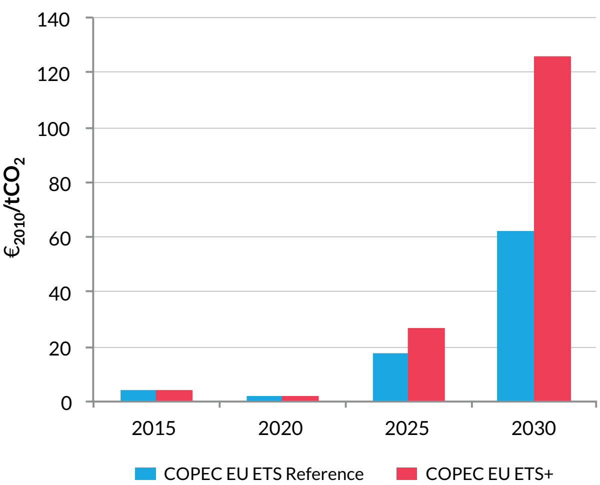
**Figure 3 - Emissions in EU ETS sectors with (right) and without (left) including road transport.**




*Source: POLES-Enerdata model, 2015.*

Figure 4 represents the level of $CO_2$ price required in the ETS in both scenarios. From 2021, including road transport leads to a gradual increase of the $CO_2$ price up to $€_{2010}126/tCO_2$ in 2030, which doubles the reference case scenario ($€_{2010}63/tCO_2$). This price level is achieved under the constraint that the carbon value is kept unchanged in non-ETS sectors and the overall objective of 40% emission reduction at the EU level relative to 1990 levels is maintained until 2030. As a consequence, the increased $CO_2$ price might impact significantly both the industry and energy sectors.

**Figure 4 - Impact of the inclusion of road transport in the EU ETS on the EUA price.**




*Source: POLES-Enerdata model, 2015.*

The burden sharing occurring among sectors after the inclusion of road transport in the EU ETS is described in more detail in Table 1. In addition to the $CO_2$ price levels achieved in the ETS and non-ETS sectors in both scenarios, reduction levels are presented, having first been aggregated for the EU-28 countries and secondly for the ETS and non-ETS sectors, as well as in relevant sub-sectors.

The figures confirm a sectoral shift occurred from the road transport sector to both the power generation sector and to a lower extent the industrial sector.[f] While road transport reduces its own emissions by only 22.2% in the ETS compared to 32.7% outside the ETS, the additional effort is mostly supported by the electricity generation sector (47.7% reduction compared to 40.4% in the reference case) and to a lesser extent by industry (18.3% compared to 17.8%). This reflects the rigidity of road transport in terms of its mitigation costs. As a consequence of this new burden sharing, emissions from the road transport sector increase by 16%[g] in 2030 compared to the reference case.

f. Even if the industrial sector offers less flexibility than the electricity generation sector in terms of emission reductions, the increase in carbon price from $€63/tCO_2$ to $€126/tCO_2$ represents a strong price signal impacting all industrials sectors.

g. Road transport emissions reduction achievement under the Reference scenario is -32.7% by 2030, compared to -22.2% in the ETS+ scenario. The difference between these two percentages shows a relative increase of $CO_2$ emissions from road transport in the scenario EU ETS+ (+16% in 2030 compared to the Reference scenario).

**Table 1 - Impact of the inclusion of road transport in the ETS on sectoral burden sharing.**

| 2030 | COPEC EU ETS Reference | COPEC EU ETS+ |
|---|---|---|
| EU-28 | | |
| Reduction/1990 | -39.5% | -39.4% |
| ETS | | |
| $CO_2$ price (€$_{2010}$/t$CO_2$) | 63 | 126 |
| Reduction/2005 | **-38.8%** | **-37.1%** |
| thereof Power | -40.4% | -47.7% |
| thereof Industry | -17.8% | -18.3% |
| thereof Road Transport | - | *-22.2%* |
| Non-ETS | | |
| Carbon value (€$_{2010}$/t$CO_2$) | 598 | 598 |
| Reduction/2005 | **-33.9%** | **-34.4%** |
| thereof Road Transport | *-32.7%* | - |

*Source: POLES-Enerdata model, 2015.*

In terms of achieving 2030 targets, including road transport in the EU ETS may lead to a reduction in energy saving efforts (23.4% energy efficiency in 2030 vs. 24.4% in the reference case). This is explained by higher overall energy consumption, particularly in the road transport sector where emission reduction efforts are reduced significantly due to the carbon price signal applied to this sector when included in the EU ETS (see Table 1 and mobility results in Table 2). The share of renewable energy sources (RES) in gross energy consumption would remain unchanged whereas the share of RES in gross electricity consumption would increase to 46.6% in ETS+ compared to 44.8% in the Reference scenario. Furthermore, including road transport in the ETS could lead to an increase in average European electricity prices, with a 6% increase in 2030 compared to the Reference scenario.

The development of the vehicle fleet in the Reference scenario is driven by the macro-economic context (GDP, population). By 2030, the passenger vehicles fleet is expected to reach 267 million (see Table 2), accounting for a progressive slowdown in new cars sales from +1.4%/year in 2020 to +0.2%/year in 2025 and +0.4%/year in 2030. Total kilometers travelled, expressed in billion vehicle kilometers (Gvkm), amounts to approximately 3,500 Gvkm in 2030 in the reference scenario vs. 3,800 Gvkm in the case where road transport is included in the EU-ETS. In the COPEC ETS+ scenario, the model projects a shift in the burden sharing of emissions from the road transport sector to the power sector. While included in the EU ETS, the road transport sector is subject to a lower value of carbon (€126/t$CO_2$) than outside the EU ETS (€598/t$CO_2$), leading to an average European price of fuel for vehicles approximately 40% lower in 2030 compared to the Reference scenario and compared to an increase in mobility.

