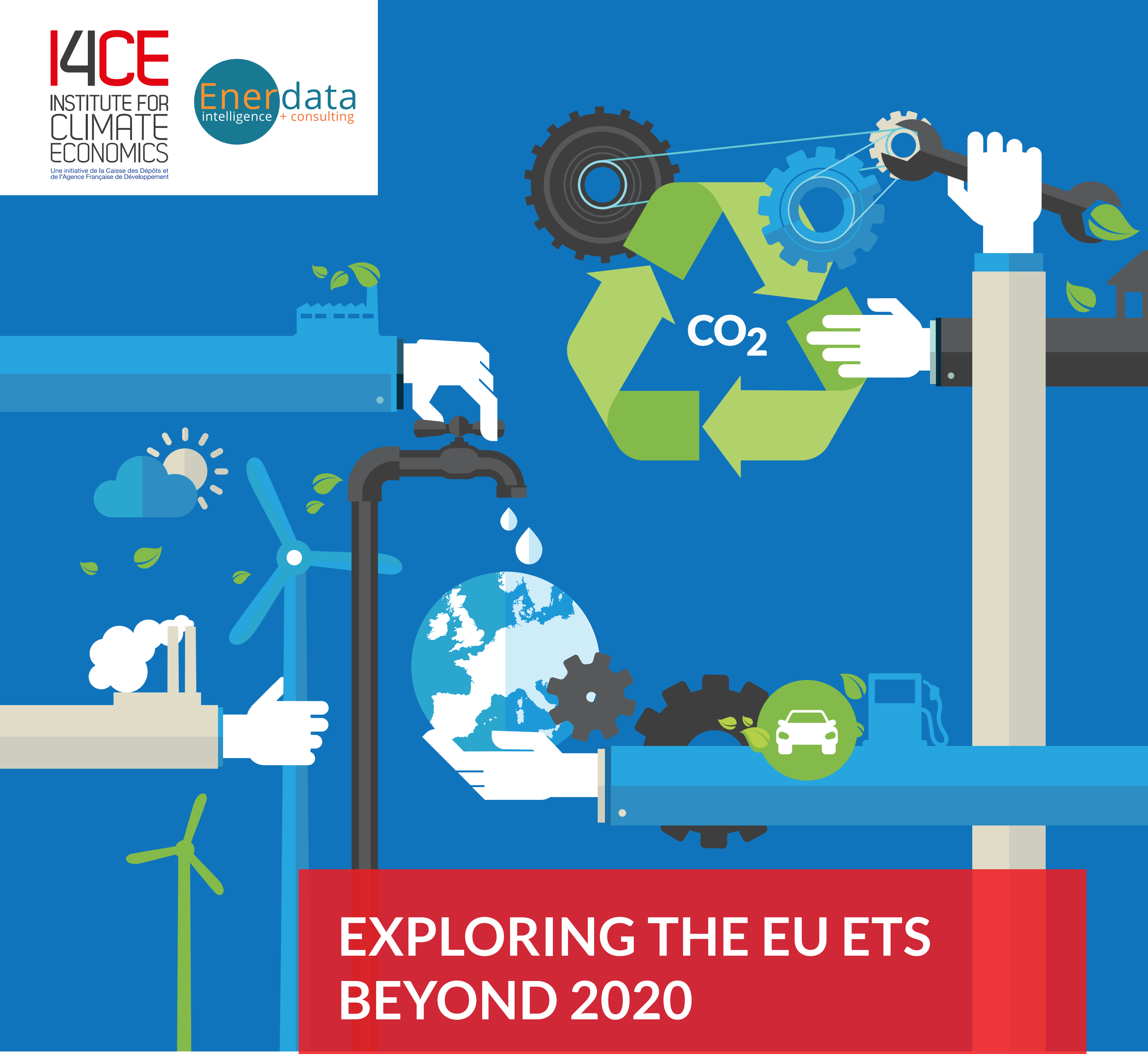


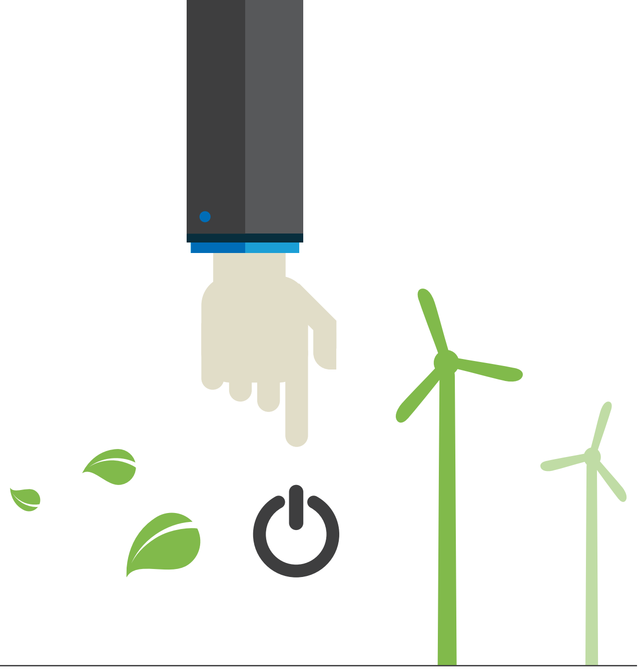
EXPLORING THE EU ETS BEYOND 2020

A first assessment of the EU Commission's proposal for Phase IV of the EU ETS (2021-2030)

COPEC Research Program: the COordination of EU Policies on Energy and CO_2 with the EU ETS by 2030

November 2015

in collaboration with IFP Energies nouvelles



ACKNOWLEDGEMENTS

This report was produced jointly by I4CE – Institute for Climate Economics and Enerdata, in collaboration with IFPen for Chapter 4. Emilie ALBEROLA conceptualized the research program.

The authors take sole responsibility for findings or ideas presented in this report as well as any errors or omissions. **This report does not reflect the opinion of the French Government.**

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The authors would like to thank the sponsors of this research program and financial support of a coalition from French public and private decision-makers involved in the EU ETS: DALKIA, Groupe EDF, ENGIE, TOTAL, VEOLIA and the Finance, Economy and Industry (DG Treasury and DG Entreprises) and the Sustainable Development Ministries in France (DG Energy and Climate).

The report benefited greatly from the valuable technical inputs and analysis provided by academic researchers and experts who attended the five workshops between September 2014 and September 2015. Hence, the authors would like to extend their gratitude to those who offered their cooperation and insights, especially Raphael TROTIGNON (Climate Change Economics Chair, University of Paris Dauphine, France), Marie-Eugenia SANIN (University of Evry, France), Anne CRETI (University Paris-Dauphine, France) and Godefroy GROSJEAN (Potsdam Institute for Climate Impact Research (PIK), Germany) on the topic of the Market Stability Reserve; Jean-Pierre PONSSARD (École polytechnique, CNRS, CIRANO, France) and Frédéric BRANGER (CIRED - France), on the topic of the free allocation mechanism; Patrick CRIQUI (EDDEN Grenoble University - CNRS, France) for his analysis of the economic tools for the decarbonisation of the road transport sector; and again Godefroy GROSJEAN (Potsdam Institute for Climate Impact Research (PIK), Germany) and Christian FLACHSLAND (Mercator Research Institute on Global Commons and Climate Change (MCC), Germany) on the topic of utilisation of EU ETS auction revenues.

PRESENTATION OF THE RESEARCH PROGRAM

With the release of the European Commission's Communication on a 2030 policy framework for climate and energy in January 2014 and the proposal for a revised EU ETS directive in July 2015, the European Commission provides a new roadmap for the decarbonisation of European energy and industry sectors beyond 2020.

The COordination of Policies on Energy and CO_2 (COPEC) program aims to prepare economic policy makers for the debate surrounding the design of the Climate and Energy Package 2030 and subsequently the European Emissions Trading Scheme. The report provides new, factual, independent and quantified analysis on the EU ETS' operation leading to 2030.

Launched in September 2014 by I4CE – Institute for Climate Economics and Enerdata, in collaboration with IFPen, the COPEC research program aims to provide an overview of academic and modeling results to an audience of decision makers on the functioning of the European Union Emissions Trading Scheme by 2030. I4CE – Institute for Climate Economics contributed to this report with new economic and institutional analysis on Phase IV of the EU ETS, based on its expertise and results from academic research. Enerdata developed the POLES model examining different scenarios for the implementation of the EU ETS in 2030. IFPen has provided its expertise on the analysis of climate and energy policies for the road transport sector.

Based on the Communication on a 2030 policy framework for climate and energy and conclusions of the European Council on energy and climate policies in October 2014, this research program focuses on five issues that could pose a major challenges to the successful implementation of Phase IV of the EU ETS:

- Defining a CO_2 target that is in line with energy policies Renewables and Energy Efficiency,
- Implementing the Market Stability Reserve,
- Addressing carbon pricing, carbon leakage and free allocation,
- Extending the EU ETS scope to include emissions from the road transport sector,
- Financing the low-carbon transition through various funding mechanisms using auction revenues.

THE RESEARCH TEAM

I4CE – Institute for Climate Economics

"I4CE – Institute for Climate Economics" is an initiative of Caisse des Dépôts and Agence Française de Développement. The think tank provides independent expertise and analysis on economic issues linked to climate & energy policies in France and throughout the world. I4CE aims to help public and private decision-makers improve the way in which they understand, anticipate, and encourage the use of economic and financial resources to promote the transition to a low-carbon resilient economy.

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In collaboration with the expertise of IFPen on transport issues

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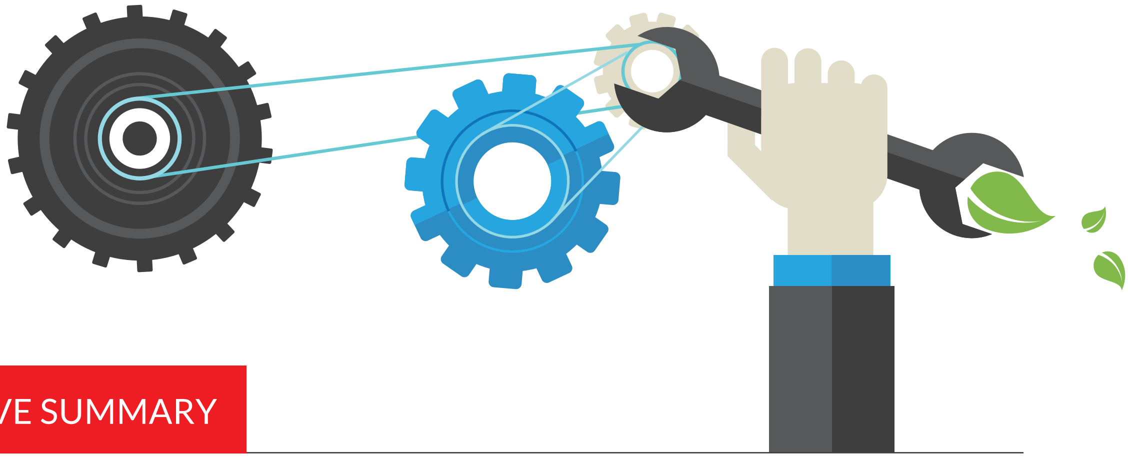


EXECUTIVE SUMMARY

With the release of the European Commission's Communication on a 2030 policy framework for climate and energy in January 2014 and the proposal for a revised European Union Emissions Trading Scheme (EU ETS) directive in July 2015, the European Commission has provided a new roadmap for the decarbonisation of European energy and industrial sectors beyond 2020. Entitled "*Exploring the EU ETS beyond 2020: a first assessment of the EU Commission's proposal for Phase IV of the EU ETS (2021-2030).* The report aims to prepare economic policy-makers for the debate surrounding the design of the 2030 framework for Climate and Energy policies and the revision of the EU ETS directive.

The new 2030 EU ETS target is in line with the 2050 roadmap towards a low-carbon economy.

The EU Commission's proposal provides an EU ETS GHG emissions reduction target of 43% by 2030, compared to 2005 levels, and a cap which will be reduced by a linear reduction factor of 2.2% from 2021 onwards. This new level of EU ETS ambition is rooted in the extended energy and climate policies package which sets three main targets to be achieved by 2030. The first is a binding EU target of at least 40% GHG reduction compared to 1990 levels, in line with the 2050 Roadmap towards a low-carbon economy, in addition to a binding EU-wide target of 27% renewable energy sources (RES) in final energy consumption and an indicative EU target for at least 27% improvement in energy efficiency (EE) compared to a 2007 baseline – with no binding obligation for individual Member States.

Based on these proposed targets, this report demonstrates that **a unique GHG emissions reduction target would help achieve the decarbonisation objectives at lower cost.** Indeed, a combination of different energy and climate targets will have some impact on the cost of the transition to a low-carbon economy. Adding RES and EE targets would decrease the ETS carbon price significantly, at around €$_{2010}$10/tCO_2 in 2030, but the costs of the necessary energy efficiency policies would be affected drastically, increased fourfold in comparison to a unique GHG target scenario.

Calibrating the EU ETS requires considering interactions with complementary climate and energy policies by 2030.

Due to existing market and behavioural failures that hinder the ability to exploit low-cost abatement potential, complementary instruments are necessary. However, the impact of the whole climate policy mix on the EU carbon price should be carefully assessed and justified in a transparent and comprehensive manner. The EU ETS emissions cap should account for complementary energy and climate policies in the same way that the 2020 Energy & Climate Package took into consideration renewable energy policies (which account for significant emissions reductions but have not impacted the EUA surplus). It appears that energy efficiency policies and offsets that were not factored into the cap have led to an increase of 1.5 GtCO_2e in the surplus between 2008 and 2014. Comparatively, demand-side uncertainties (overachievement of RES policies, downturn) have contributed only 1.2 GtCO_2e to the surplus.

The surplus of CO_2 allowances is estimated to reach 2.6 billion in 2020 and will grow, without any changes in rule, to more than 3 billion during Phase IV. The growing surplus has undermined the EUA price incentive which until now seems to have played a weak role besides creating a strong incentive for the reduction of 1.2 billion tons of CO_2 emissions outside the EU ETS through Kyoto credits (CDM-JI). As such, **some flexibility is necessary in the supply of free allowances to improve the resilience of the EU ETS to external shocks.** The correct balance must be found between improving long-term predictability so as to increase investor confidence, and increasing short-term flexibility for greater stabilization.

Complementary instruments should be more geared towards technology developments in system-friendly RES, storage and demand response measures. Together with more market-based renewable support and targeted power market-design, the ability of the EU ETS to drive emissions reductions in the power sector cost-effectively could be enhanced.

Introducing the Market Stability Reserve is necessary to support the ambition of the EU ETS.

Since the beginning of Phase II, the growing surplus of allowances has undermined the overall effectiveness of the EU ETS. Market participant myopia and a general lack of confidence in the scheme have encouraged them to focus on the short-term surplus instead of taking into consideration the expected long-term scarcity. Disclosed in January 2014, after an intensive debate among Member States, the MSR (Market Stability Reserve) legislative proposal was adopted by the EU Council in September 2015 and will enter into force in 2019. The legislation also stipulates the reintroduction of 900 million backloaded allowances and unallocated allowances in Phase III directly into the MSR, provisions for monitoring the MSR including two reviews in Phase IV, and increasing the responsiveness of the mechanism. The MSR reserve aims to provide flexibility in the supply of allowances in order to achieve cost-effective transition to a low-carbon economy.

The analysis developed in the COPEC report confirms that **the MSR will likely help restore the short-term scarcity** needed during Phase IV of the EU ETS, enabling market participants to take into consideration the long-term stringency of climate policies. Ultimately, the MSR could limit the surplus to 2 billion tons of CO_2 in 2020 and gradually decrease it until it reaches 500 $MtCO_2$ in 2030 compared to 3 billion tons of CO_2 without MSR. In addition, the analysis demonstrates that **the MSR will also help increase resilience to external shocks, such as the overachievement of complementary policies.** According to POLES modelling results, introducing the MSR from 2019 will lead to an increase in the CO_2 price of roughly $€_{2010}$15/tCO_2 by 2030 (compared to the reference scenario). This would help to achieve long-term targets at a lower cost by bringing the current price trajectory into alignment with a more efficient pathway.

Guaranteeing MSR effectiveness calls for a governing framework to be established before 2030.

The major drawback of the mechanism lies in its inability to discriminate between surplus stemming from abatement efforts and surplus stemming from exogenous shocks. This “robot-like” withdrawal of surplus is likely to spur volatility if not adjusted to hedging needs and can have detrimental consequences on the low-carbon investment framework. Given the likely and unforeseeable evolution of business models and hedging needs in the power sector, some degree of “human intervention” could be essential to recalibrate the MSR in a timely fashion and to safeguard dynamic efficiency. Some stakeholders have called for a committee of experts to assess the state of the EU ETS before formulating recommendations to adapt the design of the MSR accordingly.

The free allocation mechanism for Phase IV requires more flexible and targeted allocation to sectors most exposed to carbon leakage risk in order to effectively drive the decarbonisation of European industry.

Based on POLES modeling results, the EU ETS carbon price required to meet the 2030 GHG emissions reduction objective will increase the intensity of energy expenditure in Europe and would reduce the competitive advantage of European industry by approximately three percentage points between 2020 and 2030. **In order to support the low-carbon transition of European industry, the new proposal for a revised EU ETS Directive provides for an updated “free allocation package” based on the European Council’s agreement to pursue free allocation after 2020.**

The cap is to be reduced by a linear reduction factor of 2.2% annually from 2021 onwards. Aside from the 400 million allowances set aside for the Innovation Fund, 40.4% of the cap will be dedicated to industry freely, which will equal 6.3 billion over the 2021-2030 period. Allocation will be defined for five years periods, based on benchmarks and activity levels updated in 2021 and 2026. Intra-period adjustments from the New Entrant Reserve (NER) will be provided in case of output fluctuations. Benchmark values shall be reduced by 1% per year compared to the value set, based on 2007-08 data, entailing a 15% reduction in 2021 and 20% in 2026. New thresholds in the carbon leakage list should classify 50 sectors to be at risk of carbon leakage for the period 2021-30 with the proposed criteria, covering 93% of industrial emissions in 2013.

The COPEC analysis shows that the free allocation mechanism for Phase IV of the EU ETS requires further improvements to effectively prevent carbon leakage and to maintain abatement incentives. The proposed mechanism could entail the application of an ex post cross-sectoral factor of 20% to all sectors in 2030 in order to remain below the allocation budget, in addition to a uniform decrease of benchmarks by 20%. This would increase carbon costs for some highly exposed sectors, while moderately exposed sectors would still enjoy large allocation volumes. In order to remedy this, **focusing allocation to the most exposed sectors, and providing tiered allocation could improve the efficiency of the protection in the long-term.**

Since 2013, allocation has been based on sectoral benchmarks and historical production levels. While this was an important step toward building and maintaining the economic incentive to reduce emissions, the method is highly inflexible. **More flexible allocation based on recent production data would provide adequate incentive to reduce emissions** per unit of output, rather than inciting reduced domestic production. With closer threshold values (every 5% for example), the NER could enhance flexibility of supply, providing better protection to efficient installations and preventing gaming of the rules. **Given the green growth potential, public financial support for low-carbon innovation, should be enhanced.** Additionally, **steering demand for low-carbon materials is of utmost importance.** Producers exposed to international trade and receiving free allocation are not supposed to pass-through carbon costs, meaning that the market for products with a smaller carbon footprint may fail to emerge.

Including road transport in the EU ETS would not be the most cost-effective means to achieve the 2030 GHG emissions reduction target.

Extending the EU ETS scope has been a long-standing discussion which began in 2006 and was brought back into the spotlight in 2012 when the EU Commission released its communication on the state of the EU ETS. The transport sector is currently responsible for 24.3% of EU GHG emissions, of which, 71.2% emanates from road transport specifically, making it an ideal candidate for potential inclusion within the EU ETS. **According to POLES modelling results, extending the EU ETS scope to include 100% of GHG emissions from road transport would not be the most cost-effective means to achieve the 2030 GHG emissions reduction target.** The results show that inclusion would lead to a new EU ETS effort-sharing dynamic between sectors which would largely be supported by the power sector. In addition, including the road transport sector would increase the carbon price for all ETS sectors. However, this increase would not be sufficient to drive significant CO_2e emission abatements in the road transport sector due to high abatement costs.

The EU ETS would need to be considered as a complementary instrument within the road transport policy mix.

Before considering whether or not to include the road transport sector, a deep cost-benefit analysis is required to justify the climate policy mix. The first challenge for the EU Commission would be to define what role the EU ETS will play in the sectoral climate policy-mix to reduce CO_2e emissions. COPEC analysis shows that the EU ETS would be more effective at reducing emissions from the road transport sector if it was considered as a complementary tool rather than central to the road transport policy mix. As a complementary tool, the EU ETS emissions cap would have to take into account the emission reduction efforts achieved by the other complementary climate policies and the optimisation of mobility in road transport. The second challenge would be to examine the design of this inclusion. For example, by selecting the point of regulation and **compliance** (fuel supplier); **defining clear EU sustainability criteria** to evaluate carbon emissions associated with the biomass component of biofuels; and finally, offering some compliance flexibility to the road transport sector, in the form of purchasing **domestic or**

international offset credits. Lastly, an increase in carbon price may not automatically impact end-user behaviour and consequently, demand for road transport. Resultantly, the third challenge would be establishing a carbon price signal that will impact end-user behaviour in the long-term.

Considering the large scale of future ETS auction revenues, the use of ETS proceeds by Member States becomes increasingly relevant to funding decarbonisation.

Financing is a key issue for the transition to a low-carbon economy. To help fund the decarbonisation of the EU economy, the proposed EU ETS revision has confirmed the creation of two new funds that are based on a carbon price. These funds are the Innovation Fund and Modernisation Fund, which will be funded with the sale of 450 million and 310 million EUAs respectively. The aim of these funds is to support innovative clean technology development and modernise the energy sector (whilst supporting solidarity and growth in certain Member States). The auction revenues accrued by Member States are also used (in part) to finance GHG reductions and other climate actions.

In Phase III (2013-2020), the EU ETS generated auction revenues worth €74.2 billion. **Assuming a gradually increasing carbon price, auctioning revenues from 2015 to 2030 could total between €230-320 billion. The large scale of future ETS auction revenues makes it important to understand the role of ETS proceeds as a financing mechanism.** Today, Article 10 of the EU ETS directive encourages Member States to use at least 50% of their auction revenue towards climate action. However, the choice to channel **auction revenues towards climate action is dependent on the sovereign choices of Member States.** Analysis of 2013 ETS auctioning revenues and spending reveals that the majority of countries allocated auction revenues primarily towards domestic mitigation. For countries that directly spent revenues towards climate action, 38.2% was spent on renewables support and 24.8% on energy efficiency, predominantly on households while some cost compensation is offered to electricity producers for including renewables in the energy mix. **In addition to domestic climate action, the revised EU ETS proposal also specifically encourages using these revenues towards international support and indirect cost compensation to certain installations.**

In order to fund the low-carbon transition using auctioning revenues, the risks of revenue variability should be managed.