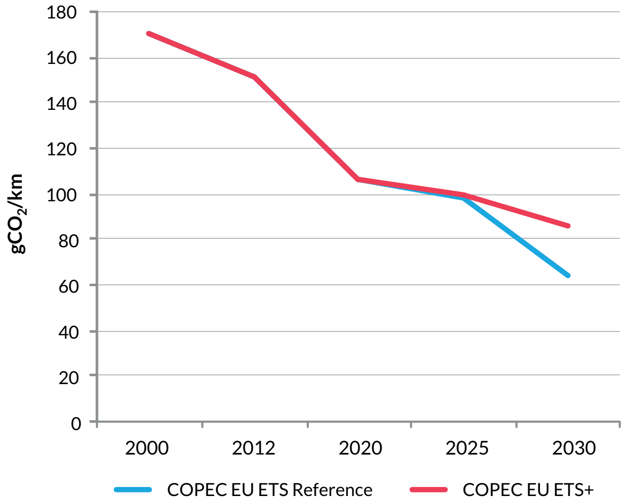
Furthermore, the road transport sector is significantly more efficient, in terms of emissions per kilometer, when it is not included in the ETS, as illustrated in Figure 5. With road transport kept outside the EU ETS, higher fuel prices, including for conventional cars due to the internalization of a higher carbon constraint, contribute to an increase in the average efficiency of new vehicles (64 g$CO_2$/km in 2030 in the Reference case-blue line, as shown in Figure 5, leading to 86 g$CO_2$/km in the ETS+ case-red line). The carbon emissions standard target of 95 g$CO_2$/km is achieved by the Reference scenario in 2026 and by the ETS+ scenario in 2027. Between 2012 and 2030, fuel consumption per kilometer for new cars is reduced by about 58%, whereas fuel consumption per kilometer of internal combustion engines is reduced by 19% over the same period.

**Table 2 - General data on passenger vehicles in the EU-28.**

| EU-28 | Unit | 2000 | 2012 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| Number of private cars | M | 195 | 238 | 252 | 260 | 267 |
| Annual increase of new car sales | %/year | - | 2.9 | 1.4 | 0.2 | 0.4 |
| Mobility COPEC EU ETS Reference | Gvkm | 2,617 | 3,048 | 3,393 | 3,609 | 3,478 |
| Mobility COPEC EU ETS+ | Gvkm | 2,617 | 3,048 | 3,398 | 3,626 | 3,831 |

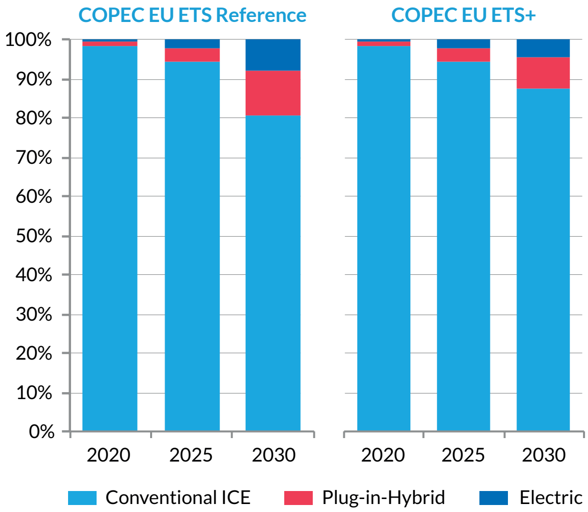
*Source: POLES-Enerdata model, 2015.*

**Figure 5 - Emissions per kilometer in internal combustion engines.**




*Source: POLES-Enerdata model, 2015.*

**Figure 6 - EU vehicle mix by technology in the reference and ETS+ scenario.**




*Source: POLES-Enerdata model, 2015.*

Up until 2025, the penetration of alternative vehicles in the market is relatively limited at about 5% to 6% of the total fleet (Figure 6). By 2030 in the Reference scenario, they represent approximately 19% of the total vehicles fleet with a sharp market share increase for plug-in-hybrid vehicles (from 4% in 2025 to 12% of total fleet in 2030) and, to a lesser extent, for electric vehicles (from 2% to 8%). This scenario brings forward issues regarding the development, especially after 2025, of an appropriate production value chain for both vehicles and batteries, as well as the development of the necessary infrastructure for the implementation of a network of charging stations in Europe.

In conclusion, according to POLES-Enerdata model (2015), results demonstrate that including road transport in the EU ETS would lead to the following consequences:

- *Lower fuel prices for vehicles by 2030*: the average European price of fuel for vehicles would be approximately 40% lower in 2030 compared to the fuel prices in the Reference scenario (due to a higher carbon value modeled for non-EU ETS sectors in the Reference scenario);
- *Increased mobility in terms of kilometers travelled in Europe*: total kilometers travelled amounts to approximately 3,500 Gvkm in 2030 in the Reference scenario versus 3,800 Gvkm in the case where road transport is included in the EU ETS;
- *A new burden sharing between sectors*: mitigation efforts are increased for the power sector and the industry;
- *A higher $CO_2$ price in the new ETS:* (€126/t$CO_2$ vs €63/t$CO_2$) impacting all ETS sectors (power generation and industry);
- *Vehicle efficiency improves at a slower rate*: the road transport sector is significantly more efficient, in terms of emissions per kilometer, when it is not included in the ETS.

Finally, 2030 emissions of road transport sector would be 16% higher if included in the EU ETS.

## 3. EXPERIENCES FROM OTHER EMISSIONS TRADING SCHEMES AROUND THE WORLD: CALIFORNIA, QUÉBEC AND NEW ZEALAND

The decision, by California, Québec and New Zealand, to include road transport within the scope of their ETSs can largely be attributed to the volume of GHG emissions coming from the road transport sector. New Zealand was the first scheme to incorporate GHG emissions from transport which constituted 17.3%[20] of its national emissions in 2013. California and Québec later following, including GHG emissions from transport which constitutes 36.8%[21] (in 2013) and 44.7%[22] (in 2012) respectively.