To ensure that EU ETS auction revenues continue to effectively finance low-carbon actions, some improvements can be recommended. The first key challenge to be addressed before 2030 will be to **manage or reduce the risk of variability in auctioning revenues** which can impede planning and implementation actions of beneficiaries, particularly for long-term projects. The second challenge will be to **improve the transparency in communications and reporting to** adequately justify, to the public, the rationale behind the States' decision-making. Finally, public sources of revenue such as ETS proceeds could be recognised as an **opportunity to leverage private capital from public funds** for low-risk climate investments. Analysing North American ETS revenue spending plans (California, RGGI, Québec) reveals an alternative approach in allocating revenues that focuses largely on funding large-scale, low-carbon infrastructure. These other ETS also provide insight into tackling the issues of variability, reporting and communication as well as leveraging potential private finance. For instance, California and Québec use multiannual investment planning as a measure to estimate and reserve revenues for various projects. Furthermore, as a measure to protect long-term and large-scale projects against variability of carbon revenues, California allocates the first 60% of revenues towards such projects. On the issue of reporting, RGGI uses basic metrics like 'kWh reduced', 'tons of GHGs avoided' to compare emissions reduction efforts across different States.

TABLE OF CONTENT

ACKNOWLEDGEMENTS 2

PRESENTATION OF THE RESEARCH PROGRAM 3

THE RESEARCH TEAM 4

EXECUTIVE SUMMARY 5

INTRODUCTION 16

CHAPTER 1 : THE EU ETS EMISSIONS REDUCTION TARGET AND INTERACTIONS WITH ENERGY AND CLIMATE POLICIES 17

1. SUMMARY OF THE EUROPEAN COMMISSION'S PROPOSAL FOR 2030 18

The 2020 energy and climate package has been effective in achieving targets but its cost-effectiveness can be put to question 18

The 2030 energy and climate package: towards a stronger focus on cost-effectiveness and security of supply in the energy union framework 18

- A central EU greenhouse gas emissions target by 2030 19
- A binding EU renewable energy target for 2030 at least cost 20
- A non-binding EU energy efficiency target for 2030 21

2. EU ETS EMISSIONS TARGET AND INTERACTIONS WITH ENERGY POLICIES: LESSONS FROM THE 2020 ENERGY AND CLIMATE PACKAGE 21

Interactions between policies have undermined the ability of the EU ETS to drive emission reductions cost effectively 22

- *Ex-ante* assessment of interactions with the EU ETS: RES deployment accounts for 40% of the EU ETS abatement effort, but was factored in the emissions cap unlike offsets and energy efficiency 22
- Mid-term assessment of interactions with the EU ETS: more than 50% of the interaction impacts on surplus could have been avoided with an exhaustive ex ante assessment 22
- Impact of complementary policies: the EU ETS has played a residual role in emissions abatement up until now 24
- Most RES abatements have been offset by an increase in coal generation 25

The way forward 2030: closing in on the efficiency frontier 26

- Complementary policies are necessary to decrease the long term cost of decarbonisation 26
- RES support should be geared more toward the development of innovative technologies in order to overcome barriers to entry in power markets and to enhance the carbon price signal 26
- An *exhaustive ex ante* assessment of all complementary policies is necessary to calibrate the EU ETS 26
- Greater EU ETS flexibility is needed to adapt to uncertainties relating to complementary policies 27

3. INTERACTIONS BETWEEN ENERGY AND CO_2 TARGETS: RESULTS BASED ON THE POLES MODEL 27

Defining the scenario and methodology 27

Reference scenario results 28

Target scenario results 28

4. ETS DESIGN BEYOND EUROPE: INTERACTION WITH ENERGY TARGETS 30

References 32

CHAPTER 2 : THE EU ETS AND THE MARKET STABILITY RESERVE 33

1. IMPLEMENTING THE MARKET STABILITY RESERVE: FROM A "ONE-SHOT" INTERVENTION BEFORE 2020 TO "ROBOTIC" ADJUSTMENTS LEADING TO 2030 34

Choosing a quantity-based instrument to address EU ETS weaknesses before the EU ETS directive is revised for Phase IV 34
Additional MSR provisions in the proposal of the revised EU ETS directive for the post-2020 period 36

2. ASSESSING THE MSR'S ABILITY TO ADJUST EU ETS SUPPLY 36

Factors leading to low and volatile EU carbon prices: structural rigidity, lack of EU ETS credibility and the myopia of market participant 36
• EU ETS rigidity gives rise to large imbalances 36
• Lack of long-term political credibility in the EU ETS 37
• Market participants short sightedness 37

Low carbon prices increase the long term cost of European decarbonisation 38

The MSR should restore the short-term scarcity and reinforce the resilience of the EU ETS 39
• Overcoming the short sightedness of market participants 39
• Ensuring MSR efficiency through proper governance 41

Conclusion - The MSR is a welcome mechanism to restore short-term scarcity but may need to be recalibrated to guarantee the long-term cost-effectiveness of the EU ETS 42

3. INTRODUCING THE MSR IN THE EU ETS BY 2030: RESULTS BASED ON THE POLES MODEL 43
Literature review 43
Scenario definition 43
Results 44

4. ETS DESIGN BEYOND EUROPE: STABILISING CARBON PRICES AND COMPLIANCE COSTS 45

References 47

CHAPTER 3 : CARBON PRICING AND CARBON LEAKAGE ISSUES IN PHASE IV OF THE EU ETS 49

1. CARBON LEAKAGE PROVISIONS: SUMMARY OF THE EUROPEAN COMMISSION'S PROPOSALS BY 2030 50
Reducing the cap and the free allocation budget 50
Continuation of the benchmark-based approach 50
Updates of activity levels and the new entrants reserve 51
Updates of benchmark values for Phase IV 51
A binary carbon leakage list 51
Compensation for indirect costs 52

2. FREE ALLOCATION, CARBON LEAKAGE AND CARBON COSTS: ASSESSING POTENTIAL MECHANISMS FOR 2030 52
The tricky equation of free allocation: Preventing carbon leakage and stimulating innovation 52

Lessons from Phase III: experiences and literature review 53
• Mechanisms established to date have largely mitigated carbon costs 53
• Allocation of free allowances using benchmarks with harmonized rules has reduced excess allocations as well as distortions between sectors and countries. 54
• Phase III free allocation limits incentives for carbon efficiency 54

Insights from academic literature on output based allocation 55
Sustainability and efficiency of free allocation through 2030: a scenario-based approach 56
• Scenario 1: Continuation of current Phase III rules 56
• Scenario 2: Enhanced flexibility for activity levels and benchmarks 57
• Scenario 3: Tiered allocation to ensure more efficient distribution of the free allocation budget 58
• Scenario 4: The proposed revision to the Directive 58

Conclusion: Carbon leakage could be combated more efficiently through flexible and targeted allocations 62

3. EUROPEAN INDUSTRY COMPETITIVENESS UNDER THE EU ETS: RESULTS BASED ON THE POLES MODEL 63

General context of the reference scenario 63

Methodology for assessing competitiveness 63

Impacts of the EU ETS on EU industry competitiveness 64

4. ETS DESIGN BEYOND EUROPE: TACKLING CARBON LEAKAGE 66

References 68

CHAPTER 4 : EXTENDING THE EU ETS TO THE ROAD TRANSPORT SECTOR 69

1. EXPANDING EU ETS SCOPE TO INCLUDE ROAD TRANSPORT EMISSIONS 70

Extending EU ETS scope: a long-standing discussion 70

• European discussions on the inclusion of road transport: requesting further cost-benefit analysis 70
• Can including road transport help tackle the growing EU ETS structural supply-demand unbalance? 70
• Can the EU ETS act as a complementary policy to the road transport policy mix leading to 2030? 70

Road transport constitutes one fifth of the EU GHG emissions profile 71

2. INTRODUCING ROAD TRANSPORT TO THE EU ETS BY 2030: RESULTS BASED ON THE POLES MODEL 72

Defining the scenario 72

Results 72

3. EXPERIENCES FROM OTHER EMISSIONS TRADING SCHEMES AROUNDTHE WORLD: CALIFORNIA, QUÉBEC AND NEW ZEALAND 75

New Zealand: pioneering the ETS experience in road transport coverage 75

California: including fuel suppliers and importers as a complementary measure to reduce GHG emissions from road transportation 77

4. INCLUDING THE ROAD TRANSPORT SECTOR IN THE EU ETS: CHALLENGES FOR THE EUROPEAN COMMISSION 80

Bringing the EU ETS into the road transport policy mix 80

Design challenges for the inclusion of road transport in the EU ETS 81

• Identifying the most efficient point of regulation 81
• Dealing with the issue of biofuels 81
• Recalibrating the EU ETS emissions cap according to complementary sectoral climate policies 81
• Providing compliance flexibility to the transport sector 82

The direct economic effect of the carbon price on fuel prices 83

5. CONCLUSION 83

References 84
End notes 85

CHAPTER 5 : THE EU ETS AND LOW-CARBON FUNDING MECHANISMS 87

1. LOW-CARBON FINANCING IN THE EU COMMISSION'S PROPOSAL FOR A REVISED EU ETS DIRECTIVE BY 2030 88

Challenges to financing the EU low-carbon transition by 2030 88

Low-carbon technology funding mechanisms at the EU level 90

• The (re)designed Innovation Fund 90
• The new Modernisation Fund 91
• Transitional free allocations for the power sector in low-income Member States 91

• Auctioned allowances for enhanced solidarity amongst Member States 92

Key issues to be addressed to enhance the effectiveness of low-carbon funding mechanisms 92

• Auction revenues 93

2. EU ETS REVENUES IN PHASES III AND IV: LESSONS FROM MEMBER STATES' FIRST EXPERIENCES 93

EU ETS revenue spending guidelines: a lenient framework 94

Auction revenue spending in Phase III: lessons from Member States' first experiences in 2013 95

• Categorising Member States into Non-Earmarkers and Earmarkers 95

• Member States use diverse decision making practices to allocate revenues 95

Non-earmarker and earmarker revenues spending: which sectors benefit the most? 96

• Non-earmarkers: reported spending largely benefiting international climate efforts 96

• Earmarkers: domestic mitigation and household support are the largest beneficiaries of auction revenues spending 97

Key questions on EU ETS auction revenue spending 98

• Should earmarking be a legally enforceable guideline in the EU ETS directive? 98

• Variability in revenue allocations: an obstacle to long-term planning? 98

• Inconsistencies in reporting: how can EU-level reports be improved? 99

• Should there be more specific guidelines on how to spend revenues? 99

3. LESSONS FROM NORTH AMERICAN AUCTION REVENUES SPENDING PLANS: CALIFORNIA, RGGI AND QUÉBEC EXPERIENCES 99

Examining the revenue spending experiences of California, RGGI and Québec 99

• California: a comprehensive revenue allocation process supported by a dedicated Fund and an Investment Plan 99

• Regional Greenhouse Gas Initiative: strong guidelines supporting energy efficiency 102

• Québec: comprehensive revenues spending process based on a dedicated Fund and a detailed spending Plan 103

• Common trends in revenue spending models between California, RGGI and Québec 104

Recommendations and conclusions 104

References 106

End notes 107

Annex 108

LIST OF FIGURES

CHAPTER 1

Figure 1 - EU GHG emissions and targets to 2030 19
Figure 2 - Achievement of 2020 RES targets by Member States 20
Figure 3 - Share of renewable energy in final energy consumption 21
Figure 4 - Energy efficiency targets relative to baseline scenarios 21
Figure 5 - EU ETS CO_2 emissions from 2008 22
Figure 6 - Baseline, cap and emissions in EU ETS Phases II and III 23
Figure 7 - EU ETS supply/demand balance in 2014 and projections until 2020 23
Figure 8 - EUA and CER prices from the beginning of Phase II 24
Figure 9 - Contributions to CO_2 emissions reductions between 2005 and 2011 25
Figure 10 - Evolution of the emission factor and the share of intermittent renewable energy generation (EU ETS) 25
Figure 11 - Estimated EU ETS emissions based on different levels of achievement in RES policies 27
Figure 12 - Emissions from ETS sectors in the COPEC GHG scenario 29
Figure 13 - CO_2 price in the ETS and carbon value in non-ETS sectors in the COPEC GHG scenario 29

CHAPTER 2

Figure 1 - Demonstration of MSR operations based on the EU commission’s proposal 34
Figure 2 - Allowance surplus without MSR: increasing to 3.25 Gt CO_2 before 2030 37
Figure 3 - Examples of efficient carbon prices from different energy-economy models 38
Figure 4 - Impact of the MSR on the allowance surplus in EU ETS Phase IV 39
Figure 5 - Impact of a large decrease in demand on the EU ETS surplus with the MSR 40
Figure 6 - Impact of large decrease in demand on the EU ETS surplus without the MSR 40
Figure 7 - Impact of a large increase in demand on the EU ETS surplus with the MSR 41
Figure 8 - Impact of the MSR on the evolution of the allowance surplus: literature review 43
Figure 9 - Scenario definition for the impact of the MSR on the evolution of the allowance surplus 43
Figure 10 - Impact of the MSR on CO_2 price in the EU ETS 44

CHAPTER 3

Figure 1 - Free Allocation Budget in Phases III and IV 51
Figure 2 - Distribution of sectors compared to the carbon leakage list frontier 52
Figure 3 - The tricky equation of free allocation in Phase IV staying in line with EU council conclusions 53
Figure 4 - Allocation of allowances divided by output based CO_2 emissions: reduction in surpluses in Phase III 54
Figure 5 - Allocation of allowances divided by output based CO_2 emissions: distortions between sectors 54
Figure 6 - Carbon costs in 2030 assuming continuation of current rules and a carbon price of €30/tCO_2e 56
Figure 7 - Carbon costs in 2030 with updates of activity levels and benchmarks 57
Figure 8 - Carbon costs in 2030 with updates to activity levels and benchmarks, and a tiered allocation 58
Figure 9 - Preliminary allocation and the free allocation cap until 2030 59
Figure 10 - CSCF values and the rate of free allocation for industrial sectors 59
Figure 11 - Estimated carbon costs in different sectors 60
Figure 12 - Emissions covered by the carbon leakage list for different coefficients 60
Figure 13 - Using the NER with 1% flat rate update of benchmarks 61
Figure 14 - NER volume and CSCF values with 1% flat rate update of benchmarks 61
Figure 15 - Using the NER with 0.5% flat rate update of benchmarks 61
Figure 16 - NER volume and CSCF values with 0.5% flat rate update of benchmarks 61
Figure 17 - Evolution of final energy demand in the COPEC GHG scenario 63

Figure 18 - Overview of methodology for analysing competitiveness 64
Figure 19 - Carbon intensity of selected countries against the European average 64
Figure 20 - Carbon content (left) and energy intensity (right) of selected countries against the European average 65
Figure 21 - Intensity of energy expenditure in selected countries against the European average 65
Figure 22 - Internalising the CO_2 price in electricity prices 65

CHAPTER 4

Figure 1 - GHG emissions by fuel type in Europe (including all vehicle types in road transport) 71
Figure 2 - Share of GHG emissions from road transport in Member States based on 2012 fuel sales 72
Figure 3 - Emissions in EU ETS sectors with (right) and without (left) including road transport 73
Figure 4 - Impact of the inclusion of road transport in the EU ETS on the EUA price 73
Figure 5 - Emissions per kilometer in internal combustion engines 75
Figure 6 - EU vehicle mix by technology in the reference and ETS+ scenario 76
Figure 7 - Variation between projected GHG emissions carbon credits and allowance profiles in California 78
Figure 8 - Supply and demand for eligible and non-eligible carbon offset credits in the California ETS 78

CHAPTER 5

Figure 1 - EU ETS based funding mechanisms in the proposal of the EU ETS revised directive 90
Figure 2 - Distribution of the capitalisation of the Modernisation Fund up to December 31st 2030 91
Figure 3 - Increases in the percentage of allowances to be auctioned by Member States for the purpose of solidarity and growth in order to reduce emissions and adapt to the effects of climate change 92
Figure 4 - Forecasts of 2015-2030 auction revenues of EU Member States 95
Figure 5 - 2013 Sectoral spending: non-earmarkers 97
Figure 6 - 2013 sectoral spending: earmarkers 97
Figure 7 - Variation in annual spending through EKF budget, 2013-2015 98
Figure 8 - Greenhouse Gas Reduction Fund (GGRF) financing process 101
Figure 9 - California auction revenue spending (2013-2015) 102
Figure 10 - RGGI investments by program type (2008-2013) 103
Figure 11 - RGGI investments by category (2008-2013) 103
Figure 12 - Québec auction revenue spending plan (2013-2020) 104

LIST OF TABLES

CHAPTER 1

Table 1 - Contributing factors to the accumulation of the surplus from 2008 until 2014 and 2020 ($MtCO_2e$) 24
Table 2 - Scenario definition and objectives for the analysis of interactions between targets 28
Table 3 - General indicators: COPEC GHG scenario 29
Table 4 - Economic indicators: COPEC GHG and COPEC Targets scenarios 30
Table 5 - Total costs in COPEC GHG and COPEC Targets scenarios 30
Table 6 - Policy interactions in Emissions Trading Schemes beyond Europe 31

CHAPTER 2

Table 1 - Comparison of Market Stability Reserve provisions in the proposed and adopted legislative text 35
Table 2 - Impact of the MSR on 2015-2030 cumulative abatement costs in the ETS 44
Table 3 - Impact of the MSR on additional permit trading ($MtCO_2$) in the ETS 45
Table 4 - Flexibility mechanisms in Emissions Trading Schemes implemented beyond Europe 46

CHAPTER 3

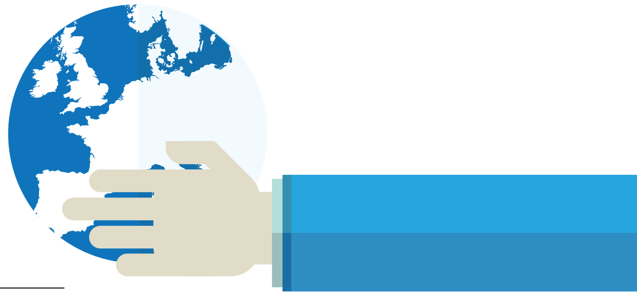
Table 1 - Free allocation and estimated emissions in Phase IV ($MtCO_2$) 50
Table 2 - Comparison of various allocation mechanisms 55
Table 3 - Example of thresholds and rates for tiered allocation 58
Table 4 - Trading tackling carbon leakage beyond Europe 67

CHAPTER 4

Table 1 - Impact of the inclusion of road transport in the ETS on sectoral burden sharing 74
Table 2 - General data on passenger vehicles in the EU-28 75
Table 3 - Covering GHG emissions from road transport beyond Europe 79

CHAPTER 5

Table 1 - Comparison of Reference scenario and concrete EE measures scenario 89
Table 2 - Phase III auction revenue forecasts 94
Table 3 - Phase IV auction revenue forecasts 94
Table 4 - Design features of the revenue spending model in California, RGGI, and Québec 100
Table 5 - Standardised reporting units to measure impact of RGGI revenue investments 105



INTRODUCTION

EXPLORING THE EU ETS BEYOND 2020: A FIRST ASSESSMENT OF THE EU COMMISSION'S PROPOSAL FOR PHASE IV OF THE EU ETS (2021-2030).

Challenges for the decarbonisation of energy and heavy industrial sectors in the period leading to 2030 are significant. The coming decade (2020-2030) will be a critical period for the transition towards a low-carbon economy. During this time, carbon intensive technologies and infrastructure will begin to be phased out at a significant scale to make way for low-carbon alternatives. With the release of the European Commission's Communication on a 2030 policy framework for climate and energy in January 2014 and the proposal for a revised European Union Emissions Trading Scheme (EU ETS) directive in July 2015, the European Commission has provided a new roadmap for the decarbonisation of European energy and industrial sectors beyond 2020.

The design of the new 2030 energy and climate package and revised EU ETS directive for Phase IV is essential to drive strategic public and private decision-making. In October 2014, the European Council endorsed a binding EU target to reduce greenhouse gas (GHG) emissions by at least 40% by 2030 compared to 1990 levels. Member States have confirmed that the EU ETS will remain the primary European instrument to achieve the GHG emissions reduction target as cost-effectively as possible. In fact, ETS sectors are expected to reduce their emissions by 43% by 2030 compared to 2005. To achieve this target, the EU ETS directive is being revised for the post-2020 period. Several changes have already been put forward, including: an updated linear reduction factor for the emissions cap which will decrease by 2.2% annually from 2021 onwards; the introduction of the Market Stability Reserve; the continuation of free allowances and the implementation of solidarity mechanisms as well as an Innovation and a Modernization Fund.

The proposal for a revised EU ETS Directive submitted in July 2015, transposing the European Council conclusions of October 2014, was part of a "summer package" of legislative proposals to help transform the European energy system (which includes a revision of the directive on the energy labelling of appliances, a public consultation on energy market design, etc.) and is part of the EU ETS' third reform. After the adoption of the backloading measure in February 2014 and the Market Stability Reserve (MSR) legislation in September 2015, the revised EU ETS Directive will define EU ETS operating rules for the 2021-2030 period to recalibrate and strengthen its efficiency.

After a decade of operation, guaranteeing the effectiveness of the EU ETS and its carbon price remains a key challenge to Europe successfully decarbonising the power sector and other heavy industrial sectors. The lessons learned from Phases II and III (2008-2020) of the EU ETS implementation during its Phases II and III (2008-2020) highlight the complexities of establishing an effective long-term carbon price signal.

In view of the debate on the revision of the EU ETS, the COPEC report aims to prepare economic policy makers by providing, over five chapters, new analyses on major challenges to the successful implementation of Phase IV of the EU ETS:

1. **Defining a CO_2 reduction target** that is in line with other energy policies such as Renewables and Energy Efficiency;
2. **Adjusting the supply of auctioned allowances with the Market Stability Reserve** to manage interactions with complementary policies;
3. **Addressing carbon leakage risk** with free allocation;
4. **Extending the EU ETS scope** to include emissions from the road transport sector;
5. **Financing the low-carbon transition** using various funding mechanisms based on auction revenues.

In each chapter, the COPEC report details lessons from Phase II and III of the EU ETS based on ex-post assessments. Then, based on the POLES-Enerdata model, the report assesses different scenarios for the implementation of the EU ETS in 2030 to formulate recommendations for the design of Phase IV. In addition, in the last section of each chapter, the report provides a table examining how emissions trading schemes beyond Europe tackle or overcome design challenges.

CHAPTER

1

THE EU ETS EMISSIONS REDUCTION TARGET AND INTERACTIONS WITH ENERGY AND CLIMATE POLICIES

Authors: Matthieu JALARD, Lara DAHAN and Emilie ALBEROLA (I4CE – Institute for Climate Economics), Sylvain CAIL and Kimon KERAMIDAS (ENERDATA)[1]

KEY MESSAGES

- ***Introduction to the proposal for a revised EU ETS directive based on the European Council agreement*** - The -43% of CO_2 emissions reduction EU ETS target and the linear reduction factor reduced at 2.2% from 2021 onwards correspond to a net additional reduction of 556 $MtCO_2e$ of the cumulative emissions cap by 2030. In addition, the European Council enforced in a binding EU target of at least 40% GHG reduction compared to 1990, a binding EU target of at least 27% Renewable Energy Sources (RES) in final energy, and an indicative EU target of at least 27% energy efficiency improvement compared to 2007 baseline - both without any binding targets for individual Member States.

- ***In the EU 2020 energy & climate package, renewable energy policies account for a large share of emissions reductions but do not contributed significantly to the increasing surplus, in contrast to the impact of energy efficiency policies and offsets which were not factored into the cap*** - The surplus undermined the EUA price incentive which seems to have played a weak role, giving however a strong incentive for the 1.2 billion tons of CO_2 emission reductions outside the EU ETS through Kyoto credits (CDM-JI). Steering technology developments in storage and demand response, together with more market based renewable supports and a targeted power market design are likely to enhance the ability of the EU ETS to drive emissions cost effectively in the power sector.