### New Zealand: pioneering the ETS experience in road transport coverage

In 2013, GHG emissions from road transport represented 15.7% of national emissions and 39.5% of GHG emissions from the power sector.[23]

The 2013 transport GHG emissions profile was dominated by road transport GHG emissions and accounted for 12.69 $MtCO_2e$ (90.7% of total transport emissions).[24]

Domestic transportation (air, maritime and road) were included in the New Zealand ETS (NZ ETS) which was enacted by the *Climate Change Response (Emission Trading) Amendment Act 2008*.[25] The NZ ETS began by covering the forestry sector in 2008 before phasing in other sectors over time. The scope was expanded in January 2010 to include reporting obligations for liquid fossil fuel suppliers.[h] Later that year in July, NZ ETS compliance obligation became mandatory for any supplier producing or importing more than 50,000 litres of liquid fossil fuels a year.[26] A voluntary opt-in procedure is authorised for large fuel distributors selling over 35 million litres (ML) per year or over 10 ML of aviation fuel.[27]

In August 2009, New Zealand's government approved a 2020 conditional GHG emissions reduction target[i] ranging from 10% to 20% below 1990 levels which was supplemented in 2013 by an unconditional 2020 GHG emission reduction target of 5% below 1990 levels.[28] Recently, in July 2015, in preparation for COP 21, the government submitted its intended nationally determined contribution to the UNFCCC and committed to reduce GHG emissions to 30% below 2005 levels by 2030.[29] The *Sixth National Communication on Climate Change* estimated the amount of avoided emissions resulting from mitigation policies and measures to be 9.8 $GgCO_2e$ in 2020. Since the NZ ETS is assumed to be responsible for the majority of these avoided emissions[30], it is considered as the primary tool underpinning New Zealand domestic climate change action.[31] However, in the road transport sector, this primary mechanism is complemented by other policies and incentives in the areas of fuel economy, biofuels, energy efficiency and electric vehicles.

Currently, the NZ ETS features no absolute cap. The *Climate Change Response (Emissions Trading and Other Matters) Amendment Act 2012*[32] introduces caps on allocated New Zealand units (NZUs) and those sold at auction. Both caps are based on an agreed net emission target[33] but for the time being, no information has been found on the design features of the cap on auctioning (which has yet to be implemented).

Fuel suppliers are not eligible to receive free allowances[34] due to the fact that upstream points of obligation are expected to pass through costs to end-users - similar to the windfall concept for the European power sector. Fuel suppliers have several options to fulfill their obligations: they can purchase NZUs on the market, buy an offset unit or buy NZUs directly from the government at a fixed price of NZ$25/2$tCO_2e$.[35] This fixed price can be considered equivalent to an NZU price ceiling. To ease the burden of the ETS on fuel suppliers, the *Climate Change Response (Moderated Emission Trading) Amendment Act 2009*[36] introduced a "*2 for 1*" compliance measure, whereby emitters can surrender one emission unit for 2$tCO_2e$ of emissions. This measure was initially designed to expire at the end of 2012, but has been extended by the *Amendment Act 2012*. Further NZ ETS revisions are expected in 2016.

As of 1st June 2015, covered entities are no longer able to use Kyoto Protocol credits.[j] However, New Zealand issued national assigned amount units (NZ AAUs) which remain eligible in the market and can be automatically carried over after June 2015.[37] As a result, only domestic offsets can currently be purchased in the program. The only domestic offsets credits currently available are those issued by pre-1990 forestry owners as they can offset their liability for deforestation by converting land to another use (not forestry) with some conditions[38] and therefore, sell these forestry offsets credits to covered New Zealand entities. The fact that the government has not yet developed domestic offset protocols, aside from the option presented above, is a challenge for fuel suppliers. Due to this, they are confronted with a quantitative limitation whereas purchasing offsets can be a means to release their compliance obligation.

Until 2014, covered entities mainly surrendered Kyoto credits due to their very low prices. In 2014, 73.87% of their compliance obligations were met by ERUs, 21.70% by CERs and 1.26% by RMUs.[39] The new ban will strongly impact the fuel suppliers' behavior. The *Amendment Act 2012* gave the government the ability to hold auctions.[40] The launch of auctioning may help to regulate the supply demand balance of allowances.

h. Liquid fossil fuel suppliers are all the suppliers of "*obligation fuels*": petrol, diesel, aviation spirit (aviation gas), maritime diesel, jet fuel, light residual fuel oil and heavy residual fuel oil. It also includes any other liquid fossil fuel that is directly combusted when used. Liquefied petroleum gas, and biofuels are exempted, together with fuel marines and kerosene used for international flights.

i. The adoption of this target is conditional upon the approval of a mandatory and comprehensive climate change agreement at the international level.

j. Kyoto Protocol credits include Removal Units (RMUs) which are forestry credits, Emission Reduction Units (ERUs) from Joint implementation, and Certified Emission Reductions (CERs) from the Clean Development Mechanism.

## California: including fuel suppliers and importers as a complementary measure to reduce GHG emissions from road transportation

The transport sector is the largest GHG emitting sector in California and accounts for 36.8%[41] of the state's total GHG emissions in 2013. Transportation is one of the key sectors to reduce GHG emissions. Since January 2015, fuels suppliers and importers have been included in the Californian Cap-and-Trade program (CA ETS).

The foundation of the CA ETS can be found in the California *Global Warming Solutions Act 2006*, also known as *Assembly Bill 32* (AB32). The AB32 Act sets a restrictive target for 2020 GHG emissions, equivalent to the 1990 Californian GHG emission in 1990, i.e. a maximum of 431 $MtCO_2e$.[42] This target corresponds to a 15% net GHG emissions reduction in California relative to the "*business as usual*" scenario. In June 2015, the California Senate approved the amended AB32 requiring the California Air Resources Board (ARB) to adopt a 2030 GHG emission reduction target of 40% below 1990 levels and 80% below 1990 levels by 2050.[43]

In this context, since January 1st 2013, the CA ETS, alongside other sector-based GHG reduction measures, have contributed to the 2020 reduction effort. At its launch, industrial sites, first deliverers of electricity (including importers) and carbon dioxide suppliers were added to the scope of the programme. The expected reductions via the ETS are estimated to be 23 $MtCO_2e$[44], almost 30% of the reductions required to reach the 2020 GHG emission target. By comparison, the expected reductions from the other sector-based measures are estimated at 55 $MtCO_2e$[45] in 2020 (half from the transport sector alone). Consequently, reductions expected from the other sector-based measures are twice as important as the ETS's reduction effort. The California ETS is therefore a complementary instrument supporting sector-based measures rather than a central policy measure. In June 2015, the California Assembly approved law *AB1288* extending the CA ETS until 2050 which is now awaiting senate approval.[46]

As a complementary tool, the CA ETS works alongside several policies to help reduce emissions from the transport sector. These include measures to enhance vehicle engine efficiency, the development of zero emission technologies, reducing the carbon content in fuels and improving land management.

On January 1st 2015, the second compliance period commenced with a $CO_2e$ emissions cap set at 394.5 $MtCO_2e$ (Figure 7).[47] The scheme was extended to all fuel suppliers and importers that emit more than 25,000 $ktCO_2e$ per year and includes suppliers of Reformulated gasoline, Blendstock for Oxygenate Blending (RBOB), distillate fuel oil, LPG, mixed fuels and Liquefied Natural Gas (LNG). As a result, CA ETS now covers 85% of California's total GHG emissions.

During the first compliance period (2013-2014), around 90% of allowances for industries and refineries (290.25 $MtCO_2e$) were freely allocated to assist industry and protect them from carbon leakage. Free allowances were also distributed to electricity deliverers and natural gas suppliers which both have an obligation to submit all these allowances into the auction pools. In addition, auction proceeds are to be used exclusively for the benefit of retail ratepayers. Fuel suppliers and importers are the points of regulation in the transportation sector and do not receive any free allocation. The decision for no free allocation is justified by the fact that upstream points of obligation were expected to pass through the cost to the final consumers. Consequently, fuel prices are expected to increase.

Under the CA ETS, two types of price control measures impact the road transport sector. The first is the Auction Reserve Price (floor price) which was set at $12.10[48] in 2015.

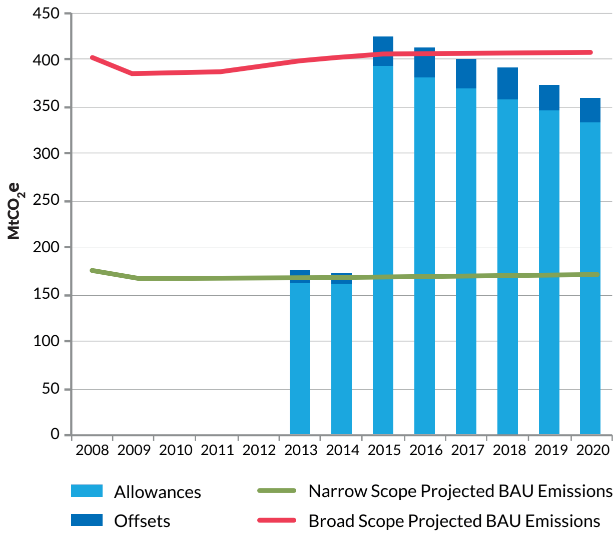
The second instrument is an Allowance Price Containment Reserve (APCR) which collects 4% of the annual allowances from auction each year and releases them if certain predetermined trigger prices are reached.[k] Only California emitters are eligible to purchase allowances from the APCR.

Fossil fuel suppliers and importers have several options to meet their compliance obligations. California-Québec markets were linked from January 2014 via the Western Climate Initiative (WCI), through which either can purchase WCI allowances (Californian or Québec allowances) at auction or in the secondary market as well as offsets for up to 8% of their obligations within a compliance period. Current offset types available to transport sector include early action offsets, international sector-based offsets and ARB

k. Tiers (2015); Tier 1: US$45.2, Tier 2: US$50.86, Tiers 3: US$56.51. These reserve prices also increase by 5% per year plus inflation.