- ***Updated effort sharing among ETS sectors with the revised ETS target*** - According to POLES-Enerdata modeling results, the power sector would be responsible for 73% of total CO_2 emission reductions achieved in the ETS between 2013 and 2030 (556 $MtCO_2e$). This corresponds to a 411 $MtCO_2e$ reduction and a 35% decrease over the period considered. Among other sectors, the industry and the upstream and refining sector would also contribute to an additional 150 $MtCO_2e$ in emission reduction.

- ***Impacts of the new target on EUA prices*** - The CO_2 price path necessary to achieve 2030 EU ETS targets could reach around €$_{2010}$71/tCO_2 in 2030. In non-ETS sectors, like road transport sector, a carbon value of €$_{2010}$ 274/tCO_2 is necessary to incentivise sufficient reductions that could achieve a 40% reduction in emissions relative to 1990 levels.

- ***EU ETS Interaction with other energy policies*** - The unique GHG emissions reduction target is sufficient to achieve a 27% share of RES in gross final consumption. Attaining the target for energy efficiency would require the implementation of costly energy saving measures. As a consequence, ETS sectors are less constrained and increase their emissions per unit of output compared to the GHG only scenario to reach the overall -40% emissions objective. Therefore the ETS carbon price is reduced significantly around €$_{2010}$10/tCO_2 in 2030.

1. This chapter on the EU ETS emissions reduction target and its interaction with energy policies is based on analysis developed in the COPEC research program workshop organized on September 26th 2014 and results from academic research.

This chapter introduces, in section 1, a synthesis of the European Commission's proposal on the 2030 Framework for climate and energy policies. Section 2 provides an analysis on the extent energy policies that support Renewable Energy Sources (RES) and Energy Efficiency (EE) targets, complementary to the Greenhouse Gas Emissions (GHG) target have impacted the European Union Emissions Trading Scheme (EU ETS) and the consequences in terms of dealing with the European allowances (EUA) surplus until 2030. Then, using POLES modeling results, section 3 presents two scenarios for the EU ETS and their potential impact on EUA prices, on additional investment costs and the effort sharing between EU ETS sectors leading to 2030. Lastly, section 4 provides an overview of how three other emissions trading schemes in the world manage their GHG emission reduction target.

1. SUMMARY OF THE EUROPEAN COMMISSION'S PROPOSAL FOR 2030

The 2020 energy and climate package has been effective in achieving targets but its cost-effectiveness can be put to question

Over the past twenty years, European energy and climate policies have progressively converged in a uniform framework. European Union (EU) energy policies, which have been defined as a balance between three pillars, security of supply, competitiveness, and environmental protection, have first endeavored to create the basis for internal electricity and gas markets, as stated in the Directives 1996/92/EC and 2003/54/EC. The Third Energy Package adopted in 2009, was a way forward to continued liberalization and the integration of energy markets planned for 2014. However, since the mid-2000, policy focus has shifted to climate and environmental objectives. The EU has committed to reduce its GHG emissions by 8% from 2008 to 2012, compared to 1990, through the signature and the ratification of the Kyoto Protocol. As a result, the EU implemented the Emission Trading Scheme (ETS) through Directive 2003/87/EC, which aims to cap emissions from industrial facilities and power plants and allows covered entities to trade emission allowances. For sectors not covered by the EU ETS, where non-price barriers to emissions reductions prevail, Member States were allocated emission reduction targets.

For the first time, in 2007, the European Council approved an "integrated climate and energy policy," which enforced the so called "2020 climate-energy package", and set out the "20-20-20" targets which aim to: (i) reduce GHG emissions by 20% by 2020 compared to 1990; (ii) save 20% of EU energy consumption by 2020 compared to a baseline (2007 PRIMES Reference scenario projection); and (iii) achieve a 20% share of renewables in EU final energy consumption. The distinction between ETS and non-ETS sectors was maintained. Directive 2009/29/EU extended the EU ETS until 2020, and the Effort Sharing Decision distributed efforts mitigation between Member States. For non-ETS sectors this was done according to per capita income. according to their per capita income for non-ETS sectors. Directive 2009/28/EC enforced binding renewable energy targets for each Member State according to their starting point, their potential, and their economic circumstances.

There is no doubt that the 2020 framework has been effective: the EU is on its way to achieve a 24% CO_2 emission reduction by 2020, a 21% share of RES, and a 19% improvement in energy efficiency.[2] However, as developed in section 2, concerns have been raised stating that the cost-effectiveness of the proposed framework could be improved and that tradeoffs between targets and objectives were not been sufficiently identified and addressed. Interactions between various economic instruments have in some ways undermined the ability of the EU ETS to drive emissions reductions efficiently. The fragmentation of policies to promote renewable generation, and the promotion of non-market based supports has led to costly deployment of renewables and undermined the functioning of power markets (Roques, 2014). Evidence is also mounting that the design of the power market implemented since the 1996 Directive is not consistent with promoting low carbon technologies and can conflict with security of supply (OECD 2015, IEA 2014).

The 2030 energy and climate package: towards a stronger focus on cost-effectiveness and security of supply in the energy union framework

In 2013, the European Commission initiated a policy dialogue through a Green Paper on the framework for climate and energy policies.[3] The objective

2. European Commission, (EC) *EU Energy, Transport and GHG Emissions Trends to 2050*. 2013.
3. EC, *A framework for 2030 energy and climate policies,* Green Paper, 2013.

was to draw lessons from the 2020 framework and analyze how tradeoffs and conflicts could be managed more effectively. Discussions focused on whether a GHG emission reduction target alone would be preferable, or whether multiple targets should be pursued using various instruments. Other issues discussed were the value and nature of the targets whether they should be binding or solely indicative, and how efforts should be allocated among Member States.

Leading on from these discussions, the European Commission published the Communication "*A policy framework for climate and energy and energy in the period from 2020 to 2030*" in 2014.[4] The proposal put forward three objectives, that follow up on the 20-20-20 strategy and by 23rd October 2014, the European Council agreed on the following 2030 EU climate and energy targets:[5]

- A binding EU target of at least 40% GHG reduction compared to 1990;
- A binding EU target of at least 27% RES in final energy, and no binding targets per Member States were set out;
- An indicative EU target of at least 27% energy efficiency improvement compared to 2007 baseline (PRIMES Reference scenario projection) - without any binding targets for individual Member States.

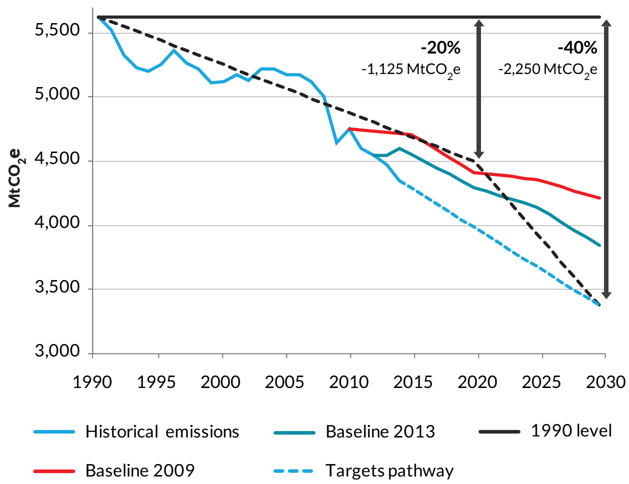
As far as economic instruments, a well-functioning and reformed EU ETS was confirmed to be the primary instrument to achieve the EU emission reduction target in a cost-effective manner. Effort sharing between Member States will be allocated in 2016, with guidelines stipulating that all Member States should participate in the effort, balancing considerations of fairness and solidarity. A new governance framework was also proposed, based on national plans for competitive, secure and sustainable energy as well as a set of key indicators to assess progress over time. The European Council agreed that a reliable and transparent governance system will be developed to help ensure that the EU meets its energy policy goals.

The 2030 framework marks an inflection point in energy and climate priorities in the ever-changing international context, featured by a widening energy cost differential between international competitors and a slow and uncertain economic recovery. International climate change talks and global cooperation are still uncertain, which can make unilateral European action more costly. The crisis in the Ukraine highlighted that high reliance on Russian gas (more than 30% of EU consumption) can be a threat to energy security. This changing framework entailed a paradigm shift to climate policies that enhance growth and cost-effectiveness. This translates into setting renewable energy targets that reflects cost effective pace of deployment, completing the internal energy market,[6] as well as allowing for more market-based renewable energy deployment,[7,8] along with European led RES industry policy in the Strategic Energy Technology (SET) plan. The framework also places a strong emphasis on energy security, which is now the cornerstone of the Energy Union strategy released in February 2015.[9]

A central EU greenhouse gas emissions target by 2030

A 40% emission reduction compared to 1990 was endorsed, representing a 2,250 $MtCO_2e$ emission reduction compared to 1990. This objective is in line with the 2050 roadmap which proposes 40%, and 60% reductions by 2030 and 2040 as milestones on the way to reaching the lower-end objective of an 80% emissions reduction by 2050.

Figure 1 - EU GHG emissions and targets to 2030.



Source: I4CE – Institute for Climate Economics, based on European Commission and Eurostat data 2015.

4. EC, *A policy framework for climate and energy and energy in the period from 2020 to 2030*, 2014.
5. EC, *Conclusions on 2030 Climate and Energy Policy Framework*, 2014.
6. EC, *Progress towards completing the Internal Energy Market*, 2014.
7. EC, *Delivering the internal electricity market and making the most of public intervention*, 2013.
8. EC, *Guidelines on State aid for environmental protection and energy* 2014-2020, 2014.
9. EC, *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*, 2015.

A continued distinction between ETS and non-ETS sectors has been delineated. The ETS cap will decrease by 2.2% from 2020 onwards to reach a target of -43% by 2030 compared to 2005, whereas it is decreasing by 1.74% from 2013 to 2020, to achieve the 2020 target of a 21% reduction. Non-ETS sectors have a target of -30% reduction by 2030 compared to 2005.

A binding EU renewable energy target for 2030 at least cost

The 2030 energy and climate framework focuses on reducing the cost of integrating RES into the energy mix in spite of potentially slowing down the deployment of renewables as a result.

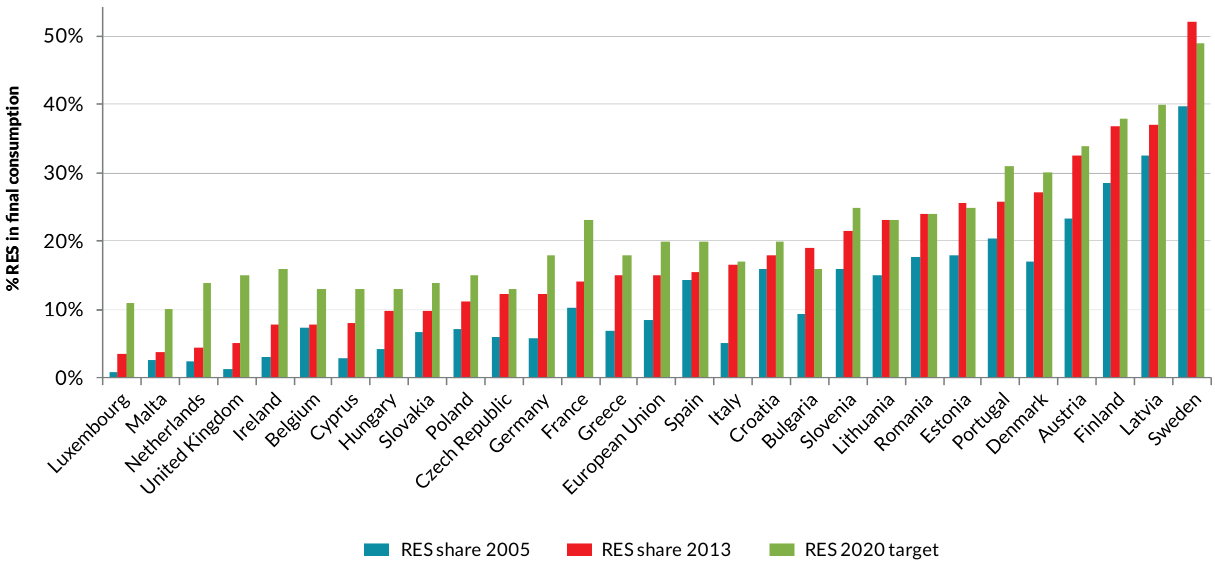
Firstly, the 2030 RES target corresponds to the model-based cost efficient target: given a 40% emission reduction target, the least cost pathway is estimated to achieve 27% renewable production in final energy consumption. Conversely, the 2020 framework's Impact Assessment set the emissions target as well as the renewable energy target exogenously. 2020 targets were also set for electricity generation (34%), energy use in transport (10%) as well as heating and cooling (21%). It gave rise to effective support mechanisms that helped to reduce risk and uncertainty, lower capital cost for the projects, and move up the learning curve. As such, a very prescriptive framework was set to ensure renewable energy deployment in all parts of the energy system and to give a clear vision to investors that renewable energy would be at the center of energy policy.

Second, national binding targets where set in the 2020 framework as illustrated in Figure 2, highlighting that strong progress has been achieved since 2005 – despite some Member States still lagging behind such as France, Netherlands, Belgium, and the United Kingdom.

Much more flexibility is afforded to Member States in the 2030 framework so as to facilitate the development of the most cost effective strategies that capitalize on national circumstances and regional potentials. National action plans should be finalised in advance of 2020 and the EU Commission committed to proposing a new Renewable Energy Package in 2016/2017. This will also include a new policy for the sustainable development of biomass and biofuels. The Energy Union package calls for more market-based deployment of renewables, in the framework of a revised electricity market designed to accommodate low carbon and capital intensive technologies.[10]

This least-cost renewable energy target will entail a continuation of a 0.70% trend in the yearly increase of the share of renewable energy observed since 2008. However, in absolute terms, as final energy consumption is expected to decrease over the period, a significant lower pace of renewable deployment is anticipated, from 5% in 2014-2020 to 2% in the 2021-2030 period, as described in Figure 3.

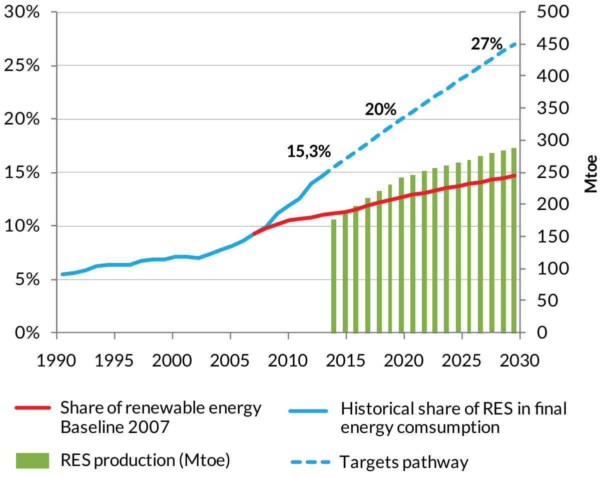
Figure 2 - Achievement of 2020 RES targets by Member States.



Source: I4CE – Institute for Climate Economics, based on European Commission and Eurostat data 2015.

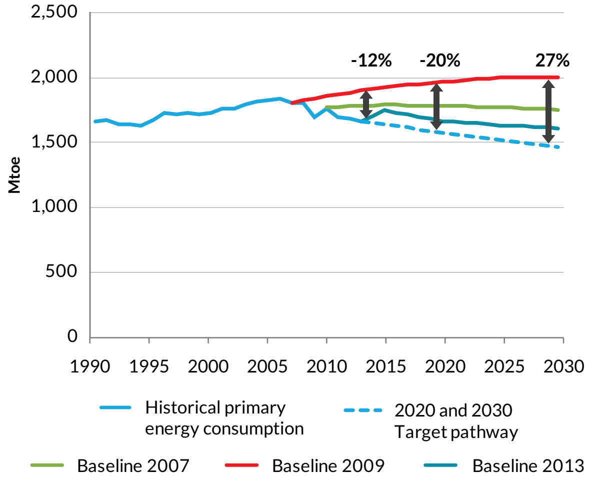
10. EC, *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*, 2015.

Figure 3 - Share of renewable energy in final energy consumption.



Source: I4CE – Institute for Climate Economics, based on European Commission and Eurostat data 2015.

Figure 4 - Energy efficiency targets relative to baseline scenarios.



Source: I4CE – Institute for Climate Economics, based on European Commission and Eurostat data 2015.

A non-binding EU energy efficiency target for 2030

The European Commission highlighted that, based on current national plans, the EU is on track to achieve energy savings of around 18-19% by 2020, of which one third will be due to the lower growth than expected. Tangible results have already been achieved with energy efficient buildings, labelling and performance standards. If all Member States implement the agreed legislation in a timely manner, the 2020 target could be achieved without the need for additional measures.

In its 2014 communication on the 2030 framework (released in January), the European Commission first proposed a non-binding target to conserve 25% of primary energy consumption compared to 2030 consumption levels from the 2007 PRIMES Reference scenario. Following requests from the European Council[11] in June 2014, the European Commission undertook further analysis on energy efficiency measures in light of the new priority given to energy security. While an energy efficiency target of 30% would increase the costs of the energy system by €20 billion (bn); it could also deliver substantial economic and security of supply benefits and would be a right balance between costs and benefits.[12] In October 2014, the EU Council eventually agreed on a non-binding target of 27%, subject to be reviewed in 2020 that will consider a higher target of 30%.

The Energy Union's package put a great emphasis on the potential for energy efficiency in buildings and transport, and proposed to review all relevant legislation that could underpin the 2030 target. As part of the summer package[13] in July 2015, a new proposal was released to revise the energy efficiency labelling scheme and enhance its clarity for EU consumers.

2. EU ETS EMISSIONS TARGET AND INTERACTIONS WITH ENERGY POLICIES: LESSONS FROM THE 2020 ENERGY AND CLIMATE PACKAGE

Several lessons can be drawn from the 2020 energy and climate framework.

- Firstly, the EU ETS has provided an EU-wide carbon price signal revealed by the EU ETS which complements the internal energy market.
- Secondly, renewable support policies have succeeded in overcoming strong market barriers, resulting in increasing their penetration share and a fall in the costs of these technologies from €5/W in the beginning of the century to €0.5/W in 2014 for photovoltaic. At the same time however, policy interactions have not been managed effectively, leading to a surplus undermining the EU ETS. Poorly designed support schemes for renewables have not been reconciled with the market integration agenda, unnecessarily increasing the cost of renewable deployment for the energy system and jeopardising security of supply.

11. EC, EUCO 79/14, June 27th 2014.
12. EC, *Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy*, 2014.
13. EC, *Transforming Europe's energy system*, 2015.

Interactions between policies have undermined the ability of the EU ETS to drive emission reductions cost effectively

It is widely acknowledged that, complementary policies spurring emissions reductions under the umbrella of the cap reduce the demand for allowances, and drive down the carbon price (Stavins 2014, Zachmann 2012). As such, less abatement is triggered via the carbon price at the margin, offsetting the emissions reduction driven by complementary policies. If the latter are more costly, then the complementary polices are said to increase the overall cost of abatement in the short run.

Fischer and Peronas (2010) consider the theoretical effects of overlapping policies with an emissions cap. They find that when emissions are capped, overlapping policies decrease allowance prices. This result is also shown by Bohringer and Rosendahl (2010). These theoretical results are supported by various empirical studies as well. Bohringer and Keller (2011) show in their Computable General Equilibrium (CGE) analysis of the 2008 energy and climate package that a restrictive renewable energy target drives down the carbon price in the ETS sector by 50% and by an even greater share in the case of a simultaneous implementation of 20-20-20 targets.

Ex-ante assessment of interactions with the EU ETS: RES deployment accounts for 40% of the EU ETS abatement effort, but was factored in the emissions cap unlike offsets and energy efficiency

The impact assessment provided by the European Commission for the 2020 energy and climate framework[14] in 2008, gives further insights on the impact of the different complementary policies on the EU ETS. Projected emissions from EU ETS sectors in the 2007 baseline scenario were of 2,477 $MtCO_2e$ in 2020, compared to a cap of 1,816 $MtCO_2e$. The cumulative reduction effort for ETS sectors amount to 5 $GtCO_2e$ over the period from 2008 to 2020.

On the same basis and the same period, I4CE – Institute for Climate Economics (Berghmans, 2012) concludes that:

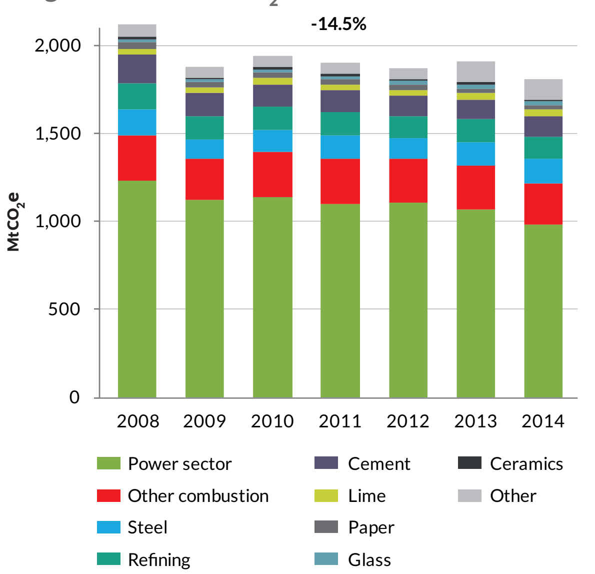
- About 2 $GtCO_2e$ are reduced through renewable energy deployment stimulated by the RES directive and targets.
- The addition of the new energy efficiency directive adds 500 $MtCO_2e$ of CO_2 emissions reduction in the scope of the EU ETS – not taken into account in the initial cap setting – and bringing the reduction needs about 2.5 $GtCO_2e$, or only 50% of the effort.
- By allowing Kyoto credits in the EU ETS in the period up to 1.65 $GtCO_2e$ (Bellassen *et al.*, 2011), the residual need to reduce domestic emissions in the EU ETS is estimated at 900 $MtCO_2e$, or only 18% of the effort.

In addition to contributing to abatement, it is worthwhile noticing that RES developments were taken into account in the ex-ante cap setting, not factoring in the impact of the Energy Efficiency Directive and international offsets.

Mid-term assessment of interactions with the EU ETS: more than 50% of the interaction impacts on surplus could have been avoided with an exhaustive ex ante assessment

Overall, EU ETS emissions reached 1,812 $MtCO_2e$ in 2014. As descripted in Figure 5, EU ETS emissions have decreased by 14.5% since the beginning of Phase II (2008-2014) when they amounted to 2,120 $MtCO_2e$. The decrease in CO_2 emissions has been particularly sharp in the power sector (-20.5%) driven by a decrease in demand, the large progresses made in terms of energy efficiency, and the penetration of RES, achieving 32.2% of EU ETS countries generation in 2014.

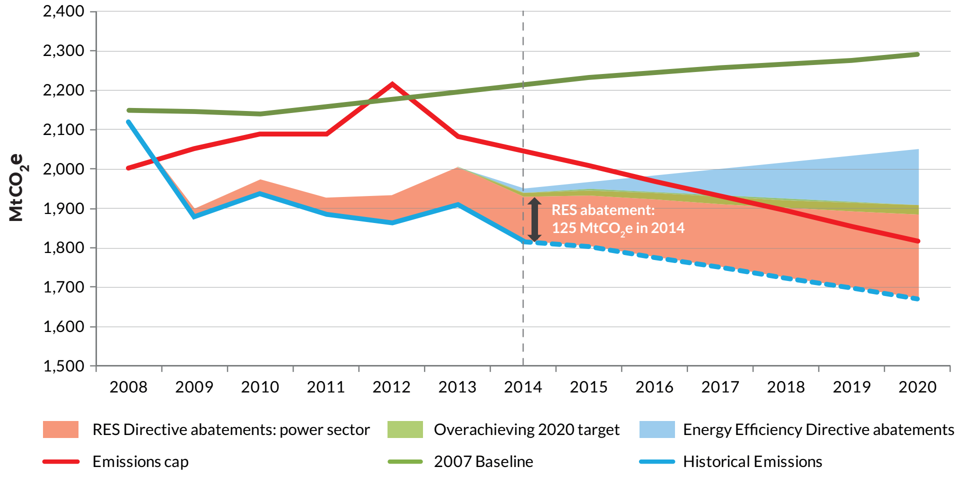
Figure 5 - EU ETS CO_2 emissions from 2008.