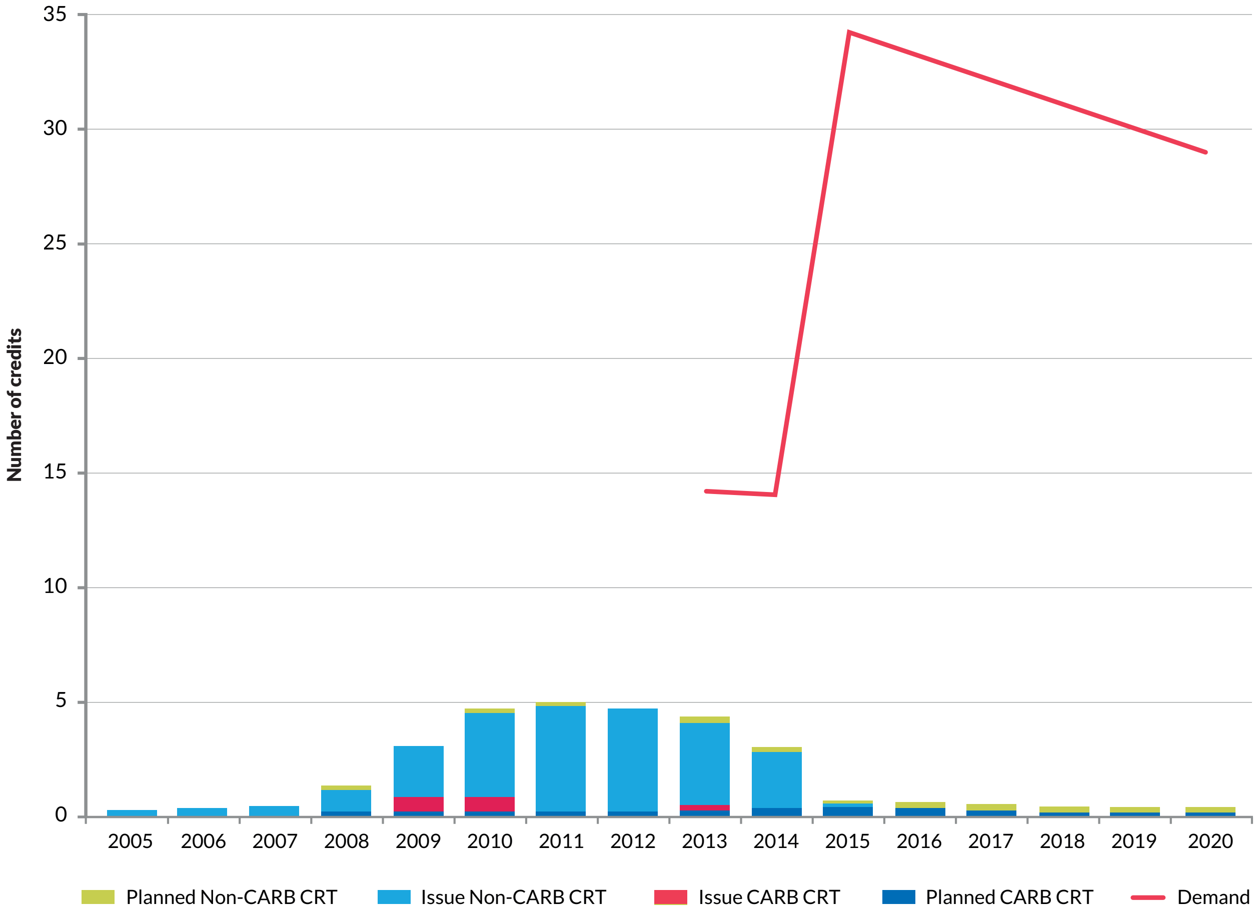
domestic offset credits. Offset projects are required to be located in the United States, United States territories, Canada or Mexico. Since offsetting emissions can effectively represent a release from compliance obligations, with the inclusion of the transport sector, the number of available offset credits is likely to be insufficient to meet the projected demand for offset credits estimated at 232 $MtCO_2e$ between 2013 and 2020 (Figure 8). As a result, fuel suppliers and importers will have to make greater use of auctioned allowances, which will increase compliance costs in the long-term.

**Figure 7 - Variation between projected GHG emissions carbon credits and allowance profiles in California.**




*Source: Center For Climate and Energy Solutions from CARB, California Cap and Trade Regulation Initial Statement of Reasons, Appendix E: Setting the Program Emissions Cap.*

**Figure 8 - Supply and demand for eligible and non-eligible carbon offset credits in the California ETS.**[I]




*Source: Thomson Reuters, Point carbon, Project Manager North America, 2015.*

I. Additional project types, such as nitrogen fertiliser management, rice production management, coal mine methane, reductions in emissions from degradation and deforestation (REDD), are potential candidates for additional supply mentioned by CARB but not yet eligible in the CA ETS.

**Table 3 - Covering GHG emissions from road transport beyond Europe.**

| | | California | Québec | New Zealand |
|---|---|---|---|---|
| **2020 GHG emissions reduction target** | | 1990 levels | 20% below 1990 levels | 5 % below 1990 levels |
| **Positionning of ETS in the national climate policy framework** | | Complementary | Primary | Primary |
| **Share of total emissions covered by the ETS** | | 85% | 85% | 55% |
| **Share of road transport emissions in the national emissions profile (2013)** | | 36.8% | 44.7% (2011) | 15.7% |
| **COVERAGE FEATURES** | | | | |
| **Scope** | | Fuel producers and importers | Fuel producers and importers | Fuel producers and importers |
| **Threshold** | | >25,000 $tCO_2e$ per year | >25,000 $tCO_2e$ per year | **Mandatory:** >50,000 litres per year<br>**Voluntary:** large fuel retailers if they use:<br>• >10 million litres per year of jet fuels or,<br>• >35 million litres per year of obligation fuels combined |
| **Covered fuels** | | Gasoline • diesel fuel • liquefied petroleum gas • blended fuels • liquefied natural gas • reformulated blendstock for oxygenate blending (RBOB) | Automotive gasoline • diesel fuel • propane • natural gas • heating fuel | • Petrol • diesel • aviation spirit (aviation gas) • maritime diesel • jet fuel • light residual fuel oil and heavy residual fuel oil • any other liquid fossil fuel that is directly combusted when used |
| **Exemptions** | **Fuels** | Exported fuels and biofuels | Biofuel | Liquefied petroleum gas, lighting kerosene and biofuels |
| | **Sectors** | Aviation and maritime transport | Aviation and maritime | International aviation and maritime transport |
| **COMPLIANCE FEATURES** | | | | |
| **Allowance Methodology** | | No free allowances | No free allowances | No free allowances |
| **Offsets** | **Threshold (%)** | 8 | 8 | Unlimited |
| | **Type** | • Early action offsets<br>• ARB offsets credits (Six offset protocols)<br>• Linked offset credits (Québec offsets credits)<br>• International sector-based offset credits (limited to 2%) | • Early reduction credits<br>• Offsets credits (three offset protocols)<br>• Linked offset credits (California offset credits) | • Pre-1990 forestry offsets |
| **Cost-containment and volatility provisions** | **By price** | • **Floor price:** US$12.10<br>• **Allowance price containment reserve (APCR):** if the price reaches one of these triggers – Tier 1: US$45.20; Tier 2: US$50.86; Tier 3: US$56.51 – one third of reserve allowances become available. *Tiers are calculated by applying: +5% per year + inflation.* | • **Floor price:** US$12.10<br>• **Allowance price containment reserve:** if the price reaches one of these triggers – Tier 1: CA$45.20; Tier 2: A$50.86; Tier 3: CA$56.51 – one third of reserve allowances become available. *Tiers are calculated by applying: +5% per year + inflation.* | • **Price ceiling:** NZ$25 for 2 $tCO_2e$ |
| | **By quantity** | • **Banking:** allowed but subject to holding limits.<br>• **Borrowing:** allowed: 1. From future periods for compliance in the current period, but only to satisfy an excess emissions obligation; 2. If the quota was purchased from the APCR to contain price. | • **Banking:** allowed but subject to holding limits.<br>• **Borrowing:** allowed: 1. From future periods for compliance in the current period, but only to satisfy an excess emissions obligation; 2. If the quota was purchased from the APCR to contain price. | • **Banking:** allowed but subject to holding limits. |
| **IMPACT ON END-USERS** | | | | |
| **Price at pump (price/liter)** | | • **Petrol:** US$0.025 - 0.12<br>• **Diesel:** US$0.028 - 0.14 | CA$0.01- 0.03 | • **Petrol:** NZ$0.031<br>• **Diesel:** NZ$0.033 |