Source: I4CE – Institute for Climate Economics, based on EU ETS data 2015.

14. EC, *Impact Assessment - Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020*, 2008.

Figure 6 - Baseline, cap and emissions in EU ETS Phases II and III.



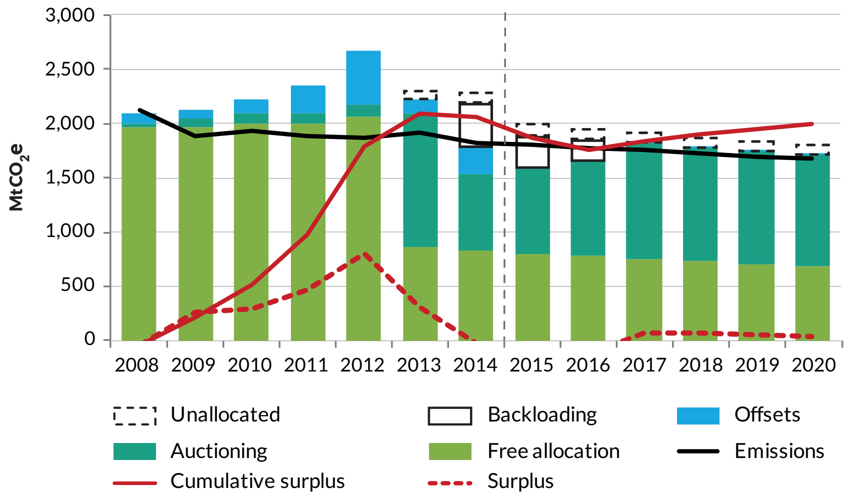
Source: I4CE – Institute for Climate Economics, estimations based on European Commission data 2015.

In 2014, CO_2 emissions are already below the 2020 emission cap of 1,816 $MtCO_2e$ and 300 $MtCO_2e$ lower than the 2007 baseline when the cap was calibrated. A mid-term assessment estimates that RES deployment has had a strong impact on emissions reduction but a low impact on the EUA surplus. Indeed, as presented in Figure 6, a counterfactual scenario based on a modelling of EU power sector without any further RES deployment after 2008 estimates that at least 125 $MtCO_2e$ were avoided in 2014 in the power sector due to the RES directive (390 $MtCO_2e$ in cumulative since 2008, and more than 1,400 $MtCO_2e$ in Phase II and III). However, these abatements were accounted for in the cap setting, and only the overachievement of the RES target may contribute to the surplus. The penetration of RES achieved 28.6% in EU-28, slightly in advance to achieve the 34% target in 2020, and the effect on the market surplus is for the moment quite negligible (roughly 10 $MtCO_2e$). Cumulatively, it is estimated to account for 120 $MtCO_2e$ in Phase III.

Abatements linked to the Energy efficiency Directive are estimated to amount to roughly 20 $MtCO_2e$ in 2014, and are estimated to reach 150 $MtCO_2e$ for the year 2020 alone (500 $MtCO_2e$ cumulatively). Therefore up until now the impact has been limited. The cumulative inflow of international credits has amounted to 1,437 $MtCO_2e$ and has played a significant role in the accumulation of the large cumulative surplus in the market amounting to 2.1 $GtCO_2e$ in 2014.

The Figure 7 shows that surplus is likely to remain high until the end of Phase III[15] even if backloaded allowances don't flow back into the market.

Figure 7 - EU ETS supply/demand balance in 2014 and projections until 2020.



Source: I4CE – Institute for Climate Economics, estimations based on European Commission data 2015.

15. Assuming a 1.4% yearly production increase in industrial sectors, 0.6% in power sector, the achievement of RES target in 2020, and without the implementation of the MSR.

Table 1 - Contributing factors to the accumulation of the surplus from 2008 until 2014 and 2020 ($MtCO_2e$).

	Energy Efficiency Directive	Kyoto Off-sets	Total surplus complementary policies not considered in the cap	Downturn and other abatements	RES over Achievement of the 2020 RES target	Total surplus linked to unforeseeable developments	Back-loading	Unallocated EUAs	Total EUA surplus
2014	20	1437	1,457	1,217	10	1,227	-400	-208	2,066
2020	500	1505	2,005	1,900	120	2,020	-900	-881	2,124

Source: I4CE – Institute for Climate Economics, based on European Commission data 2015.

In 2014, the EU ETS was balanced for the first time since 2008, but this was due to the withdrawal of 400 million backloaded allowances and 110 million unallocated allowances. Otherwise, surplus would have reached 500 $MtCO_2e$ in 2014, increasing the cumulative surplus to 2.6 $GtCO_2e$.

Following these results, it is possible to estimate the contribution of different energy and complementary policies on the accumulation of the surplus, as outlined in Table 1. It appears that more than half of the impact of complementary polices on surplus (1,457 $MtCO_2e$) could have been avoided with an exhaustive ex ante assessment, whereas uncertainties underlying the demand side (overachievement of policies, downturn) have contributed only 1,200 $MtCO_2e$ to the surplus. Different adjustments (backloading and unallocated allowances) could decrease the supply by only 608 million allowances within this timeframe.

Impact of complementary policies: the EU ETS has played a residual role in emissions abatement up until now

This short term surplus, combined with the myopia of market participants and low confidence in the market has led to a fall in prices from €15/tCO_2e in 2011, to a price range of €3 - €8/tCO_2e in the 2013 - 2015 period (as shown in Figure 8). Prices have been unable to drive significant operational abatements in the power sectors, where the switch price between coal and gas generation is about €40/tCO_2e,[16] and great abatement potential remains unused. Low and highly volatile carbon prices have largely undermined the EU ETS's ability to drive investments in the development and deployment of low carbon technologies which require a credible long term price signal, consistent with the lifetime of investments.

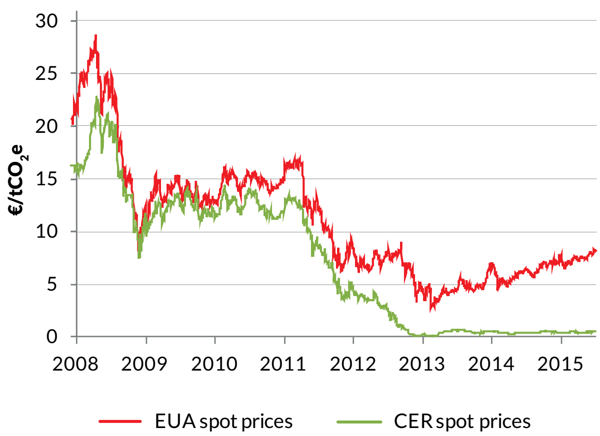
As such, the EU ETS, which was expected to be the cornerstone of the energy and climate policy, has become a residual market and has played a weak role in achieving significant emissions reduction up until now. I4CE – Institute for Climate Economics' analysis (Gloaguen *et al.*, 2013) highlights that compared to a counterfactual scenario from 2005 to 2011 more than 1 billion tons of CO_2e have been reduced in the EU ETS (as shown Figure 9), of which:

- 50% were encouraged through 2020 RES and EE policies, and
- 50% result from the economic context: economic downturn and primary energy prices.

However, there was a strong incentive for the 1.2 billion tons of CO_2e emission reductions made outside the scope of the EU ETS through Kyoto credits (CDM-JI).

When focusing on the electric sector covered by the EU ETS, the analysis of CO_2 emissions reduction factors (Berghmans *and al*, 2014) confirms the role played by economic conditions.

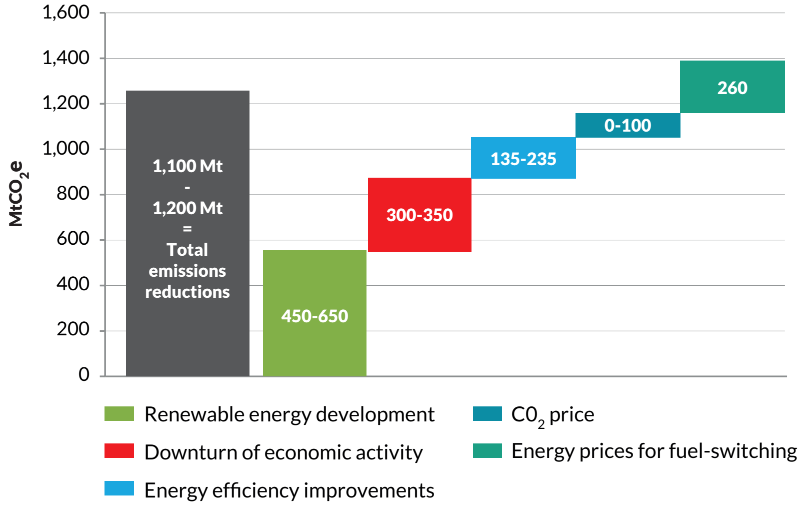
Figure 8 - EUA and CER prices from the beginning of Phase II.



Source: I4CE – Institute for Climate Economics, based on I4CE data 2015.

16. Calculated on a monthly basis in Tendances carbone, I4CE – Institute for Climate Economics.

Figure 9 - Contributions to CO_2 emissions reductions between 2005 and 2011.



Source: I4CE – Institute for Climate Economics, 2013.

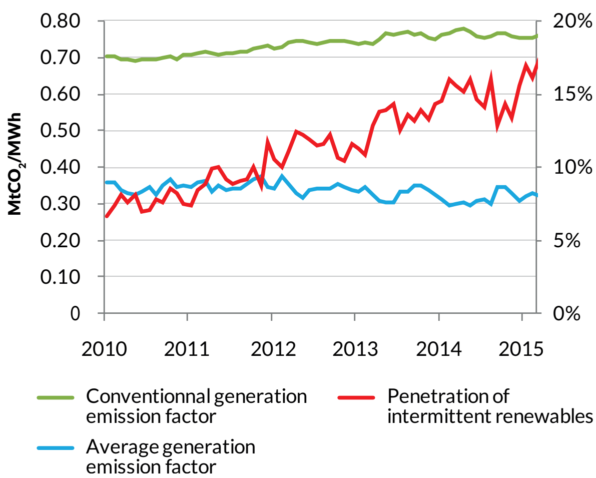
Indeed, the economic crisis and changes in primary energy prices largely influenced CO_2 emissions from the electricity sector, as well as support policies for renewables between 2005 and 2012. The study also reveals that other regulations have influenced emissions such as the carbon price in the EU ETS and the directive known as Large Combustion Plant (LCP). The energy efficiency of power plants also appears to have had an impact on emission reductions: for gas-fired and coal, the oldest plants (less efficient) have emitted more than the most recent plants.

Most RES abatements have been offset by an increase in coal generation

Since 2008, the drop in EU ETS prices has given further competitive advantage to coal generation in a context of falling coal prices and growing gas prices. While renewable energy generation (excluding hydro) has grown from 6% to 17% of monthly power generation from January 2010 to January 2015, the average carbon intensity of conventional power generation in the EU ETS countries has increased from 0.70 to 0.75 $MtCO_2e$/MWh. As such, while investments in the deployment of high abatement cost technologies (Marcantonini, 2013) have grown in Europe, the average emission factor of generation has only slightly decreased, from 0.35 to 0.32 $MtCO_2e$/ MWh in five years as described in Figure 10.

Coal generation has increased in Germany, from 130 TWh in 2010 to 148 TWh in 2014, putting pressure on the country to achieve its emission reduction target by 2020. In 2015, Germany had no choice but to enforce the closure of more than 3.2 GW of lignite generation, giving rise to stranded costs. Similarly, the UK, on risk to achieve its emission target and in order to deter investments in coal generation in the coming years, has put in place a carbon floor price.[17] Continued dysfunction of the carbon price signal is likely to spur further fragmentation of approaches to decarbonise the European power sector.

Figure 10 - Evolution of the emission factor and the share of intermittent renewable energy generation (EU ETS).



Source: I4CE – Institute for Climate Economics based on ENTSOe data, 2015.

17. The UK's Carbon Price Floor increased from £9.54/tCO_2e to 18.08/tCO_2e in April 2015, and the total carbon price, including the EU ETS price, payable by UK power stations is about €30 to €35/tCO_2 in 2015.

The way forward 2030: closing in on the efficiency frontier

Based on lessons from the 2020 energy and climate package, four main recommendations could be defined in order to manage interactions between policies to reduce the cost of the various climate and energy policies and to get closer to the efficiency frontier in the 2030 framework.

Complementary policies are necessary to decrease the long term cost of decarbonisation

The negative interactions that have occurred in the 2020 framework do not imply that complementary policies are not necessary. Even though the EU ETS is the flagship of EU climate policies, and enables the delivery of an economy-wide price signal for sectors covered by the ETS, it cannot guarantee, as a standalone policy, decarbonisation at the lowest cost. Energy efficiency abatement potential comes at low cost and even negative cost, but is facing non-price barriers, like imperfect information, split-incentives, and risk aversion of households. Not exploiting the full potential of energy efficiency measures would increase the overall cost of decarbonisation (IEA 2011).

Besides, carbon prices are not always able to encourage sufficient innovation and diffusion of clean technologies because of the inability to appropriate the full benefits of innovation (so called technology spill-over market failures, Fisher 2013). This calls for public support to develop and deploy technology options to decarbonise a lower cost in the future.

Furthermore, there are several barriers to entry that hinder the integration of low carbon technologies in power markets: investments are capital intensive and carry high risk, in addition to the fact that the intermittency of these technologies can be a strong commercial handicap in the framework of power markets designed for conventional power plants.

These core complementary policies are necessary to decrease the cost of decarbonisation both in the short and the long run, and are likely to deliver a wide range of benefits in terms of energy security, public health, term of trade, technological expertise. However, the interactions between policies must be better managed in order to reduce the cost of the various climate and energy policies and to get closer to the efficiency frontier in the 2030 framework.

RES support should be geared more toward the development of innovative technologies in order to overcome barriers to entry in power markets and to enhance the carbon price signal

It has been argued that support for renewable has been excessively geared towards deployment subsidies, amounting to €48bn in the five largest EU countries in 2010, against 315 million in public spending dedicated to R&D in the same year (Zachmann, 2014). However, increased support for further innovation in RES technologies linked to storage, production forecasting, and demand-response could enable to reduce their balancing cost linked to intermittency. Combined with a targeted market design focusing on short term flexibility, this could enable a progressive removal of barriers to entry for renewable energy. To this end, a switch towards market-based supports and long term arrangements may enable investments in renewable energy to be market driven in the mid to long term. This will in turn enhance the role of the EU ETS as an EU-wide price signal to drive abatements in a cost-effective way. This would limit the scope of interactions with other objectives, and gives EU technological leadership as stated in the Energy Union Package - "Becoming the number one in renewables".[18]

An *exhaustive ex ante* assessment of all complementary policies is necessary to calibrate the EU ETS

Unforeseen events are inherent when calibrating an emissions trading scheme's cap. However in the 2020 EU energy and climate framework, energy efficiency measures and international offsets were not taken into account in the cap setting, although they account for nearly half of the abatement effort. This has been the main contributing factor to the accumulation of the surplus. As such, a thorough ex-ante analysis, which takes into account the whole spectrum of complementary policies is of paramount importance to improve the cost effectiveness of the EU ETS. Ultimately, all the complementary targets must be taken into account by the emissions cap, whose stringency should be increased accordingly.

18. EC, *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*, 2015.

Greater EU ETS flexibility is needed to adapt to uncertainties relating to complementary policies

Even if complementary polices are taken into account in the cap setting, they are likely to overachieve, or underachieve on their objectives, as it is the case for the renewable energy policy. In the 2030 framework, the achievement of a 55% RES target, overachieving by 7% the 2030 target, would lead to additional 860 $MtCO_2e$ cumulative abatement in the 2021 to 2030 period as illustrated in Figure 11. Conversely, if there is no more RES integration in the power system when the 34% target is reached in 2020, additional 1,320 $MtCO_2e$ would be emitted in the 2021 to 2030 period.

As such, the achievement of policies induces additional uncertainties concerning the future demand of allowances in addition to those regarding macroeconic trends and technology developments, and could lead to severe imbalances in the EU ETS subsequently undermining the investment framework. This calls for further flexibility in the supply of allowances in order to stabilise prices and expectations. The governance of the Energy Union, based on national plans focusing on energy efficiency improvements and RES deployment, and on the publications of indicators, can lay the basis of a dash board to oversee the EU ETS and how it interacts with other targets. This has to be complemented with ad hoc mechanisms adapting the supply accordingly. The correct balance must be found between improving predictability so as to increase investor confidence, and increasing flexibility for greater stabilisation. The Market Stability Reserve (MSR) has been proposed, and its efficiency at addressing this issue is analyzed in more detail in Chapter 2.

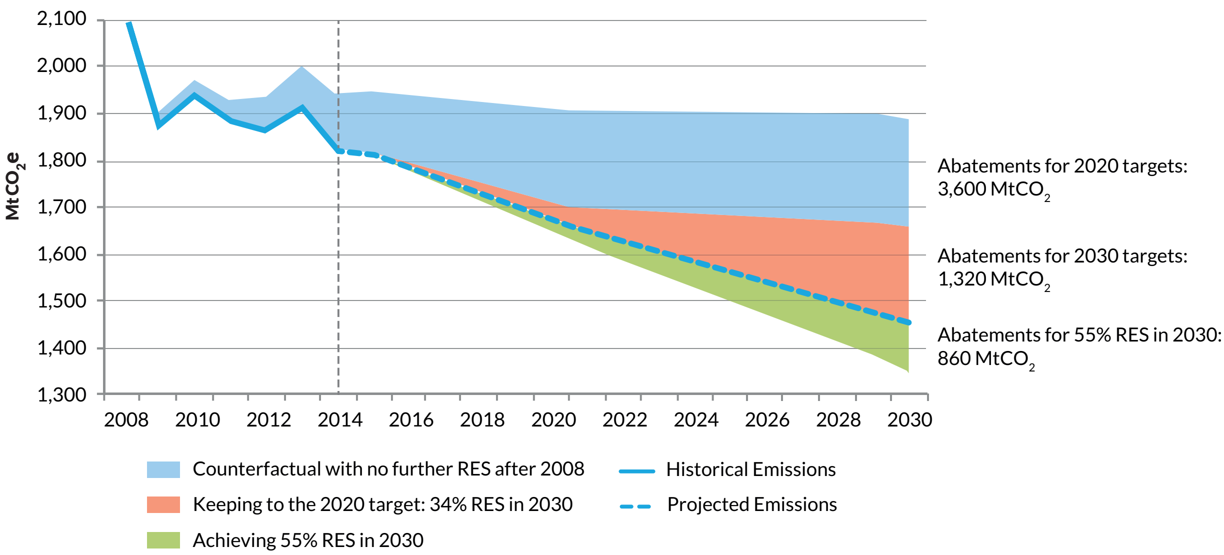
3. INTERACTIONS BETWEEN ENERGY AND CO_2 TARGETS: RESULTS BASED ON THE POLES MODEL

Defining the scenario and methodology

To assess the impact of individual energy and CO_2 targets by 2030 in the European Union, two scenarios are calculated using the POLES-Enerdata model (see Annex for a detailed description of the modelling approach, main assumptions and data sources):

- **COPEC GHG:** in this reference scenario, the only target considered is the reduction of emissions by 40% in 2030 compared to 1990 levels. This objective is split into two sub-objectives: -43% in the ETS, -30% for non-ETS sectors, both compared to 2005 levels.
- **COPEC Targets:** in this scenario, not only the emission reduction target is to be achieved, but also a 27% share of RES in gross final consumption and a 27% reduction of primary consumption (compared to the baseline derived from the PRIMES scenario in 2007, see e.g. EC, 2008).[19]

Figure 11 - Estimated EU ETS emissions based on different levels of achievement in RES policies.



Source: I4CE – Institute for Climate Economics, estimations based on European Commission data 2015.

19. For 2020, targets are defined at national level according to the countries' respective national allocation plans (NREAP and NEEAP). For 2030, targets are defined the European level and apportioned among countries according to the 2020 repartition.

Table 2 - Scenario definition and objectives for the analysis of interactions between targets.

2030	COPEC GHG	COPEC Targets	EC GHG40
Objectives			
GHG emission reduction (vs 1990)	-40.0%	-40.0%	-40%
RES share in gross final consumption	-	27.0%	-
Reduction of primary consumption	-	-27.0%	-
Achieved			
GHG emission reduction (vs 1990)	-39.2%	-39.6%	-40.6%
RES share in gross final consumption	28.6%	27.7%	26.5%
Reduction of primary consumption	-23.0%	-27.0%	-25.1%

Source: POLES – Enerdata model, 2015.

Both scenarios follow the same pathways leading to 2020 and the objectives for 2030 are illustrated in Table 2 along with the model results achieved after the simulation in POLES.

As observed, the renewable energy target of 27% is already achieved within the COPEC GHG scenario (28.6% in 2030), whereas the energy efficiency objective has not yet been met.[20] As a consequence, the COPEC Targets scenario raises the primary consumption reduction to 27% and assessing the consequences to the European energy system.

The methodological framework of POLES offers several leviers to approach the different objectives required:

- **Emission reductions:** the emission cap is defined for each year of the time period considered (linear reduction factor of 1.74%/year until 2020, then 2.2%/year) so as to meet the 2020 and 2030 objectives, and the resulting ETS price is observed. In non-ETS sectors, the emission reduction level is calibrated to achieve -40% in total in Europe vs. 1990.
- **Renewable energy sources:** support policies are implemented (feed-in tariffs and premiums, subventions). In the COPEC GHG scenario, support levels are maintained until 2020, and then stopped from 2021 onward.
- **Energy efficiency:** to achieve the energy efficiency objective, an “energy tax” is applied on all energy consumption outside the ETS.

More details about scenario assumptions are provided in the Annex.

Reference scenario results

In the COPEC GHG scenario, only the GHG emission reduction objective is implemented and achieved (39.2% reduction vs. 1990, the difference largely being the effect of offset credits). Table 3 provides an overview on several consumption, renewable energy and emission indicators for specific (2020 and 2030), and as growth rates over ten-year periods.

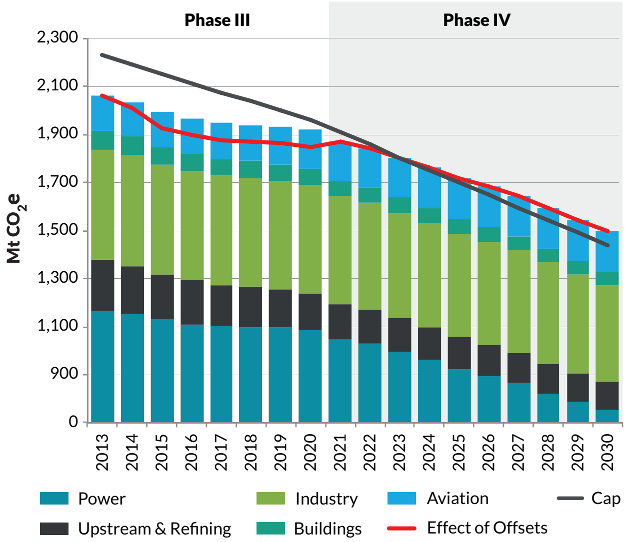
Most future indicators are in rupture with historical values. For example, while primary energy consumption had been increasing between 2000 and 2010, it is expected to decline until 2020 and thereafter. The efforts are also intensified in terms of energy intensity and carbon intensity. As for renewables, the figures show that the growth rate of RES installed capacities will not be as significant in the future as during the period 2000-2010. Despite this slowdown, the 27% European renewable objective should be met by 2030.