*NZ dollars (2010)

*Source: I4CE – Institute for Climate Economics, July 2015.*

## 4. INCLUDING THE ROAD TRANSPORT SECTOR IN THE EU ETS: CHALLENGES FOR THE EUROPEAN COMMISSION

Decarbonising the European road transport sector will be a challenge, in the context of meeting the EU's binding GHG emission reduction target -40 % by 2030. In order to achieve this EU decarbonisation target in a cost-efficient pathway, the EU Commission must carefully take into account various policy interactions at both the national and regional level as well as the diversity of individual Member States' emissions profiles. Between 2011 and 2012, European emissions from road transport decreased by 32 $MtCO_2e$[49]. However, at the same time several countries saw an increase in their road transport emissions such as Bulgaria, Estonia, Lithuania, Romania, Slovakia and Slovenia.[50]

Based on the previous analysis of other countries experiences and on modelling results, it is possible to identify the main challenges that may arise if the EU ETS were to include $CO_2e$ emissions from road transport. This section examines what role the EU ETS can play to reduce emissions from road transport in view of the other policies and explores how to design this inclusion.

### Bringing the EU ETS into the road transport policy mix

Emissions trading schemes are contributing to meeting GHG reduction targets around the world, but not all are considered to be the main public policy tool to achieve these targets. However, The EU's ETS is the primary instrument used to reduce GHG emissions in the region. Conversely, in California, despite a 36.8% share of emissions from the transport sector, the ETS is used as a complementary policy in conjunction with direct regulations and public policies to meet targets.

Between 1990-2012, the EU has not had a significant impact on reducing absolute emissions from the transport sector. In fact, over this period, emissions from the transport sector increased by 123 $MtCO_2e$[51]. Since 2008, however, GHG emissions from road transport have decreased by 1% annually. Decarbonising the European automobile fleet presents a significant challenge to policy makers. Several key factors will have to be considered to reduce GHG emissions in this sector including: the expected increase in demand for transportation, energy efficiency of new vehicles, the evolution of mobility supply, the share of alternative fuels in the consumed mix (such as biofuel and electricity vehicles). Different measures have already been put in place by the EU Commission, such as emission standards ($gCO_2$/km) for new vehicles and biofuel targets. However, current policies on vehicles – light duty vehicles, vans, biofuels and effectiveness of mobility behaviors – could be reasonably emphasised to try to meet the 2030 target or the objectives set by the 2050 Roadmap.

In view of the very important impact of the inertia of fleets, evolution in mobility behaviors could be encouraged along with existing policies being made more effective. The key factors to reducing GHG emissions from road transport are emissions standards on vehicles, biofuel mandates associated with durability criteria as well as technological development of connected cars[m] and optimisation of mobility. Also, an efficiency target could be implemented in the heavy-duty fleet to manage GHG emissions. In addition, improvements in freight transportation management and public transportation development could also be made to help reduce the demand on road transport and subsequently GHG emissions.

Whatever the role played by the EU ETS in the policy mix – central pillar or complementary climate policy – including the road transport sector should require a deep cost-benefit analysis to demonstrate that inclusion would lead to the best most cost-effective means to achieve the 2030 GHG emissions reduction target. Obviously, the results will be very different depending on whether the EU ETS is considered as the main or complementary instrument to reduce road transport emissions. According to results from the Enerdata-POLES model and other studies[n], in the scenario that included 100% of emissions from road transport, the carbon price signal emerging from the EU ETS would not be enough to effectively drive significant $CO_2e$ emission reductions in the road transport sector due to high abatement costs. In consequence, defining a place for the EU ETS in the road transport policy mix would require calibrating a new and appropriate mix that is in line with the most efficient carbon value pathway for this sector.

m. A car that is connected to a wireless local area network which can allows for the automatic notification of crashes, notification of speeding, car parks…etc.

n. For more analysis, see 2014, Cambridge Econometrics for EU Climate foundation, *The impact of including the road transport sector in the EU ETS*; 2014, International Council on Clean Technologies, *Road transport in the EU ETS: an engineering perspective*; and 2009, Institute for European Environmental Policy, *An analysis of the obstacles to inclusion of road transport emissions in the EU ETS.*

## Design challenges for the inclusion of road transport in the EU ETS

Whether or not the EU ETS is considered as a central or a complementary instrument, the first issues to address are the point of regulation, the treatment of emissions from biofuels, the definition of the new EU ETS and to what extend flexibility can be given as this will help to ensure the efficiency of the ETS.

### Identifying the most efficient point of regulation

In both the California-Québec ETS and the New Zealand ETS, the point of regulation is set at fuel suppliers and importers. The 2007 EU Commission's Impact Assessment on the results of *the review of the Community strategy to reduce $CO_2$ emissions from passenger cars and light-commercial vehicles*[52] analyzes the possibility to set the point of regulation with vehicle drivers. However, this option is considered to incur high administrative and monitoring costs. In addition, this strategy would also be at odds with the EU principle of "*simplification and better regulation*". Since 2006, all the European Commission's analyzes landed at the same stalemate: choose to be consistent with the principle of direct emissions or choose the cost-effective approach which is an upstream strategy as California, New Zealand and Québec have implemented.