As a result of the emission cap to be followed in the ETS, Figure 12 illustrates the evolution of emissions in the different sectors. The power sector is responsible of 73% of total CO_2 emission reductions achieved in the ETS between 2013 and 2030. This corresponds to a 411 $MtCO_2e$ reduction and a 35% decrease over the period considered. Among other sectors, the industry and the upstream and refining sector contribute together to an additional 150 $MtCO_2$ reduction.

The carbon price path necessary to achieve these reductions is represented in Figure 13. In 2030, the carbon price in the ETS reaches $€_{2010}71/tCO_2$.[21]

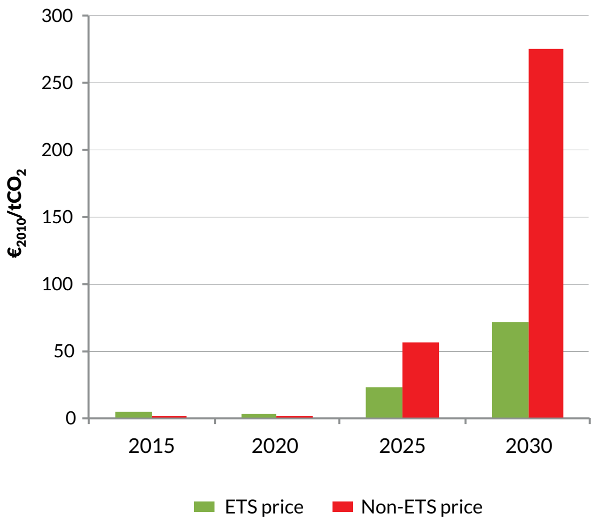
20. All POLES scenarios approach their defined objectives at the 2030 EU level. Modelling and calibration processes led to accuracy errors that result in differences between the initial targets and the final calibrated objective. This is also observed in studies where other models are used, including in the European Commission’s Impact Assessment.
21. In this chapter, the Market Stability Reserve of the ETS is not considered. The effects of its introduction from 2019 are analyzed in Chapter 2.

Figure 12 - Emissions from ETS sectors in the COPEC GHG scenario.



Source: POLES – Enerdata model, 2015.

Figure 13 - CO_2 price in the ETS and carbon value in non-ETS sectors in the COPEC GHG scenario.



Source: POLES – Enerdata model, 2015.

In non-ETS sectors, a carbon value[22] of $€_{2010}$274/tCO_2 is necessary to incentivise sufficient reductions aimed at fulfilling the objective of a global 40% reduction of emissions in the EU compared to 1990 levels.

Target scenario results

In addition to the COPEC GHG scenario, where both emission reduction and renewable objectives are met, the COPEC Targets scenario aims at increasing demand-side energy efficiency to achieve the 27% objective of the European Union by 2030. The additional energy efficiency objective necessitates the inclusion of ambitious policies, valuated at levels about four times larger than in the reference scenario (average energy efficiency value[23] of $€_{2010}$896/toe applied to energy consumptions of all non-ETS sectors, vs. $€_{2010}$236/toe in COPEC GHG, see Table 4).

Table 3 - General indicators: COPEC GHG scenario.

COPEC GHG	2020	2030	2000-2010	2010-2020	2020-2030
Primary energy			+0.2%	-0.8%	-0.5%
Energy efficiency	17%	23%			
Energy intensity			-1.3%/a	-2.1%/a	-1.9%/a
RES share in gross final consumption	21%	29%			
RES electric capacity			+6.0%/a	+4.9%/a	+3.1%/a
Emissions vs 1990	-23%	-39%			
Emissions ETS vs 2005	-22%	-40%			
Emissions non-ETS vs 2005	-16%	-32%			
Carbon intensity			-2.1%/a	-2.5%/a	-3.6%/a

Source: POLES – Enerdata model, 2015.

22. The carbon value reflects the global price signal (including e.g. price of permits, carbon tax, other regulations) required in non-ETS sectors to achieve the reduction targets.
23. The average energy efficiency value represents the global valuation of efforts (e.g. policies, retrofitting, technological shifts, energy tax, etc.) required to reach a given level of energy efficiency.

Table 4 - Economic indicators: COPEC GHG and COPEC Targets scenarios.

2030 projections	COPEC GHG	COPEC Targets
ETS CO_2 price (€$_{2010}$/tCO_2)	71	10
Non-ETS CO_2 price (€$_{2010}$/tCO_2)	274	16
Energy efficiency value (€$_{2010}$/toe)	236	896
Electric renewable support policy (€$_{2010}$/MWh)	12.0	12.0
Expenditure for energy (€$_{2010}$bn/a)	1,208	1,164

Source: POLES – Enerdata model, 2015.

The energy tax applied to non-ETS sectors contributes to a decrease of their emissions. As a consequence, ETS sectors are less constrained and increase their emissions per unit of output compared to the COPEC GHG scenario, to reach the overall -40% emissions objective. Therefore the need for a high ETS carbon price is reduced significantly in the COPEC Targets scenario. The implemented energy efficiency policies in non-ETS sectors contribute to reducing the carbon price signal needed in those sectors as well. The effect of the additional energy efficiency target can be assessed further in terms of total system costs. In the following each scenario is compared to a "no policy" counterfactual scenario and Table 4 gives an overview of additional costs (compared to this counterfactual scenario) for different components of total system costs.

The implementation of a 27% energy efficiency target by 2030 is in total more costly than the unique emission reduction objective, requiring a cost increase of approximately 180%.[24]

The unique GHG emission reduction target is sufficient to reach a 27% share of RES in gross final consumption. Attaining the target for energy efficiency would require the implementation of costly energy saving policies.

4. ETS DESIGN BEYOND EUROPE: INTERACTION WITH ENERGY TARGETS

As demonstrated, when developing a climate-energy policy package it is of paramount importance to consider how other energy policies and low carbon initiatives can impact carbon pricing. Even more important still, is to ensure that an overlap in policies does not lead to lower emission reductions than if there were only one policy in place. An efficient policy mix requires management across all policies to avoid overlap and duplication. All the examined ETSs below are supported by legislation that designates an authority to be responsible for the design, implementation and enforcement of climate/energy regulations. Through regular assessments, it is possible to determine the impacts of overlapping policies and correct them to enhance positive interactions.

Table 5 - Total costs in COPEC GHG and COPEC Targets scenarios.

€$_{2010}$bn/a 2011-2030	COPEC GHG Δ / Counterfactual	COPEC Targets Δ / Counterfactual
Investment in final demand	17.0	1.4
Investment in power generation	3.8	4.0
Renewable subsidies	0.0	0.0
Energy efficiency costs	0.0	52.8
Total cost indicator	20.8	58.2

Source: POLES – Enerdata model, 2015.

24. Total costs provided are based on compound cost indicators, not directly comparable with e.g. the European Commissions' output costs. All figure are given compared to a counterfactual scenario (with no policy objectives) and therefore provide indications on additional investments and costs for the implementation of the policies the scenario focuses on. The figures include investment per sectors, costs of energy tax implementation and renewables subsidies. These investments result in energy purchases savings and carbon tax avoidance.

Table 6 - Policy interactions in Emissions Trading Schemes beyond Europe.

	California				RGGI				(Repealed) Australia ETS			
Targets	**State-wide emissions reduction target**	**ETS-cap emission reduction target**	**State-wide renewable energy target**	**State Energy Efficiency Target**	**Federal emissions reduction target**	**ETS emission reduction target**	**RGGI States' renewable energy target**	**RGGI States' Energy Efficiency Target**	**National emissions reduction target**	**ETS emission reduction target**	**National Renewable Energy Target**	**National Energy Efficiency Target**
	Reduce emissions to 1990 levels by 2020.	Gradual reduction of 0.1% each year until 2015, 3% in 2016 and 3.5% in 2020.	33% electricity generation from renewables by 2020.	0.9% annual savings though 2020.	26-28% reduction in emissions by 2025 compared with 2005 levels.	45% reduction in CO_2 emissions from power plants by 2020 compared with 2005 levels.	-	-	-5% (unconditional) to -25% (conditional)-below 2000 levels by 2020.	Total emissions covered by the carbon pricing mechanism in 2012-13, minus 38 million tonnes.	20% renewable electricity supply by 2020.	10 years energy efficiency strategy.
% total Emissions Covered by ETS	85% of California's total GHG emissions.				85% of total RGGI state CO_2 emissions from fossil fuel consumption.				60%			
ETS Governing Authority & Mandate	The California Air Resources Board (CARB) is the state's delegated regulatory authority in charge of matters concerning air pollution. They report directly to the Governor's Office in the Executive Branch of the California State Government and are responsible for the design, implementation and management of the California cap-and-trade system.				Regulations are agreed upon by member states through an MOU prior to implementation. RGGI Inc, generally supports the development of RGGI by providing technical assistance, developing system reporting and offset protocols.				The ex-Climate Change Authority's role was to set targets, conduct independent research and govern mitigation policies while the Clean Energy Regulator administrates ETS policy, tracks ETS development and manages the supply of allowances.			
ETS central or Complementary Emission Reduction Policy?	Complementary policy 29% of the 2020 target is expected to be achieved by the ETS.				Central for GHG reduction within the energy sector and complementary to other individually implemented measures taken by states in renewable energy uptake and energy efficiency.				Intended to be central.			
Ex-Ante Impact Assessment	The analysis estimates of the overall costs, savings, and cost-effectiveness of the reductions, not only for greenhouse gases (GHGs) but also for co-pollutants; Estimates of the timing of capital investments and the resulting savings; Sensitivity of the results to changes in assumed conditions Impacts on small businesses.				REMI Macroeconomic Modelling and Integrated Production Modelling conducted Ex-ante and at scheduled review periods. Assessments focus on impacts on the energy and retail market.				The regulator employs consultants to review and conduct analysis annually which informs the design of the cap and target. This helps regulators tailor the cap to market conditions.			
Ex-Post Impact Assessment & Review Period	Every five years.				Every four years.				Annually.			

Source: I4CE – Institute for Climate Economics, 2015.

REFERENCES

Berghmans N, 2012, *Energy efficiency, renewable energy and CO_2 allowances in Europe: a need for coordination.* CDC Climat Research, Climate Brief n°18

Böhringer, C. and Keller, A, 2011, *Energy Security: An Impact Assessment of the EU Climate and Energy Package*. University of Oldenburg.

Böhringer, C., and Rosendahl, K, 2011, *Greening electricity more than necessary: on the cost implications of overlapping regulation in EU climate policy*. Schmollers Jahrbuch, pg. 131, 469-492.

European Commission, 2013, *EU Energy, Transport and GHG Emissions Trends to 2050*. Available at: http://ec.europa.eu/transport/media/publications/doc/trends-to-2050-update-2013.pdf

European Commission, 2014, *Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy.* Communication: Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52014DC0520

European Commission, 2014, *A policy framework for climate and energy and energy in the period from 2020 to 2030 - COM(2014) 15.* Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52014DC0015

European Commission, 2013, *Green Paper, A framework for 2030 energy and climate policies - COM(2013) 169.* Available at: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013DC0169

European Commission, 2014, *Progress towards completing the Internal Energy Market - COM(2014) 634 final.* Available at: https://ec.europa.eu/energy/en/topics/markets-and-consumers/single-market-progress-report

European Commission, 2015, *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy - COM(2015) 80 final.* Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2015:80:FIN

European Council, 2014, *Conclusions - 26/27 June*. Available at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/143478.pdf

Fischer Carolyn, Newell Richard, Preonas Louis, 2013, *Environmental and Technology Policy Options in the Electricity Sector: Interactions and Outcomes.* Available at: http://www.rff.org/research/publications/environmental-and-technology-policy-options-electricity-sector-interactions

Fischer Carolyn, Preonas Louis, 2013, *Combining Policies for Renewable Energy: Is the Whole Less Than the Sum of Its Parts?* International Review of Environmental and Resource Economics vol. 4, no. 1 pg. 51-92

Gloaguen, O., and Alberola, E. 2013, *Assessing the factors behind CO_2 emissions changes over the phases 1 and 2 of the EU ETS: an econometric analysis.* CDC Climat Research Working Paper No, 2013-15.

International Energy Agency, 2011, Summing Up the Parts: Combining Policy Instruments for Least-Cost Climate Mitigation Strategies. Available at: https://www.iea.org/publications/freepublications/publication/Summing_Up.pdf

International Energy Agency, 2014, *Energy Investment Outlook.* Available at: https://www.iea.org/publications/freepublications/publication/WEIO2014.pdf

Marcantonini, Claudio and Ellerman, Denny, 2013, *The Cost of Abating CO_2 Emissions by Renewable Energy Incentives in Germany.* Available at: http://web.mit.edu/ceepr/www/publications/workingpapers/2013-005.pdf

Organisation for Economic Co-operation and of the results to changes in assumed conditions Impacts on small businesses. Available at: http://www.oecd.org/fr/gov/aligning-policies-for-a-low-carbon-economy-9789264233294-en.html

France Strategie, 2014, *European Electricity Markets in Crisis: Diagnostic and Way Forward.* Available at: http://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/archives/CGSP_Report_European_Electricity_System_030220141.pdf

Stavins Robert, 2014, *Will Europe Scrap its Renewables Target? That Would Be Good News for the Economy and for the Environment.* Huffington Post. http://www.huffingtonpost.com/robert-stavins/will-europe-scrap-its-ren_b_4624482.html

Zachmann Georg, 2012, G*reen growth and green innovation.* Investment and growth in the time of Climate Change, European Investment Bank and Bruegel

Zachmann Georg, 2012, *When and how to support renewables? Letting the data speak.* Available at: http://bruegel.org/2014/02/when-and-how-to-support-renewables-letting-the-data-speak/

CHAPTER

2 THE EU ETS AND THE MARKET STABILITY RESERVE

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KEY MESSAGES

• ***Structural changes in the adopted MSR legislative text*** **-** The legislative proposal for the Market Stability Reserve (MSR), disclosed in January 2014, was approved by the EU Parliament on 7th July 2015 with some substantial changes from its initial version. The revised parameters detail: a start date in 2019; the reintroduction of 900 million backloaded allowances and unallocated allowances in Phase III in the MSR; provisions for monitoring the MSR which includes two reviews in Phase IV, and a reduced time lag of the mechanism. The decision was adopted by the EU Council on 18th September.

• ***MSR impacts on the EUA surplus*** **-** According to the Institute for Climate Economics, verified CO_2 emissions will remain below the CO_2 emission cap until mid-Phase IV. Without the implementation of the MSR, the estimated surplus could increase to 3 $GtCO_2e$ by 2020. With the implementation of the MSR from 2019 and the return of backloaded allowances to the reserve, the EUA surplus could be limited to 2 $GtCO_2e$ in 2020 and decrease gradually from 2021 to 2030 until reaching 500 $MtCO_2e$. This means that the MSR would not begin re-injecting EUAs into the ETS market before 2030 because the surplus would still be higher than 400 $MtCO_2e$ in 2030. As such, the MSR will likely help to restore the short term scarcity needed during Phase IV of the EU ETS, enabling market participants to take into consideration the long term stringency of climate policies. It will also help increase its resilience to external shocks. However, given the wide range of uncertainties, an appropriate governance of the MSR will be essential to ensure its efficiency by recalibrating its parameters in order to avoid important deviations from an efficient decarbonization pathway.

• ***MSR impacts on EUA prices*** **-** According to the POLES model's results, the introduction of the MSR from 2019 will lead to an increase in the CO_2 price by roughly $€_{2010}$15/tCO_2 (compared to the Reference scenario) by 2030. Additional abatement costs amount to $€_{2010}$ 1.7 billion from 2015-2030 are supported at about 66% by the power sector with an important emissions reduction potential associated with relatively low average reduction costs ($€_{2010}$ 39/tCO_2 avoided).

• ***Experiences beyond Europe*** - California, RGGI and the Beijing pilot ETS in China have implemented flexible mechanisms to stabilize the price of carbon in their program. While these mechanisms may differ from the approach taken by the EU ETS, they equally help to manage the supply of allowances, while maintaining an incentive to decarbonise.

1. This chapter on the Market Stability Reserve (MSR) is based on I4CE & Enerdata expertise and analysis developed in the COPEC research program organised on 6th November 2014 and results from academic research. We thank Raphael TROTIGNON (Climate Change Economics Chair), Marie-Eugenia SANIN (University of Evry) and Anne CRETI (University Paris-Dauphine) and Godefroy GROSJEAN (Potsdam Institute for Climate Impact Research (PIK) for their very comprehensive analysis and insight on this issue.

This chapter begins with an introduction to the design of the Market Stability Reserve proposal adopted on 7th July 2015 to be implemented in the EU ETS from 2019 onwards. Section 2 provides an analysis of the consequences of introducing the MSR and its potential impacts on the EU ETS supply-demand balance, with specific reference to the level of EUA surplus expected in 2030. Section 3 uses POLES modelling results to demonstrate the potential impacts of the MSR on the EUA price, investment and effort sharing among EU ETS sectors leading to 2030. Lastly, section 4 provides an overview of three other emissions trading schemes in the world which have implemented provisions to help stabilize the price of carbon in their programs.

1. IMPLEMENTING THE MARKET STABILITY RESERVE: FROM A "ONE-SHOT" INTERVENTION BEFORE 2020 TO "ROBOTIC" ADJUSTMENTS LEADING TO 2030

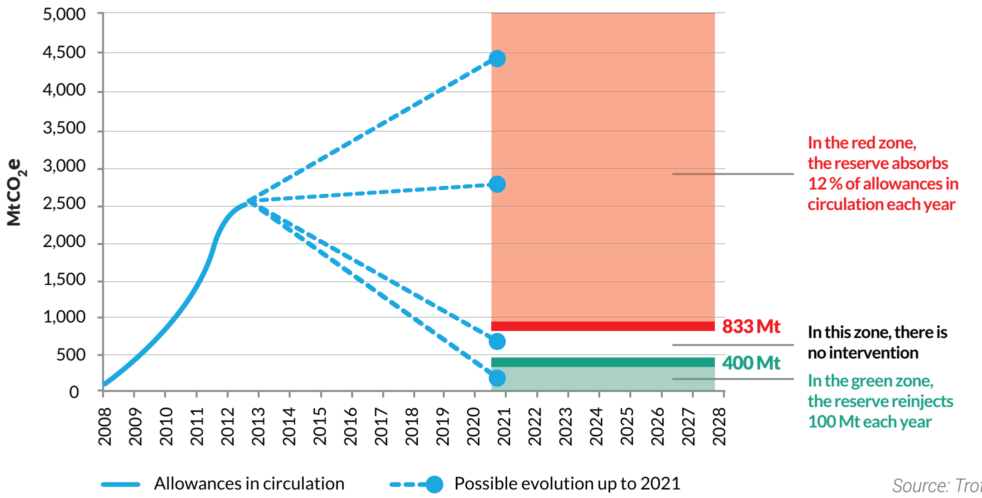
After over two years of discussions, the EU Commission disclosed on 22nd January 2014 a legislative proposal for a Market Stability Reserve (MSR),[2] in its communication titled "A policy framework for climate and energy in the period from 2020 to 2030".[3] This measure was planned to be implemented from the next compliance period (2021-2030) onwards, in an effort to reduce the growing allowance surplus of allowances since 2008 and improve the ETS's resilience to external shocks. The MSR operations are based on predefined rules that leave no discretion to either the EU Commission or Member States as the supply of allowances to be auctioned will be automatically adjusted.

Choosing a quantity-based instrument to address EU ETS weaknesses before the EU ETS directive is revised for Phase IV

Intervention of the MSR is premised on the cumulative EUA surplus representing the total number of allowances held by market participants that are not used to cover actual emissions. From 2018, the EU Commission will calculate the surplus which equals all allowances (auctioned and freely allocated), plus all Kyoto credits minus the total covered verified emissions from 2008. Two quantity thresholds and a price threshold are defined. The lower quantity threshold is set so that when allowances in circulation fall below the limit, the Commission commits to reintroduce more allowances. The upper threshold is set so that allowances in circulation above the limit would lead to allowances being removed. The price threshold is an "emergency" trigger that is activated if there is an extremely volatile rise in prices. More specifically, the EU Commission has committed to:

- Removing 12% of the total allowances in circulation and place it in the MSR if the **cumulative surplus is greater than 833 Mt.**
- Adding 100 Mt worth of allowances to the auctioning volume by removing them from the MSR if the total amount of the **cumulative surplus is less than 400 Mt.**

Figure 1 - Demonstration of MSR operations based on the EU commission's proposal.



Source: Trotignon et al. 2014.

2. EU Commission (EC), *A policy framework for climate and energy in period from 2020 to 2030*, 2014.
3. EC, *Proposal for a Decision concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EU*. 2014.

Backloading: A temporary measure to tackle surplus allowances with limited effect on EUA prices[4]

In July 2012, the European Commission introduced a proposal to reduce the supply of allowances between 2013 and 2015 to tackle the current EU ETS surplus. This proposal, termed "backloading", involved setting-aside 900 million allowances early in Phase III and reintroducing these allowances back into the market at the end of Phase III (thereby maintaining the level of the cap for that phase).
The European Parliament finally approved the measure in December 2013, and in February 2014, the EC amended its auctioning regulation (EU) No. 1031/2010 to reschedule the auction volume from 2013-2020. As a result the volume of auctioned allowances is reduced by 400 million in 2014, by 300 million in 2015 and by 200 million in 2016.

In theory, assuming rational actors that optimize dynamically without any informational constraints, the backloading measure is expected to have little, if any, effect on the carbon price due to the fact that backloading creates a temporary and artificial scarcity of which participants are aware. As a result, participants can sell allowances safely with the knowledge that the extra allowances will be reintroduced later in the scheme and can be bought back at the same price. However, the European Commission (2014) finds this outcome unlikely in a market with a limited time horizon.

It expects the price to rise in the short-term because the surplus holders will require a price premium to sell allowances. It also expects the price to fall at the end of Phase III when allowances are reintroduced to absorb the extra supply.

Table 1 - Comparison of Market Stability Reserve provisions in the proposed and adopted legislative text.