Fuel suppliers as the point of regulation would be the "*preferred option*"[53] for European institutions (EU Commission and EU Parliament). This choice would help to limit the number of covered entities, streamline GHG emission monitoring and limit the transaction costs of the inclusion. On the other hand, it could create border effects between neighboring non-ETS countries with high fuel price differentials. Nonetheless, fuel suppliers have limited access to direct emission reduction measures, aside from increasing fuel prices passed through to the end-user and maintaining the regulated minimum standards for the inclusion of biofuel in fuel sales. In this case, the increased price would need to be very high to have a significant impact on end-user behavior.

### Dealing with the issue of biofuels

The transport sector in California, New Zealand and Québec is dominated, like in Europe, by the use of fossil fuels (mainly gasoline and diesel). Other fuels with lower carbon content during combustion such as Liquefied Petroleum Gas, Compressed Natural Gas or biofuels represent a very small percentage of fuel consumption.

Under the *EU Renewable Energy Directive*[54], a set of sustainability criteria were defined to ensure that the use of biofuels in transport guarantees real GHG emission reductions.[o] The three main criteria for sustainability determine that:

1. For installations existing before October 5th 2015: biofuels must reach GHG emission savings of at least 35% until December 31th 2017, at least 50% from January 1st 2018. For new installations in operation after October 5th 2015: biofuels must reach GHG emission savings of at least 60%[55];
2. Biofuels cannot be grown in areas converted from land with previously high carbon stock;
3. Biofuels cannot be produced from raw materials obtained from land with a high level of biodiversity.

In the case that one or all of these criteria are not applied, biofuels will be dealt with as a fossil fuel. The EU ETS definition for biomass has been aligned with the definition for biomass used in Directive 2009/28/EC of 23/4/2009[56] to take into account these sustainability criteria. It is only if the biomass component of the biofuel complies with the sustainability criteria, that the carbon emissions associated with the combustion of the biomass is accounted as equal to zero for the EU ETS compliance obligation. Otherwise, carbon emissions from biomass would be considered as fossil fuel and therefore its $CO_2$ emission factor would be accounted for as higher than zero.

The big challenge here for the EU Commission will be to ensure that when taking into account biofuels, all the sustainability criteria lead to real and global decreases in GHG emissions from biofuels. For the time being, Land use changes factors are still subject of controversy.

### Recalibrating the EU ETS emissions cap according to complementary sectoral climate policies

The inclusion of the road transport in the EU ETS as a complementary tool could have a stabilising effect on the EU ETS. Drivers of EUA demand from the road transport sector are less sensible to macroeconomic cycles and the innovation dynamic is different to the power and industrial sectors. However, the impact of extending the EU ETS scope on achieving the 2030 GHG emission

o. In 2012, to reduce the risk of indirect land use change, the European Commission has proposed amending current legislations relatingto biofuels, specifically the Renewable Energy Directive and the Fuel Quality Directive.

reduction target will depend on updating the EU ETS emission cap and how the EU ETS is regarding in the overall policy mix.

Changing the cap may require establishing a baseline for $CO_2$e emissions from the road transport sector that takes into account all complementary climate and energy policies that lead to $CO_2$e emissions abatements. This exercise would be based on numerous assumptions that have been determined with a high level of uncertainty. For example, defining the turnover rate of each vehicle in the fleet (gasoline, diesel or alternative vehicles); the speed of deployment for electric or hydrogen vehicles etc; how emissions standards will be achieved (taking into account that their penalties are very high[p]); and of determining the share of biofuels in the fuel mix would pose a significant challenge today. Furthermore, beyond the development of low-carbon technologies in this sector (such as connected cars), assumptions regarding the effectiveness of mobility behaviors and on changes to final end-user behavior (frequency at which vehicle are changed, number of kilometers driven) involve a high level of uncertainty.

Assuming these uncertainties and taking into account the EU ETS experience, revising this baseline raises some challenges: how to recalibrate the road transport sector's emissions cap when the sectorial climate and energy policy-mix has changed? Can we expect the Market Stability Reserve to adjust the supply of allowances accordingly? Or, should we expect that the EU Commission produce an ex-ante assessment to evaluate the new $CO_2$e emissions baseline and to update the emissions cap?

Finally, whatever the emissions cap level, the treatment of the inclusion of the road transport would be very particular as the sector is not exposed to the carbon leakages risk and compliance costs will be passed-through to end-users. In this case, the road transport sector would not receive free allocation. Moreover, emissions reductions in the road transport sector will continue to capitalise on the current regulatory framework even after 2020. Given the uncertainties of customer behavior (as yearly mileage or vehicle replacement frequency), establishing a cost-effective tool (offset credits for example), to fill the gap between regulatory framework and the quantity of emission reductions, is required. Consequently, without any other alternative to purchasing EUAs (such as using offsets credits), the sector's demand on EUAs would have an impact on the EUAs price in the long-term.

**Providing compliance flexibility to the transport sector**

The 2030 emission reduction target (-40% compared to 1990 levels) set by the EU Commission and the EU Council is a domestic target.[57] This means that international credits will no longer be used to comply with covered entities' obligation after 2020. Additionally, the EU Commissions proposal to revise EU ETS Directive does not include any provision for domestic offsets. Beyond the EU region, most other emissions trading schemes have introduced credits from domestic projects. For example, domestic offset credits are used by the linked California-Québec ETS. By allowing limited use of offset credits issued by various types of projects located in the United States and Canada[q], the schemes provide entities an alternative to purchasing allowances. Thus, considering the ban on the use of international credits in the fourth EU ETS compliance period, a discussion on the development of domestic credits could emerge.

In this case flexibility mechanisms such as purchasing domestic or international offsets credits should be considered. Achieving $CO_2$e emissions reductions in the road transport using project based mechanisms would offer two advantages.