	MSR legislative proposal - Initial text (January 2014)[5]	MSR legislative proposal - Adopted text (July 2015)[6]
Date established/ Date of implemented	1st January 2021	(Art 1.) 2018 / 1st January 2019
Reintroduction of 900 million backloaded allowances in Phase III auctioning volumes	Yes	No. (Art 1.1.a) ... shall not be added to the volumes to be auctioned in 2019 and 2020 but shall instead be placed in the reserve.
Return of unallocated allowances in Phase III	-	(Art 1.1.b) ... shall be placed in the reserve in 2020
Monitoring and review	(Art. 3) By 31st December 2026, the Commission shall on the basis of an analysis of the orderly functioning of the European carbon market, review the Market Stability Reserve and submit a proposal, where appropriate, to the European Parliament and to the Council.	(Art. 3) The EC will monitor the functioning of the MSR and publish a report that should consider relevant competitiveness effects, in particular in the industrial sector, including GDP, employment and investment indicators. Within three years of the start of the operation of the reserve and at five year intervals thereafter, the Commission shall review the Market Stability Reserve and submit a proposal whether appropriate.
Responsiveness of the mechanism	Changes to the auction volumes take place two years after the emissions have occurred. Thus, the cumulative surplus calculated in year n is in fact that of year n-2.	Each year, a number of allowances equal to 12% of the total number of allowances in circulation, as set out in the most recent publication under paragraph 2, shall be deducted from the volume of allowances to be auctioned by the Member States under Article 10(2) of Directive 2003/87/EC and shall be placed in the reserve **over a period of 12 months beginning in September of that year.**

Source: I4CE – Institute for Climate Economics, based on EU legislative texts 2014, 2015

4. EC, *Commission Regulation (EU) No 176/2014 of 25 February 2014 amending Regulation (EU) No 1031/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013-20.*
5. EU Council & Parliament, *Concerning the establishment and operation of a Market Stability Reserve for the Union greenhouse gas emission trading scheme and amending directive 2003/87/EC* , 2014.
6. EU Council & Parliament, *Concerning the establishment and operation of a Market Stability Reserve for the Union greenhouse gas emission trading scheme and amending directive 2003/87/EC , ANNEX 2014.*

- Adding 100 Mt worth of **allowances if the allowance price is higher than three times its average value over the previous two years.** This threshold is only valid when the price is increasing; there is no provision to remove allowances on the basis of a volatile drop in prices.

The legislative proposal submitted for the MSR gave rise to an intensive debate among Member States in 2014 and 2015. Three main issues were discussed: the commencement date for the MSR, the introduction of backloaded allowances into the MSR and various design parameters such as thresholds. After two trilogue meetings in March and May 2015, the legislative proposal of the MSR was approved by the European Parliament on 7th July 2015 with some substantial changes from the initial version, as presented in Table 1. The decision was adopted by the EU Council on 18th September 2015.

Additional MSR provisions in the proposal of the revised EU ETS directive for the post-2020 period

The proposal of the revised EU ETS directive disclosed in July 2015 specifies two complementary provisions for the MSR. Firstly, 250 million unallocated allowances from the MSR shall be set aside for new entrants.

Secondly, the Innovation Fund will be infused with 50 million unused allowances from Phase III that would otherwise have been placed in the MSR in 2020, in addition to 400 million free allowances coming from the free allocation budget.

2. ASSESSING THE MSR'S ABILITY TO ADJUST EU ETS SUPPLY

As specified by the European Commission,[7] the "reserve" should be operational from 2019 to address the increasing surplus, to build the EU ETSs resilience to supply-demand imbalances and to enhance synergy with other climate and energy policies.[8] The role of the MSR is to help adjust the scheme to create an orderly and largely predictable market. While taking stock of EU ETS shortcomings, this section provides an assessment on how effectively the MSR can deliver on expectations.

Factors leading to low and volatile EU carbon prices: structural rigidity, lack of EU ETS credibility and the myopia of market participants

EU ETS rigidity gives rise to large imbalances

The EU ETS is a regulatory market. On the one hand, the demand of allowances is fluctuating according to cyclical and more structural patterns. On the other hand, the supply of allowances is inelastic, as it was set years back, in line with economic and technological development forecasts of the time. The lack of flexibility in the EU ETS was designed intentionally to ensure regulatory stability, and environmental effectiveness. However, in other markets, supply fluctuates in order to adjust to the level of demand and allow price discovery.

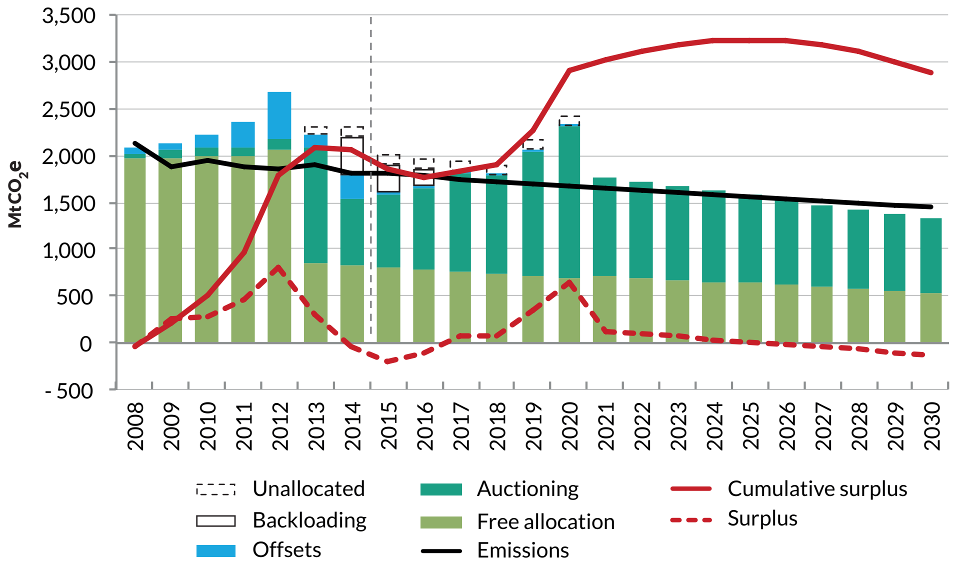
Verified emissions by installations covered by the ETS decreased by 15% (19% with constant scope) between 2008 and 2014, or by 2.7% per year on average which was a much faster rate than the cap is set to decline in Phase III (1.74% per year). Combined with a large inflow of international credits amounting to 1,400 million in 2014, the slump in demand for allowances has led to a growing surplus, estimated to be 2.1 billion in 2014, as described in Chapter 1. This surplus is expected to be carried over to the end of Phase III, and is fuelling expectations of low scarcity (Trotignon, 2014). The emissions cap in Phase III compared to the Business As Usual emissions trajectory, is no longer perceived as stringent.

According to Institute for Climate Economics' projections, verified CO_2 emissions are likely to remain below the emission cap until mid-Phase IV.[9] As shown in Figure 2, returning backloaded allowances to the market without implementing the MSR would increase the surplus to 3 $GtCO_2$ in the 2020 to 2030 period.

However, EU allowances surplus should not be perceived as an issue per se, as it could be the result of abatement efforts and banking behaviors[10] corresponding to optimal strategies undertaken by market participants (Bosetti, 2008). With the prospect of an increasingly stringent cap as of mid-Phase IV, market participants should retain their banked allowances, and prices should increase to reflect long term scarcity. This is not the case in the EU ETS: prices are depressed

7. EC, *Adopted MSR legislative proposal*, 2015.
8. EC, *Proposal for a directive amending directive 2003/87/EC*, 2015. pg. 25.
9. Assuming a 1.4% annual growth of industrial output, 0.6% growth of power generation, and renewable generation progressively entering the market to reach the 2020 objective.
10. Long term banking of market participants anticipating the position of market is not used, even if theoretically this option exists in the system.

Figure 2 - Allowance surplus without MSR: increasing to 3.25 Gt CO_2 before 2030.



Source: I4CE – Institute for Climate Economics, based on data from EC, EU TL, 2015.

despite the fact that the market is expected to be tight within ten years. This is generally explined by two reasons. Banking of allowances may not be used enough because of the lack of credibility of the scheme driving market participants to heavily discount allowances in the long run. Another contributing factor could be the shortsightedness of market participants, and their excessive focus on the short-term, preventing them from adopting long-term cost minimizing strategies.

Lack of long-term political credibility in the EU ETS

By deciding a 2030 ETS emissions reduction target with a long term objective for 2050 binding, uncertainty regarding climate policy and the EU ETS has been significantly reduced. However, the credibility of climate commitments may be undermined by the lack of time-consistency of climate policies. As highlighted in Chapter 1, the multiple (and sometimes conflicting) objectives of energy and climate policies (affordability, security of supply) evolve overtime, and governments may embrace different priorities at different points. This may be further reinforced by the uncertainties surrounding global cooperation in the fight against climate change. In practice, evolving policies adjusting the supply of allowances have somewhat undermined the overall credibility of the EU ETS. For instance, the inflow of more than 1.5 billion international credits in Phase III highlighted that the cap in the future may not be as legally binding in nature as suggested, and that there may be possibilities to negotiate more lenient objectives. Given that capital intensive low-carbon investments are largely irreversible and their profitability deeply relies on climate policies, lack of time-consistency can have a significant impact on investment decisions.

As a response to a wide array of uncertainties relating to the state of the EU ETS in the future, participants may disregard long-term anticipated scarcity, leading to the carbon price being driven largely by the short-term surplus. Based on an extended database (2012 to the end of 2013), Koch (2014) attempts to quantify the impacts on price formation of three commonly cited demand-side fundamentals: Economic Sentiment Indicator, renewable energy production, and offsets. He finds that these market fundamentals explain only 10% of EUA price changes. Among these, the Economic Sentiment Indicator is still statistically significant, whereas renewable energy sources production seem to have an impact of secondary importance. It is then suggested that political decisions are alternative drivers of carbon price formation.

Market participants short sightedness

It has been highlighted that covered installations have a limited planning time horizon linked to their operational production cycles. Neuhoff (2013) exposes the case of the power sector, emitting half of the EU ETS cap. Utilities are used to selling power in forward markets within a three year timeframe. This means that they start to sell a part of the planned production three years in advance, and they gradually close their open positions until the time of production. While selling power, they buy underlying commodities, including EUAs in the forward market to secure a margin – so called "clean spread". This procedure is defined by precise risk mandate strategies. EUA forward contracts are provided by financial operators, that trade off the cost of capital as they buy EUA allowances in the spot market and sell it on forward markets with low discount rates (risk neutral "cash and carry" strategy). However, when the need to hedge is satisfied, speculative market participants intervene and adopt open positions, applying much higher discount rates, 10% or 15% against 5% for utilities hedging (Neuhoff, 2013). As such, given an expected price signal in the long term, EUA spot prices undergo downward pressure due to high discount rates. For example, according to the EU's 2014 Impact Assessment, EU carbon prices in 2030 are expected to reach €40/tCO_2. Consequently, with a 12.5% discount rate, EUA prices in 2015 would be only of €7/tCO_2 compared to €20/tCO_2 assuming unlimited banking at low discount rates of 5% (I4CE – Institute for Climate Economics, 2015).

There is no scarcity in the EU ETS market, in the short-term nor is it anticipated in the medium term. For different reasons identified, market participants are unable to take into consideration the long term scarcity that should be conveyed by the emissions cap by 2030. Consequently, EUA prices have been depressed since 2011.

Low carbon prices increase the long term cost of European decarbonisation

Low prices in an ETS should not be considered as inherently negative: the emissions cap secures the EU ETS reduction target and therefore, low prices may imply that the schemes objectives can be achieved at a lower cost than expected. If the objective of the EU ETS is to simply lower the cost of compliance within a given trading period, no reform would be required. However, climate policies focus on forging the most cost effective – long-term – pathway to a low carbon economy as expressed in the EU 2050 Energy Roadmap. EU carbon pricing is assigned a wider role beyond short-term optimizations to reduce the CO_2 emissions of existing capital stock. It should provide a clear and credible long term signal that can lead investors to progressively "green" their capital stock, and drive the necessary development of low carbon technologies.

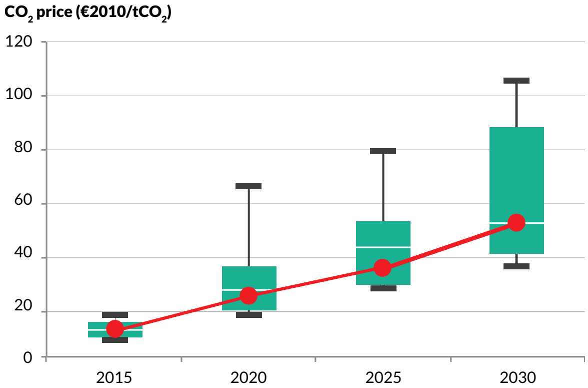
From this perspective, low EUA prices are likely to prevent the carbon price from playing its dynamic efficiency role, and will be detrimental to the cost effectiveness of the scheme. Three issues are highlighted:

- With low carbon prices, early cost abatement opportunities may be disregarded by market participants, which will raise their cost of compliance in the long run;
- Low prices delay investments in low technologies development, meaning that fewer options may be available to combat climate change in the future, and at high cost;
- Low carbon prices are likely to give rise to investments in high carbon technologies referred to as carbon lock-in. Later on, the rise of carbon prices is likely to devaluate high carbon assets before the end of their economic lifetime, steering an inefficient allocation of capital.

To address these three issues that increase the long-term cost of the European decarbonisation effort, the carbon price must follow an efficient pathway that can induce sufficient technological developments and provide a credible framework for the investment of low carbon technologies. Figure 3 provides a wide array of efficient carbon price pathways observed in economic literature (Knopf *et al,* 2013) which could drive the transformation towards a low carbon economy at the least cost in order to achieve the -80% GHG emission reduction target by 2050.

These carbon price trajectories are subject to a large degree of uncertainty in terms of technological and economic development. However, it appears clear that current EUA prices are far below the recommended levels and are likely to encourage a deviation from an optimal abatement pathway.

Figure 3 - Examples of efficient carbon prices from different energy-economy models.



Euro Case, 2014, based on Knopf et al. 2013.

This is all the more true when EU ETS prices are compared to the level of the social cost of carbon recommended in the French Quinet report (2009), from €32 in 2010 to €100 in 2030.

This situation warrants intervention in EU ETS design to help restore adequate scarcity in the short-term and drive more efficient abatement decisions. The question then remains, to what extent can the MSR play this role?

The MSR should restore the short-term scarcity and reinforce the resilience of the EU ETS

In view of the need to intervene in the EU ETS and improve its dynamic efficiency, a wide debate took place in 2012 on the type of instruments that could be implemented. Many economists have advocated for price based stabilization mechanisms like price corridors (Taschini, 2014; Euro-Case 2014) due to the fact that they are simpler, more transparent, less easy to manipulate, and would be more likely to reduce regulatory uncertainty than a quantity based mechanism. Others, building on the existing monetary policy literature, have advocated for a higher degree of delegation to overcome, time inconsistency issues more efficiently (Helm 2003, Grosjean 2014).

There has been a wide support among stakeholders for a mechanism based on quantities to adjust supply. The European Commission have emphasized that a price based mechanism goes against the intrinsic nature of a market and would hinder price discovery. Moreover, a price corridor would require, on a preliminary basis, difficult political negotiations to define a price target. Eventually, the MSR became the preferred option, as it is non-discretionary and cap neutral. This leads to the question on whether or not the MSR will be able to correct the identified failures.

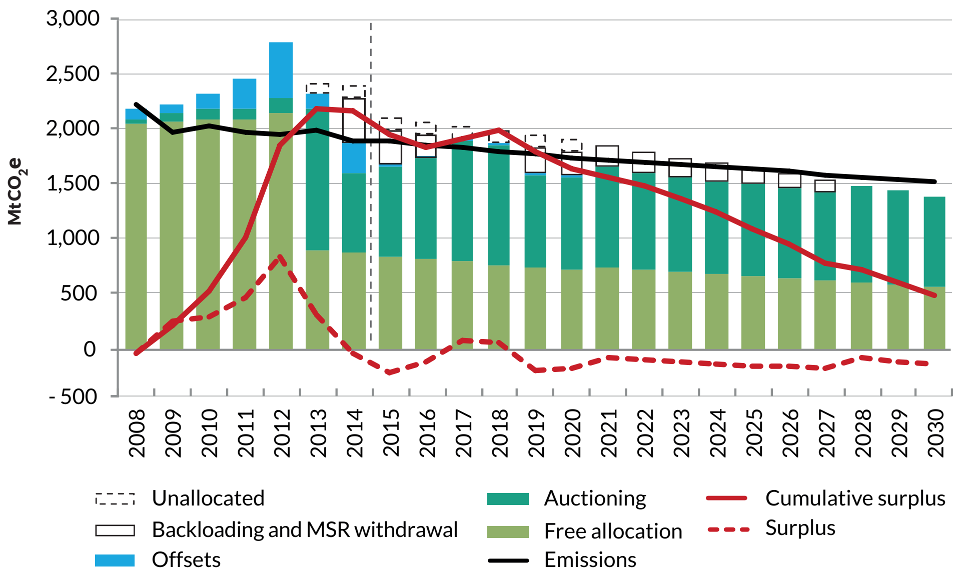
Overcoming the short sightedness of market participants

The MSR will provide some flexibility in the supply of allowances and will mechanically increase short-term scarcity and prices. If the short sightedness of market participants is thought to be the key element, the MSR will force market participants to take into consideration long-term scarcity. This will drive early and consistent investment decisions and help get closer to an efficient abatement pathway.

As outlined in Figure 4, implementing the MSR in 2019 and the return of backloaded allowances in the reserve, would limit the EUA surplus to 2 $GtCO_2$ in 2020 (relative to 3 $GtCO_2$ without the MSR), and will continue to gradually decrease it from 2021 to 2030 until it reaches 500 $MtCO_2$. As such, the MSR will likely restore the needed short term scarcity during Phase IV of the EU ETS.

Climate Strategies (2015) have used a set of models to test the ability of the MSR to increase the cost-effectiveness of the EU ETS using three criteria: the inter-temporal efficiency, price credibility and robustness.

Figure 4 - Impact of the MSR on the allowance surplus in EU ETS Phase IV.



Source: I4CE – Institute for Climate Economics, based on data from EC, EU TL, 2015.

They demonstrate that with the MSR, abatement trajectories of market participants are closer to an efficient pathway, reducing efficiency losses from market failures by two thirds. They also demonstrate that market participants bank allowances more efficiently, and that the EU ETS is more responsive to and robust against exogenous shocks.

According to Institute for Climate Economics modelling results, the MSR will help to increase the EU ETS's resilience to potential future shocks. To demonstrate this, a shock in demand was simulated with a drop in annual growth from 1.4% to -3% from 2024 to 2026. This was followed by a slow recovery with 0% growth from 2027 to 2029, coupled with a major breakthrough in storage technologies that would enable a higher pace of deployment for intermittent renewables.[11]

As shown in Figures 5 and 6, EUA surplus in the EU ETS is not significantly affected by these large exogenous shocks. At the end of Phase IV, the EUA surplus settles at 1,300 $MtCO_2e$, relative to 3,800 $MtCO_2e$ without the MSR, which seems to be a reasonable surplus size for a well-functioning market.

Figure 5 - Impact of a large decrease in demand on the EU ETS surplus with the MSR.

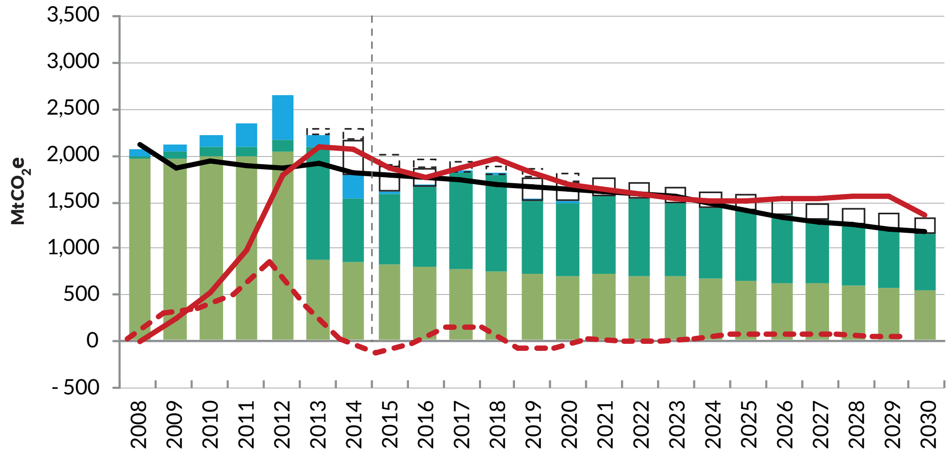
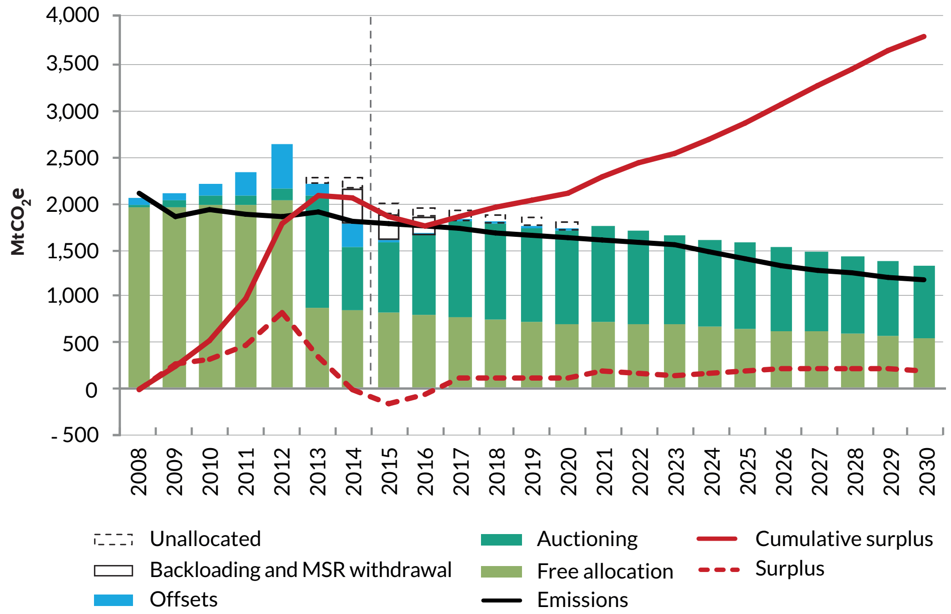


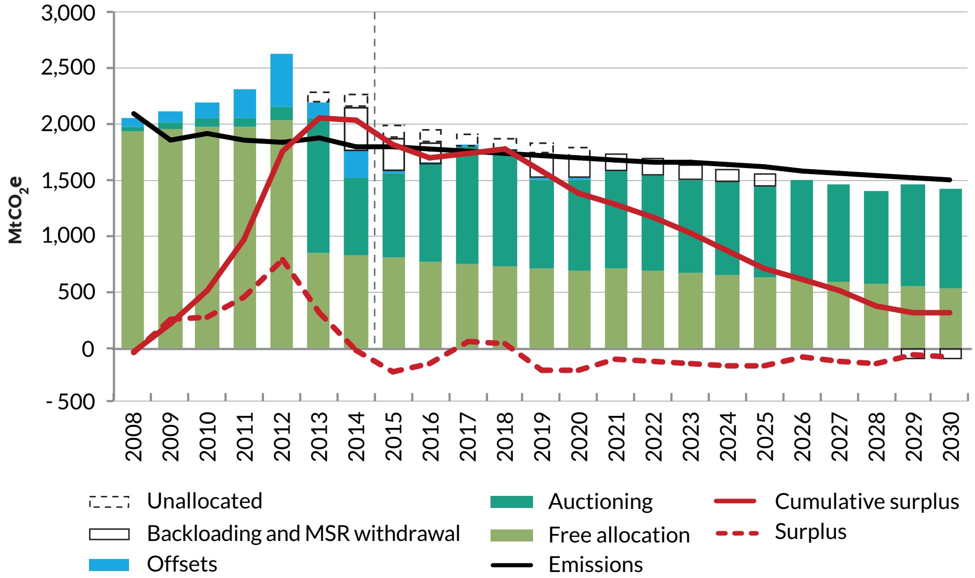
Figure 6 - Impact of large decrease in demand on the EU ETS surplus without the MSR.



Source: I4CE – Institute for Climate Economics, based on data from EC, EU TL, 2015.

11. 45% share in electricity generation compared to 35% in the impact assessment 2030 framework, on top of 11% of hydro generation.

Figure 7 - Impact of a large increase in demand on the EU ETS surplus with the MSR.



Source: I4CE – Institute for Climate Economics, based on data from EC, EU TL, 2015.

Conversely, a 2% annual growth rate leading to 2030 would significantly increase the demand for EUAs and the surplus would reach the lower thresholds of 400 million by 2028. With the reinjection of 100 million allowances in 2029 and 2039, the surplus stabilizes to 320 million allowances in the end of Phase IV as outlined in Figure 7.

As a result, the MSR deeply reinforces the robustness of the EU ETS, which ensures better price consistency, and provides a more credible framework for investment in low carbon technology development and deployment. Attention is however required regarding the injection rate that may be too low in case of positive economic shock.

Ensuring MSR efficiency through proper governance

The MSR is likely to enhance the dynamic efficiency of the EU ETS, and is a positive step towards achieving emission reductions at the least cost in the long run. However, dynamic modelling results underline the difficulties in forecasting the impact of the MSR on banking behaviors of operators and EUA prices. Inadequate parameters are likely to spur volatility and can have detrimental consequences on the low-carbon investment framework.

Trotignon (2014) highlighted that, if thresholds are not set properly, there is a high risk of instability. Carbon prices could increase significantly over short timeframes, leading to high levels of abatement that could be followed by a sudden drop in price.

- If the upper threshold of the surplus corridor is below hedging needs, this may entail additional banking behaviors that will lead to a growing surplus and prompt increasing withdrawal of allowances by the MSR.
- Increasing withdrawals may send further scarcity signals to market participants and drive them to increase abatement beyond what would be efficient. Such a chain reaction would likely give rise to great volatility.

In order to insulate the scheme from this risk, a thorough understanding of hedging needs and the design of parameters accordingly are of paramount importance. With the ongoing transformation of the power sector, epitomized not only by an increasing share of renewable energy, but also by the emergence of new business models for utilities, hedging needs are likely to evolve significantly. Only appropriate governance can adapt the MSR to these changing circumstances in a timely fashion.

Moreover, a major default of the mechanism lies in its inability to discriminate between different types of surplus. A "good" surplus, stemming from abatement efforts and a "bad" surplus stemming from exogenous shocks should not be dealt with the same way. As demonstrated in Chapter 1, surplus spurred by complementary policies should be withdrawn from the supply of allowances. As a first best, this adjustment should be done in the ex-ante assessment and embedded in the emissions cap. In this case, the complementary policy would not give rise to additional surplus.

For policies undertaken after the cap has been defined, intervention of the MSR would be warranted to eliminate the corresponding surplus. This also holds true when complementary policies over achieve their objectives.

Beyond complementary policies, a surplus of allowances arising from macroeconomic cycles could be viewed as a countercyclical effect but could however be harmful for the cost-effectiveness of the trading scheme. Indeed, it would have a downward impact on prices whereas the need to stimulate low carbon investments and innovation still exist. In case of technological breakthrough and massive low carbon investments entailing large abatements, a structural surplus would mean that long term commitments can be achieved at a lower cost than expected and this should be revealed by the carbon price. Therefore, it should not systematically be removed from the supply, as this could trigger the 'chain reaction' mentioned earlier.

Therefore, it is necessary to establish a regulatory and institutional framework in order to recalibrate the MSR. Given the wide range of uncertainties, some degree of "human" intervention will be essential to carry out a thorough analysis of the surplus and its impact on behaviors and banking.

A periodical review, based on the annual report of the carbon market functioning, should determine whether the surplus in the market provides sufficient liquidity, and whether it undermines the perception of long term scarcity by market participants. If the surplus is thought to be harmful for the least cost achievement of long term goals, a review of the parameters should be undertaken to tackle the surplus. A clear procedure should be established to ensure predictability, outlining which parameter can be updated and at what time (for instance, in 2021, and every five years thereafter). However, the governance should allow for sufficient reactivity to avoid important deviations of the carbon price from the efficient pathway. If very large changes in the fundamentals are witnessed, a process for a quick update should be necessary.

Conclusion - The MSR is a welcome mechanism to restore short-term scarcity but may need to be recalibrated to guarantee the long-term cost-effectiveness of the EU ETS

The MSR is a highly welcome provision for the EU ETS as it is expected to gradually absorb the current surplus and provide flexibility to face exogenous shocks. This will clearly help overcome market imperfections linked to the shortsightedness of market participants and their limited ability to bank allowances at social discount rates. Therefore, it will help drive the price trajectories closer to more efficient ones.

At the same time, the surplus is not necessarily a good indicator of the health of the EU ETS, and the major drawback of the mechanism lies in its inability to discriminate between surplus stemming from abatement efforts and surplus stemming from exogenous shocks. A "robot-like" withdrawal of surplus is likely to spur volatility and can have detrimental consequences on the low-carbon investment framework. Some degree of "human intervention" will be essential to recalibrate the MSR in a timely fashion and to safeguard the dynamic efficiency. Some stakeholders have called for a committee of experts to assess the state of the EU ETS before formulating recommendations to adapt the design of the MSR accordingly.

If one considers that the lack of credibility in long term climate commitments is the core issue, more than myopia of market participants, a price corridor would be more efficient to stabilize expectations and reduce price uncertainties. Going forward, (Helm, 2003; Grosjean, 2014), show that some degree of delegation to an independent authority could have positive effects on the stability of the market by adjusting the supply of allowances according to long term price expectations in line with the decarbonisation target.

3. INTRODUCING THE MSR IN THE EU ETS BY 2030: RESULTS BASED ON THE POLES MODEL

The ex-ante impact analysis of the MSR is performed using the POLES model, with which it is possible to use as an input the level of surplus to be used in the ETS over the simulation period leading up to 2030. The impact of the MSR on the level of surplus is first estimated in the context of a brief literature review. Further, two comparative scenarios (with and without the MSR) are calculated and analyzed.

Literature review

As an input of the modelling exercise, the level of surplus and its evolution over time can be considered under various framework conditions. Most of the analyzes performed on the potential impact of the MSR on allowances surplus include:

- EC, 2014: the Impact Assessment of the European Commission, January 2014;
- UK, 2014: UK position on the MSR, October 2014;
- Ecologic Institute Berlin, 2014: the Next EU Climate and Energy Package, August 2014;
- Ecofys, 2014: assessing the EU 2030 Climate and Energy targets, March 2014.

These sources provide a broad and diverse array of approaches to the methodology referred to for the quantification of the surplus, going from a brief government's position to more detailed analysis reports. These studies, which differ in their treatment of backloaded allowances leading up to 2020, rely further on the assumption of the introduction of the MSR from 2021 onwards. The present analysis provides an assessment of the surplus evolution accounting for the MSR introduced as of 2019. Figure 8 summarizes the results of the studies mentioned in terms of surplus' projections up to 2028-2030 if available. This Figure compares these projections with the reference scenario of the European Commission, leading up, in 2028, to a surplus reduction ranging between 1,625 $MtCO_2$ (Ecologic Institute Berlin), and 1,860 $MtCO_2$ (Impact Assessment of the European Commission, MSR option 2c). The projections provided by Institute for Climate Economics, which are consistent with (Ecologic Institute Berlin, 2014) in the long run and account for an introduction of the MSR in 2019, are considered for the present scenario analysis.

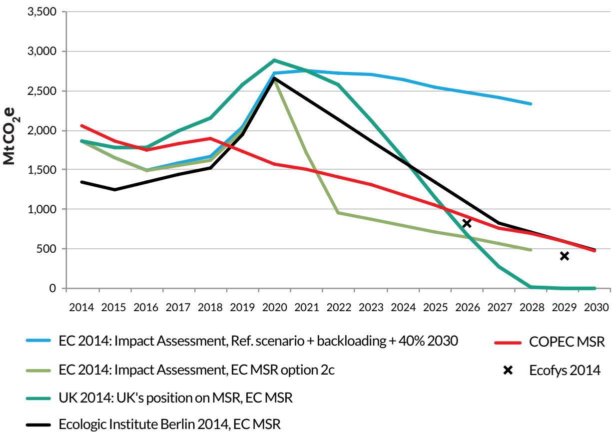
Scenario definition

Based on the literature review described above, two scenarios are defined, both following the same evolution of surplus until 2018 (I4CE – Institute for Climate Economics, 2015):

- **COPEC Reference:** in the reference scenario, the level of surplus from 2019 corresponds to the EC, 2014 reference case;
- **COPEC MSR:** in this scenario, the MSR is introduced from 2019, leading up to a level of surplus of 475 $MtCO_2$ in 2030 (I4CE – Institute for Climate Economics, 2015, see previous section).

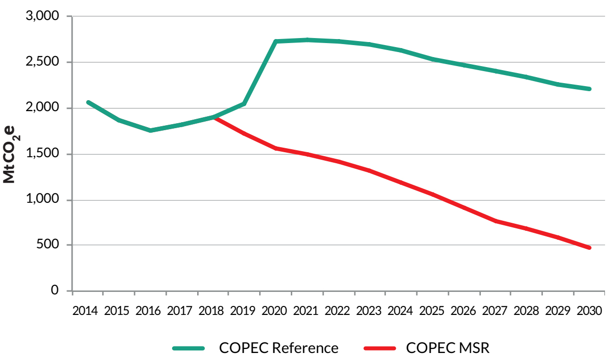
The evolution of the surplus, illustrated in Figure 9, is used as an input for the POLES-Enerdata model, in the way that it impacts the reduction cap of the EU-ETS sector until 2030 and therefore the carbon price incentive needed to reach this yearly level of emissions reduction.[12]

Figure 8 - Impact of the MSR on the evolution of the allowance surplus: literature review.



Source: EC 2014, UK 2014, Ecologic Institute Berlin 2014, Ecofys 2014, I4CE – Institute for Climate Economics, 2015.

Figure 9 - Scenario definition for the impact of the MSR on the evolution of the allowance surplus.



Source: I4CE – Institute for Climate Economics, 2015.

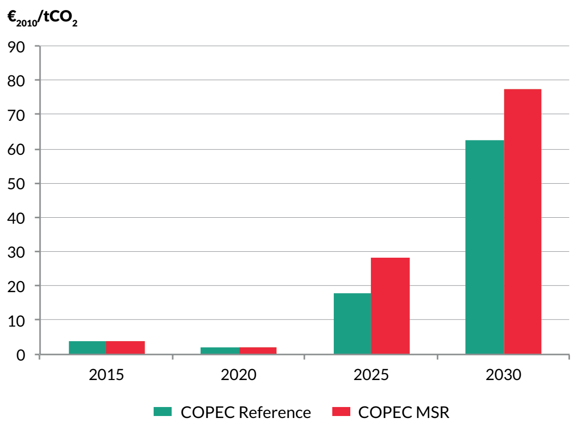
12. The modelling approach does not consider free allocation to inductrial sectors exposed to carbon leakage in Phase IV.

Results

As seen in Figure 10, the introduction of the MSR from 2019 leads to an increase in the CO_2 price due to a reduced number of surplus allowances. The difference in CO_2 price observed between both scenarios increases progressively to reach $€_{2010}15/tCO_2$ in 2030. For comparison purposes, this impact has been analyzed in a wide range of further studies. Among others, Ferdinand(2014) calculates a price increase of about $€_{2010}11/tCO_2$ (from $€_{2010}28/tCO_2$ to $€_{2010}39/tCO_2$) by 2028, whereas Trotignon(2014) estimates it could reach approximately $€_{2010}26/tCO_2$ (from $€_{2010}40/tCO_2$ to $€_{2010}66/tCO_2$),[13] compared to a $€_{2010}13.2/tCO_2$ increase in the present analysis for the same year.

The methodology applied allows for analysis of the economic impacts that the introduction of the MSR from 2019 could have in different EU ETS sectors.[14] Table 2 provides an overview of the additional abatement costs that can potentially accumulate from 2015-2030, resulting in the ETS individual sectors from the MSR. Approximately two thirds of additional abatement costs are supported by the power sector. This sector is one of the most flexible and has significant emissions reduction potential derived from relatively low average reduction costs ($€_{2010}39/tCO_2$ avoided). To a lesser extent industry, and in particular the mineral products sector, also plays a significant role in the additional reduction effort needed.

Figure 10 - Impact of the MSR on CO_2 price in the EU ETS.



Source: Enerdata, POLES and Carbon Market Tool models, 2015.

For the EU ETS as a whole, total additional abatement costs amount to $€_{2010}1.7$ billion cumulated over the period 2015-2030.[15]

Apart from abatement costs due to emission reductions, the EU ETS will see, with the introduction of the MSR, an additional cumulated investment reaching $€_{2010}$ 21 billion from 2015-2030. The power sector is estimated to support about 66% of this investment in new production capacities, whereas 34% would be invested in final demand sectors such as industry and households. As a consequence of the introduction of the MSR from 2019, the end user price of electricity is increased by approximately 2% in 2030 compared to the case without MSR.

Table 2 - Impact of the MSR on 2015-2030 cumulative abatement costs in the ETS.

Sector	Δ abat. costs cum. 2015-2030 [$€_{2010}$mio]	2015-2030 % of total	Average cost/tCO_2 avoided [$€_{2010}/tCO_2$]
Industry	**403.4**	**23.6%**	**46.1**
Chemicals	47.8	2.8%	40.9
Manufacturing	29.7	1.7%	38.3
Mineral Products	178.3	10.4%	46
Steel	76.4	4.5%	71.2
Upstream and Refining	71.1	4.2%	38.4
Power	**1,129**	**66.0%**	**38.6**
Buildings	**21.4**	**1.3%**	**15.9**
Residential	14.5	0.8%	30.4
Services	6.9	0.4%	8
Air Transport	**152.8**	**8.9%**	**43.4**
Domestic	21.8	1.3%	42.8
International	130.9	7.7%	43.5
Agriculture	**4.2**	**0.2%**	**28**
Total ETS	**1,710.8**	**100%**	**39.8**

Source: Enerdata, POLES and Carbon Market Tool models, 2015.

13. Both Ferdinand, 2014 and Trotignon, 2014 results are based on the introduction of the MSR from of 2021.
14. The analysis carried out in the following of this section has been performed by a model coupling between the long-term energy system model POLES and the Carbon Market Tool, dedicated software for the analysis of carbon markets worldwide. Please see the Annex for more information about Carbon Market Tool.
15. These results would probably be amplified in the reality by considering possible free allocations for industrial sectors subject to carbon leakage over Phase IV of the ETS, provision which is accounted for in the modeling work.

Table 3 - Impact of the MSR on additional permit trading ($MtCO_2$) in the ETS.

Sector / Δ $MtCO_2$ imports	2025	2030
Industry	**4.1**	**16.1**
Chemicals	0.0	1.4
Manufacturing	0.4	1.5
Mineral Products	1.1	8.9
Steel	0.9	-1.1
Upstream and Refining	1.6	5.4
Power	**-4.0**	**-18.3**
Buildings	**0.2**	**1.8**
Residential	0.2	1.1
Services	0.1	0.6
Air Transport	**-0.6**	**-1.0**
Domestic	0.1	0.3
International	-0.7	-1.3
Agriculture	**0.2**	**0.7**

Source: Enerdata, POLES and Carbon Market Tool models, 2015.

Table 3 provides detailed information on sectorial burden sharing within the ETS. The introduction of the MSR is basically supported by the power sector, which achieves additional domestic reductions that allow it to sell approximately 18 $MtCO_2$ to the market. To a lesser extent, the aviation sectors' international bunkers offer flexibility to increase their emission reduction efforts and become a net permit exporter in comparison to the case without MSR. On the demand side of the ETS market, the industry sector increases it sourcing on the market by about 16 $MtCO_2$. Two sectors in particular, namely mineral products and upstream and refining are responsible for this trend.

4. ETS DESIGN BEYOND EUROPE: STABILISING CARBON PRICES AND COMPLIANCE COSTS

It can be useful to refer to the experiences of other emissions trading schemes when assessing flexibility provisions. To guarantee a certain level for the price of carbon a price floor, a price ceiling or an allowances reserve can be implemented. Many programs such as those implemented in North America, and China have implemented at least some flexible mechanisms to help stabilise the price of carbon in their respective programs, thereby managing supply, market uncertainty while maintaining an incentive to decarbonise. The table below provides a brief overview of how other emissions schemes use flexibility mechanisms to counteract the effects of market uncertainties.

Table 4 - Flexibility mechanisms in Emissions Trading Schemes implemented beyond Europe.

Scheme		California	RGGI	Beijing Pilot
Banking		Allowed but subject to holding limits (quantity is based on a multiple of the entities annual allowance budget).	Unlimited, banked allowances will factor into future state emissions budgets.	Allowed, but banked allowances cannot be carried forward beyond the pilot period.
Borrowing		Allowed for two situations: 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 the price.	Not permitted.	Not permitted.
Offsets		Up to 8% of total compliance obligation. Includes early action offsets international sector based offsets and ARB offset credits.	Up to 3.3% of compliance obligation. Domestic offsets within RGGI jurisdiction only (landfill methane capture, SF6 in the power sector, forest sequestration and afforestation, avoidance of CO_2 from natural gas and oil, avoided methane from agriculture).	5% of annual compliance obligation can be met using CCERs or other certified projects. 50% of offsets generated have to be located in Beijing.
Price Floor		$12.10 (2015) the price increases annually by 5% plus the rate of inflation.	$2.05 (2015), the minimum price increases by 2.5% annually.	None.
Reserve	**Cost Containment Reserve (price based)**	Allowance Price Containment Reserve: collects a portion of allowances each year to release them if certain predetermined trigger price is reached.	Cost Containment Reserve: Contains fixed quantity of allowances above the cap that are held in a reserve. In 2015 the reserve will contain 10 million allowances.	Government sets aside 5% of total annual allowances. When the average price of allowances are above 150 Yuan or below 20 Yuan (over ten consecutive trading days), the government will purchase surplus allowances from the market.
	Allowance Reserve (quantity based)	None.	None.	None.

Source: I4CE – Institute for Climate Economics, 2015 based on national ETS legislation.

REFERENCES

Aglietta M., E. Espagne, B. Perrissin Fabert, 2015. *A proposal to finance low carbon investment in Europe* Policy Brief n°24, February, France Stategies.

Bosetti, V., C. Carraro, E. Massetti, 2008, *Banking Permits: Economic Efficiency and Distributional Effects,* Journal of Policy Modeling, Volume 31, Issue 3, May-June 2009, Pg. 382-403

California Air Resource Board, 2014. *Climate Change Draft Scoping Plan. Economic Analysis Supplement.* Available at: http://www.arb.ca.gov/cc/scopingplan/document/economic_analysis_supplement.pdf pg.8

California Air Resource Board, 2014. *First update to the Climate Change Scoping Plan (Scoping Plan) 2014*, May 2014. Available at: http://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm

California Air Resources Board, 2011, *Final Regulation Order Article 5: California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms to Allow for the use of Compliance Instruments Issued by Linked Jurisdictions adopted 2011, last updated January 2015*. Available at: arb.ca.gov

Ecofys, 2014. *Assessing the EU 2030 Climate and Energy targets*, March 2014. Available at: http://www.ecofys.com/files/files/ecofys-2014-assessing-the-eu-2030-targets.pdf

Ecologic Institute Berlin, 2014. *The Next EU Climate and Energy Package – EU Climate Policies after 2020*, August 2014. Available at: http://www.ecologic.eu/sites/files/publication/2014/eu_climate_energy_package_study_2014.pdf

Euro-CASE, 2014. *Policy Position Paper Reform Options for the European Emissions Trading System (EU ETS).* Available at: http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Aktuelles___Presse/Presseinfos___News/ab_2014/Euro-CASE_policy_paper_ETS_reform.pdf

EU Commission, 2014, *A Proposal for a Decision concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EU*. 22 January. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014PC0020&from=EN

EU Commission, 2014. *Proposal for a Decision concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EU*. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014PC0020

European Commission, 2014, *A policy framework for climate and energy in period from 2020 to 2030*, 28 January. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52014DC0015

European Commission, 2014. *Commission Regulation (EU) No 176/2014 of February 25th 2014 amending Regulation (EU) No 1031/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013-20.* Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.056.01.0011.01.ENG

European Commission, 2014. Impact assessment, *Accompanying the Proposal for a Decision of the European Parliament and of the Council concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC*. Available at: http://ec.europa.eu/clima/policies/ets/reform/docs/swd_2014_17_en.pdf

European Council, 2014. *Decision of the European Parliament and of the council concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC.* 1 January. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014PC0020&from=EN

European Parliament and Council, 2014. *Concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC. ANNEX*. Available at: http://www.europarl.europa.eu/meetdocs/2014_2019/documents/envi/dv/ets_msr_annex_/ets_msr_annex_en.pdf

Ferdinand, 2014. *The MSR: Impact on balance and prices. CEPS Task Force: EU ETS Market Stability Reserve,* April 2014, Point Carbon and Thomson Reuters, Brussels.

Koch, Nicolas and Grosjean, Godefroy and Fuss, Sabine and Edenhofer, Ottmar, 2015, *Politics Matters: Regulatory Events as Catalysts for Price Formation Under Cap-and-Trade.* 6 May. Available at: http://ssrn.com/abstract=2603115

Kollenberg, Sascha and Taschini, Luca, 2015, *The European Union Emissions Trading System and the Market Stability Reserve: Optimal Dynamic Supply Adjustment.* 25 May. Available at: http://ssrn.com/abstract=2610213

Leiby, P. and J. Rubin, 2001. *Bankable Permits for the Control of Stock and Flow Pollutants: Optional Intertemporal Greenhouse Gas Emission Trading,* Environmental and Resource Economics, pg. 229-256.

Leguet, B and Lafitte M, 2015. *Proposal of an innovative funding mecanism by implementing certifticate « eTICC » (Energy Transition Infrastructures with Carbon reduction Certificates) to support « early adopters » of solutions for the low-carbon transution*. Institute for Climate Economics.

NDRC, 2014, *National Climate Change Plan for 2014 to 2020.* September. Available at: http://qhs.ndrc.gov.cn/gzdt/201411/t20141105_647419.html

NDRC, 2015, *National voluntary carbon trading registry.* January Available at: http://qhs.ndrc.gov.cn/gzdt/201501/t20150114_660168.html

Regional Greenhouse Gas Initiative, 2005. *Memorandum of Understanding*. Available at: https://www.rggi.org/design/program-review

Regional Greenhouse Gas Initiative, 2013. *Module Rule.* Available at: https://www.rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Model_Rule_FINAL.pdf

Regional Greenhouse Gas Initiative, 2015. *Program Design*. Available at: https://www.rggi.org/design/overview/cap

Rubin, J.D., 1996. *A model of intertemporal emission trading, banking, and borrowing.* J. Environ. Econ. Manag. 31, 269–286.

Schopp, A., Neuhoff, K., 2013. *The role of hedging in carbon markets, DIW Berlin Discussion Papers 1271. German Institute for Economic Research, Berlin.* Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2239646

Taschini, L., Kollenberg, S., Duffy, C., 2014. *System responsiveness and the European Union Emissions Trading System.* Policy Pap. Cent. Clim. Change Econ. Policy Grantham Res. Inst. Clim. Change Environ., Based on a presentation at Dahrendorf Symposium 2013 28.

Trotignon, R., Gonand, F., de Perthuis, C., 2014. *EU ETS reform in the Climate-Energy Package 2030: First lessons from the ZEPHYR model.* (Policy brief No. 2014-01). Climate Economics Chair, Paris.