Firstly, international offsets credits[r] could help transport entities mitigate the cost of their compliance obligation if offsets are cheaper than allowances. This option was, until recently, illustrated by the New Zealand ETS in allowing the use of international credits. Secondly, allowing offset credits can lead to extending the carbon price signal to other economic sectors or to other countries leading to new emission reduction reserves. Domestic projects would allow for further mitigation options outside the EU ETS. This would be very cost-effective for government finances, seeing as they operate on the basis of private funding and are driven by the demand emanating from the EU ETS. Domestic offsetting also provides cost-effective mitigation, as emissions reduction projects that were not foreseen by the public authority, emerge in a bottom-up manner, which can be profitable for the private sector (Shishlov *et al.*, 2012).

p. In the case that the manufacturer has not achieved the $CO_2$ emission standards by 2021, they will be required to pay a penalty of €95 for the first gram that is exceeded onwards for each car registered. For more information see: EC, 2014, *Reducing $CO_2$ emissions from passenger cars*.

q. In California, compliance offset protocols are related to U.S forest projects, urban forest projects, livestock projects, ozone depleting substances projects and mine methane capture projects. In Québec credits are issued from projects related to Agricultural methane destruction, small landfill site methane destruction and ozone depleting substance. The first two protocols require that projects take place within Québec. The Ozone Depleting Substance (ODS) Destruction (foam and refrigerants)'s protocol allows for projects to take place across all of Canada or the US, except that the ODS may be destroyed either in Canada or in the U.S.

r. Kyoto Protocol credits include Removal Units (RMUs) which are forestry credits, Emission Reduction Units (ERUs) from Joint implementation, and Certified Emission Reductions (CERs) from the Clean Development Mechanism.

According to the past experience of the EU ETS during Phases II and III (see Chapter 1), if the EU Commission were to allow the use of domestic (or international) offsets, it would need to be accounted for under the $CO_2$ emissions cap by subtracting, the maximum amount of $CO_2$ emissions reductions permitted through offsetting. This adjustment would help avoid negative interactions and the creation of a surplus of unused allowances.

## The direct economic effect of the carbon price on fuel prices

Currently the pass-through cost added to pump prices in California, New Zealand and Québec ETS [s] are estimated to range between US cents 1-3 per liter. This creates a low level of incentive to encourage vehicle drivers' to change their behavior.

Including the road transport sector in the EU ETS will cause a direct rise in fuel prices in the short-term, even if this rise could be limited due to the effectiveness of the road transport policy mix. This is a result of the passed through cost of EUA's impacting the cost of retail fuel prices. The impact of this on consumer behavior will depend on the level and speed of the EUA price increase.[t] Including the road transport sector in the EU ETS, when the carbon price is relatively low, would have a very marginal impact on overall fuel costs and transport energy demand in short term. As for an illustration, with a carbon price of €10/$tCO_2$e, the additional carbon price is only of €0.70 for petrol and €0.78 for diesel for a full tank (30 liters average). This price is certainly too low to impact consumer behaviors. Furthermore in another extreme case, a higher carbon price set at €100/$tCO_2$e, leads to an additional increase of €7 for a full tank of petrol and €7.8 for a full tank of diesel. In the latter case, if the increased cost is sudden, it may impact the behavior of consumers at least for a short period.

Indeed, the end-user consumer's reaction to an increase in fuel price and the subsequent impact on demand for the transport sector is highly complex and inelastic. This is due to a high level of fuel taxation and a breech in the psychological threshold for fuel prices. A low pass through cost on fuel prices would have a small impact on consumer behavior. However, a high pass through cost of a few euros for a full tank can induce a psychological reaction which can impact consumer behaviors at least for a short period of time.

## 5. CONCLUSION

To conclude, including the road transport sector should require a deep cost-benefit analysis to demonstrate that inclusion would lead to the best most cost-effective means to achieve the 2030 GHG emissions reduction target.

Before expanding the EU ETS scope, the EU Commission will have to address several important questions. Firstly, it would have to be decided whether the EU ETS will be a central or complementary measure to reduce emissions from road transport. Furthermore, several design challenges should be considered: defining the point of regulation (which in view of the administrative and economic constraints relating to measuring and monitoring GHG emissions would likely be set at fuel suppliers); recalibrating the EU ETS emissions cap to rebalance the scheme; defining the relevant sustainability criteria and a clear methodology (to ensure the substitution of fossil fuels by biofuels leads to a global decrease in GHG emissions) and, providing compliance flexibility to mitigate road transport's compliance costs and to extend carbon price signal to other non-ETS sectors.

Results from the POLES model demonstrate that including the road transport sector leads firstly to a shift in effort sharing between EU ETS sectors supported largely by the power sector. Secondly, it would lead to an increase in the carbon price to $€_{2010}$126/$tCO_2$ in 2030, which would still be too low to trigger structural abatements in the road transport sector. In consequence, defining a place for the EU ETS in the road transport policy mix would require calibrating a new and appropriate mix that is in line with the most efficient carbon value pathway that can drive the decarbonisation of this sector. Moreover, choosing the EU ETS as a complementary tool to the road transport policy mix, would require taking into account the emission reduction effort of the climate policy mix and optimizations of mobility. The difference between these emission reduction efforts and the target is defined as an emission reduction gap that will be fulfilled by purchasing units for compliance from the EU ETS.

s. I4CE – Institute for Climate Economics and IFPEN calculations based on *New Zealand emissions trading scheme - information for business owners* brochure, June 2010. Available at: http://climatechange.govt.nz/emissions-trading-scheme/about/what-it-means-for-me/brochure-farmers/index.html, personal communications and IFPEN assessment of carbon emission content per liters for diesel and gasoline.

t. Increase in price by €cents 1.2-1.3/l if the EUA price is €5/$tCO_2$ (corresponding to a decrease in consumption of 0.5%) and by €cents 5.8-6.6/litre if the EUA price is €25/$tCO_2$ (corresponding to a decrease in consumption of 2.3%) - Kasten, P. *et al.* 2015.

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