UK, 2014. *UK's position on the European Commission's proposal to reform the EU ETS by introducing a Market Stability Reserve*, October 2014. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/364992/UK_MSR_position_gov.uk.pdf

Zachmann G., 2013. *You'd better bet on the ETS*, Bruegel Policy Brief n°2013/02.

CHAPTER

3

CARBON PRICING AND CARBON LEAKAGE ISSUES IN PHASE IV OF THE EU ETS

Authors: Matthieu JALARD, Emilie ALBEROLA, Lara DAHAN, (I4CE – Institute for Climate Economics) and Sylvain CAIL (ENERDATA) [1]

KEY MESSAGES

• ***The new proposal for a revised EU ETS Directive provides an updated "free allocation package" based on the European Council's agreement to pursue free allocation after 2020 -*** The linear reduction factor is to be reduced by 2.2% from 2021 onwards. Aside from the 400 million allowances set aside for the Innovation Fund, 40.4% of the cap will be dedicated to industry freely, which will equal 6.3 billion over the 2021-2030 period. Allocation will be defined for five years periods, based on benchmarks and activity levels updated in 2021 and 2026. Intra-periods adjustements from the NER will be provided in case of output flucations. Benchmark values shall be reduced of 1% per year compared to the value set based on 2007-08 data, entailing a 15% reduction in 2021 and 20% in 2026. Updated thresholds of the carbon leakage list should classify 50 sectors to be at risk of carbon leakage for the period 2021-30 with the proposed criteria, covering 93% of industrial emissions in 2013.

• ***Carbon leakage could be combated more efficiencly using more flexible and targeted allocations -*** To stay below the allocation budget, the proposed mechanism could include an ex post reduction (CSCF) of 20% to all sectors in 2030, additional to the 20% reduction of benchmarks. This would entail increased carbon costs for some highly exposed sectors, while moderately exposed sectors would still enjoy large allocation volumes. Focusing allocation to the most exposed sectors, and providing tiered allocation could improve the efficiency of the protection in the long-term. Implementing a flexible allocation based on more recent production data would provide an adequate incentive to reduce emissions per unit of output, rather than inciting reduced domestic production. With closer threshold values (every 5% for example), the NER could enhance the flexibility in the supply, providing better protection to efficient installations and preventing gaming of the rules.

• ***EU ETS competitiveness in 2030 -*** Based on POLES modeling results, the EU ETS carbon price to meet the 2030 GHG emissions objective increases European energy expenditures, thus reducing the competitive advantage of the European industry by approximately 3 percentage points between 2020 and 2030.

1. This chapter on the carbon leakage issue and free allocation mechanisms is based on I4CE & Enerdata expertise, on analysis developed in the workshop of the COPEC research program organized on 3rd March 2015 and results from academic research. We thank Jean-Pierre PONSSARD, Professor of Economics - École polytechnique, Senior researcher - CNRS, Associate Research Fellow - CIRANO and Frédéric BRANGER, PhD candidate CIRED - France, for their participation to the workshop and for their valuable and relevant analysis.

This chapter introduces in section 1, a synthesis of the EU Commission's proposals on the free allocation mechanism in its proposal for a revised EU ETS directive disclosed on July 15th. After reviewing the main lessons from the first Phases of the EU ETS and the economic literature, section 2 gives, based on a scenario-based approach, an insight concerning the sustainability of different free allocation mechanisms for 2030, and the rules proposed by the European Commission. Then, with the POLES modeling results, section 3 demonstrates consequences for the industry with an analysis of several variables for the EU ETS carbon price by 2030 on competitiveness. Lastly, section 4 examines three other emissions trading schemes tackling carbon leakage issues and how they utilise free allocation mechanisms.

1. CARBON LEAKAGE PROVISIONS: SUMMARY OF THE EUROPEAN COMMISSION'S PROPOSALS BY 2030

On 15th July, the European Commission published a legislative proposal[2] to revise the EU ETS Directive 2003/87/EC, and proposed a set of rules concerning the EU ETS post-2020. This proposal translates into legislation, the political objectives stated by the October 2014 Council Conclusions. With regards to carbon leakage provisions, it proposes a continuation of free allocation until 2030 with the following proposed rules.

Reducing the cap and the free allocation budget

The linear reduction factor of 1.74% by which the cap declines from 2013 to 2020 is to be increased to 2.2% from 2021 onwards. The European Commission has proposed a free allocation budget of 40.4% of the emissions cap within the period (or 43%[3], including the 400 million allowances from the innovation fund[4], which corresponds to the average share of free allowances in Phase III). Hence, 6.3 billion free allowances will be available to industrial sectors relative to the 6.6 billion which were available throughout the eight years of Phase III. Furthermore, 400 million allowances will be placed in a New Entrants' Reserve and made available for new entrants and significant production increases, of which:

- 250 million allowances come from the Market Stability Reserve (MSR), likely corresponding to the amount not allocated during Phase III due to partial cessations of activity (according to the EC, 196 million allowances from the free allocation budget have not been allocated in the 2013 to 2016 period due to partial cessations of activity);
- 150 million allowances from the allocation budget that will not be allocated in Phase III due to the application of the Carbon Leakage Exposure Factor declining from 80% to 30%, meaning that the final allocation remains below the free allocation cap in Phase III.

According to estimated industrial emissions[5], the cumulated deficit of allowances will amount to 1,800 million allowances in Phase IV. However, if the 400 million allowances from the NER are released throughout the period, the cumulative deficit would amount to only 1,400 million allowances.

Continuation of the benchmark-based approach

The European Commission has proposed to continue using benchmark-based allocation in Phase III. Allocation to installations will be defined in five year periods (2021-2025, and 2026-2030).

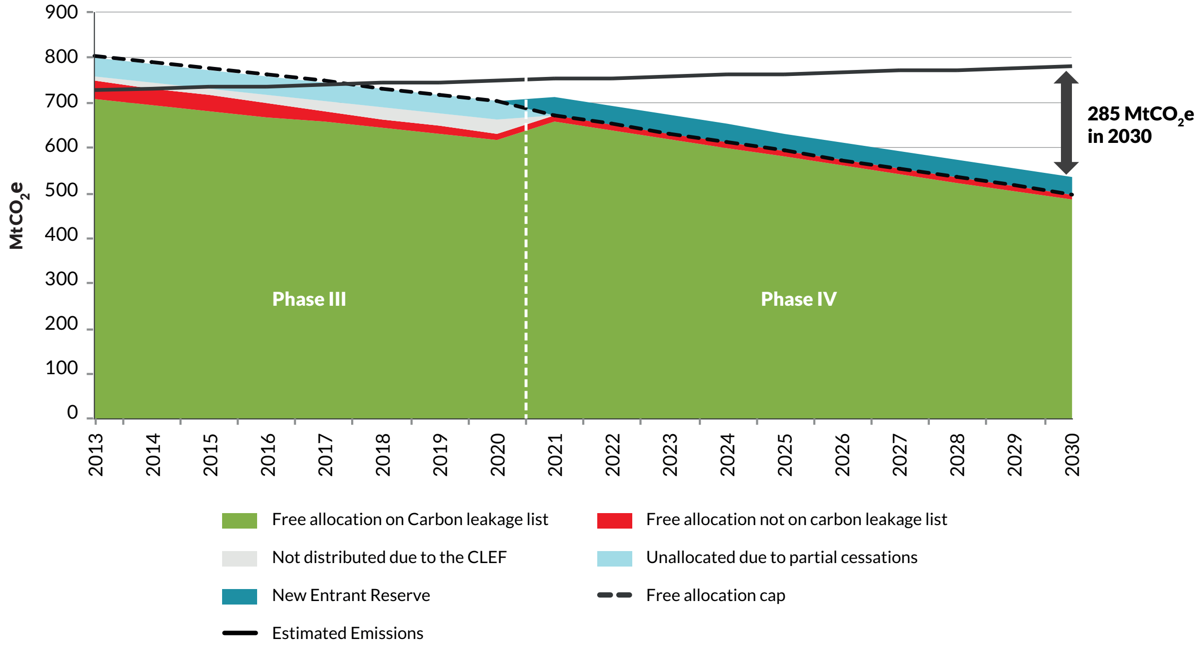
Table 1 - Free allocation and estimated emissions in Phase IV ($MtCO_2$).

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL
Free allocation[6]	677	657	638	618	599	579	560	540	521	501	**5,889**
Estimated emissions	758	761	764	767	770	773	777	780	783	786	**7,720**
Estimated deficit	81	104	127	149	172	194	217	240	262	285	**1,831**

Source: I4CE – Institute for Climate Economics, based on European Commission data, 2015.

2. European Comission (EC), Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, 2015.
3. Proposal for a directive amending directive 2003/87/EC, article 1, amendments 4, page 17, 2015.
4. EC Proposal, article 1 , amendments 5 (c), page 18, 2015.
5. Assuming a 1.4% annual growth rate of activity levels and a 1% annual efficiency improvement.
6. Without free allocation for heat sectors assuming to amount to 400 million allowances in Phase IV.

Figure 1 - Free Allocation Budget in Phases III and IV.



Source: I4CE – Institute for Climate Economics, based on European Commission data, 2015.

Updates of activity levels and the new entrants reserve

In the period 2021-2025 and 2026-2030, allocation will be determined based on updated activity levels respectively from the years 2013-2017 and 2018-2022.

If production increases[7] significantly, activity levels will be adjusted by applying thresholds[8] and allocation adjustments as applied to partial cessations of operations in Phase III. Allowances not allocated to installations due to closures or partial cessation of operations shall be added to the New Entrants' Reserve instead of being auctioned.

Updates of benchmark values for Phase IV

Benchmark values will be updated twice in Phase IV to avoid windfall profits and reflect technological progress.[9] The first update will provide values that will be used from 2021-2025. The second update will concern values applied as of 2026 until 2030. Benchmark values shall be reduced compared to the value that was set based on 2007-08 data. It will decline by 1% each year between 2008 and the middle of the relevant free allocation period[10] i.e. 2023 and 2028. As a result, benchmarks will be decreased by 15% and 20% in the two periods. If there is evidence that the values of a benchmark differ from the default annual reduction by more than 0.5%, benchmarks will be adjusted upward or downward by 0.5%.

A binary carbon leakage list

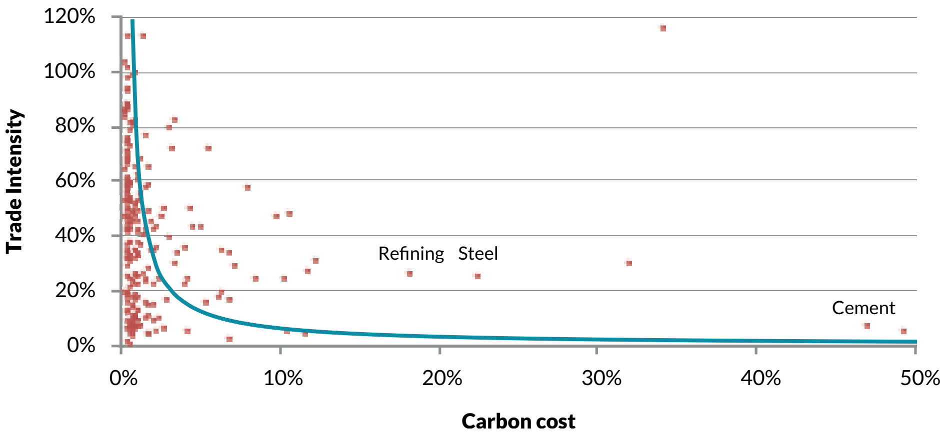
Installations deemed to be exposed to carbon leakages will receive up to 100% of benchmark-based allocation, while other installations will receive only 30%.

A sector is deemed to be at risk of carbon leakage if the multiplication of the two below factors exceeds 0.2:

- Trade intensity with third countries (calculated as the ratio between total value of exports to third countries plus the value of imports from third countries and the total market size of the European Economic Area - calculated as the annual turnover plus total imports from third countries);
- Emission intensity[11] (measured in kg/CO_2 divided by the Gross Value Added).

7. EC Proposal, article 10a and 10b , page 10, 2015.
8. Thresolds are expected to be updated through a delegated act from the current values of 50%, 75% and 90%.
9. EC Proposal, article 10a and 10b , page 10, 2015.
10. EC Proposal, article 10a and 10b , amendment (5) (b) (i) page 18.2015.
11. Currently based on direct plus indirect emissions, but there is no guarantee that this will remain so.

Figure 2 - Distribution of sectors compared to the carbon leakage list frontier.



Source: I4CE – Institute for Climate Economics, European Commission data, 2015.

Figure 2 outlines the position of different sectors compared to the frontier between the two categories of sectors. It has been calculated with data from the European Commission concerning the 2015-2019 carbon leakage list. With the 0.2 threshold proposed, 50 sectors representing 93% of industrial emissions are in the carbon leakage list.

Compensation for indirect costs

The proposed legislation[12] highlights the importance of the provision provided by Members States to compensate for indirect costs. In this regard, the wording has been adapted, to state that Member States *should* (instead of *may*) partially compensate sectors exposed to the risk of carbon leakage for the carbon cost passed on in electricity prices. In addition, '*Financing measures to compensate for indirect costs*' is described as an explicit option to use auctioning revenues for Member States.[13]

2. FREE ALLOCATION, CARBON LEAKAGE AND CARBON COSTS: ASSESSING POTENTIAL MECHANISMS FOR 2030

The tricky equation of free allocation: Preventing carbon leakage and stimulating innovation

Despite the growing urgency of climate change, international climate negotiations have postponed the prospect of a climate agreement which would implement a globally harmonized framework to limit global greenhouse gases emissions. As a result climate policies will remain largely sub-global in the years to come, giving rise to unilateral initiatives which internalise the costs of GHG emissions, such as the EU ETS which covers the equivalent of 2 $GtCO_2e$ of emissions from the European industrial and energy sectors.

However, global cost-effectiveness of unilateral action is reduced by the lack of flexibility in the geographical distribution of GHG emissions reductions and may be further undermined by the phenomenon of carbon leakage. The carbon cost differential between two regions is indeed likely to lead to a delocalization of production towards jurisdictions which are bound by weaker environmental constraints. Such carbon leakages would reduce the environmental benefits of the policy and would have a negative impact upon the economy in question.

The economic literature has taken a close look at this phenomenon:

- So-called *'ex-ante'* partial or general equilibrium models generally present carbon leakage rates ranging from 5% to 20% (Branger *et al.* 2014), but the diversity of underlying assumptions on the elasticity of demand for energy or substitution between local and foreign goods makes it difficult to compare and interpret results.
- To date, empirical studies relating to the first phases of the EU ETS have not shown any significant evidence of carbon leakage (Reinaud, 2008; Sartor *et al.* 2012, Branger *et al.*, 2013). Indeed energy and carbon costs do not appear to influence international trade as much as other

12. EC Proposal, article 10 a and 10b , amendment (5) (d) page 19, 2015.
13. EC Proposal, article 10 a and 10b , amendment (4) (j) page 18, 2015.

factors, such as proximity of demand, or the institutional framework (Sato, 2015). However, to date, observed CO_2 prices have been low and protection mechanisms have been very generous.

Several studies show that climate policies can induce, in some cases, two symmetrical phenomena related to carbon leakage and competitiveness losses that are likely to offset them, at least partially. These are additional GHG emission reductions induced by the diffusion of low-carbon technologies and policies (so called spill-over effect, Dechezleprêtre, 2008, 2012), and the positive competitive impact provided by the first mover advantage (Pollit, 2015). On a broader basis, the Porter Hypothesis (1995) argues that beyond the short-term costs, climate policies are, from a dynamic point of view, likely to stimulate additional innovation efforts increasing productivity, which would not be made otherwise due to unavailability of information or risk aversion. Concerning Europe, this hypothesis is supported by Constatini *et al.* (2011) who made use of a gravity model to show that the EU-15 environmental policies tended to support innovation and exports rather than undermine industrial competitiveness over the period 1996-2007. These results argue for a European industrial renaissance oriented towards resource efficient and green goods that will of high value in future markets.

However, some sectors, producing relatively homogeneous, energy intensive goods and exposed to international trade may incur most of the cost of the climate policy and constitute a major political obstacle to implementing ambitious and economically efficient climate policies. Thus, specific and targeted measures aiming to protect the most exposed sectors to the risk of carbon leakages are required to encourage the acceptability and credibility of climate policies and eventually to strengthen their ambition and reduce their long-term costs.

Strengthening the EU ETS through to 2030 has led the European Council, in October 2014, to commit to pursue free allocation post 2020 so that high performing installations do not face any undue carbon cost if it can be a source of carbon leakage. However, mitigating of carbon costs must not weather carbon efficiency incentives and associated investment in innovative technologies required for deep, long-term decarbonisation of the industrial sectors.

According to the conclusions of the European Council in October[14], free allocation must not lead to sectoral distortions or windfall profits resulting from the allocation surplus. The allocation of free allowances must be sustainable and predictable for industry, especially in the context of a diminishing free allocation budget to preserve the share of auctioned allowances. In view of this, which free allocation mechanisms could be implemented to respond to these specifications?

Lessons from Phase III: experiences and literature review

Mechanisms established to date have largely mitigated carbon costs

Installations subject to the EU ETS face a direct carbon cost which can estimated by multiplying verified CO_2 emissions levels by the average carbon price. The allocation of free allowances is assumed to mitigate this cost. Thus, net carbon cost is defined as the difference between the allocation of allowances and verified CO_2 emissions multiplied by the observed carbon price.

Figure 3 - The tricky equation of free allocation in Phase IV staying in line with EU council conclusions.

Source: I4CE – Institute for Climate Economics, 2015.

14. European Council, 2014, European Council conclusions, October 24th 2014.

According to I4CE – Institute for Climate Economics, for most sectors, net carbon cost has been lower than 1% of sectoral added value in 2013, assuming a carbon price of €5/tCO_2. For some sectors, carbon cost has been negative: this means that free allocation was higher than observed emissions. Moreover, this calculation takes into account neither the potential repercussion of carbon costs to the end consumer in certain sectors, nor the use of international offsets reducing the compliance cost. The perceived cost could therefore have been further mitigated.

Allocation of free allowances using benchmarks with harmonized rules has reduced excess allocations as well as distortions between sectors and countries.

Between 2005 and 2012, every Member State was allocated a budget for their eligible installations depending on historically observed CO_2 emission levels. This allocation method led to significant allocation surpluses: during Phase II, the industry was allocated a quantity of allowances corresponding to 130% of its actual CO_2 emissions. In addition, the allocation level was unequal across sectors. For example, in 2009, the allocation rate, defined as the allocation divided by emissions, was nearly 200% for the steel sector, compared to 100% for the refining sector.

From 2013, the implementation of harmonized European-wide rules, allocating free allowances according to benchmarks and historic output levels, considerably reduced allocation surpluses and, to a lesser extent, distortions between sectors. As illustrated in Figures 4 and 5, the allocation rate was, on average, only 100% for industrial sectors in 2013 and differences between sectors tended to reduce.

However, due to the rigidity of the rules, some sectors still enjoyed significant surpluses in 2013: the steel sector was allocated up to 140% of its emissions[15] and 120% in the case of the cement sector. Indeed, allocation is proportional to the reference historical output levels, and for some sectors, industrial output has fallen compared to pre-crisis levels. Free allocation has not significantly reduced, insofar as most installations continue to produce above the 50% historical output threshold.[16] To a lesser extent, allocation differences between sectors result from the different distributions of installations' carbon efficiencies in relation to benchmarks (Jalard M., *et al*, 2015).

Phase III free allocation limits incentives for carbon efficiency

Beyond unjustified distributional effects, allocation surpluses are likely to damage the efficiency of the EU ETS. Using industrial data, Zachmann *et al.* (2011) showed that over-allocations are prone to reduce installations efforts to reduce emissions. These empirical results are in contrast with the economic theory which states that installations equate the observed CO_2 price with their marginal abatement costs, regardless of the volume of free allowances. He concludes that too high allocation levels tend to mask the price signal observed by market participants.

Figure 4 - Allocation of allowances divided by output based CO_2 emissions: reduction in surpluses in Phase III.

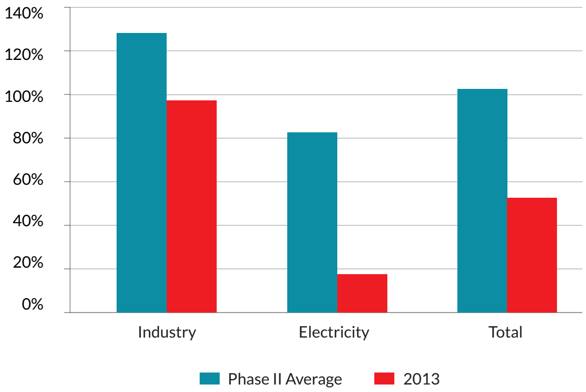
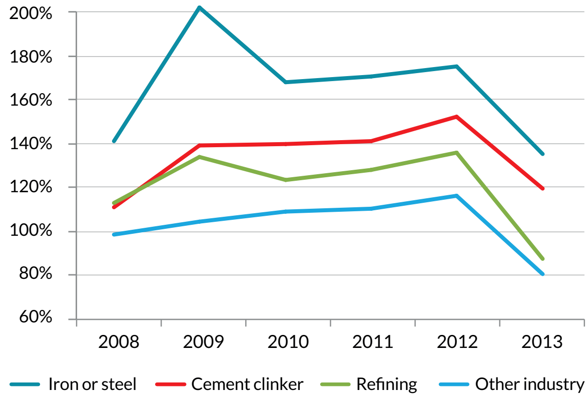


Figure 5 - Allocation of allowances divided by output based CO_2 emissions: distortions between sectors.



Source: I4CE – Institute for Climate Economics, 2015 (calculations based on European Commission data, 2014, EUTL).

15. This figure for steel might be somewhat overestimated as some free allowances are allocated for the sale of sidurgic gases that are not burnt in steel installations.
16. When the annual production level of an installation falls below 50%, 25% or 10% of the historical output level, the allocation received the following year is reduced respectively by 50%, 75% and 100%.

This also means that the opportunity cost of free allowances is not fully passed through to consumers as theory would predict. On the one hand, this means that free allocation is likely to help industries retain their market shares, but on the other hand, it is muting carbon price for intermediate and final consumers, and let some abatement potential along the value chain untapped.

Last but not the least, the current mechanism, which is correcting allocations according to output thresholds, is giving rise to strategic behaviours, ultimately encouraging certain installations to emit more CO_2 per unit produced. The rationale for reducing allocation according to thresholds is to reduce potential allocation surpluses identified during the preceding phases in the event of a large output reduction. However, it has been shown that some installations, particularly in the cement sector where demand remains low, increased their output levels in 2012 to reach these thresholds and to benefit from a higher volume of free allocation. Using a counterfactual scenario, Branger *et al.* (2014) show that strategic behaviours of cement plants in order to reach the 50% historical output threshold entailed an increase in European clinker production of 6.4 Mt in 2012, i.e. an emissions increase of 5.8 $MtCO_2e$.

To conclude, although the current allocation mechanism has effectively mitigated the carbon costs for all industrial sectors, thus protecting those most at risk, the rigidity of the current regulation is entailing significant distortions between sectors and giving rise to perverse incentives that fail to properly reward carbon efficiency improvements. Thus, it seems necessary to increase the flexibility of the current free allocation mechanism and to make it more responsive to output fluctuations. In this regard, economic literature suggests that output-based allocation (OBA) would be more efficient to combat carbon leakages, rather than historical allocation (HA).

Insights from academic literature on output based allocation

In the absence of a harmonized price signal on the international scale, the economic literature suggests (Demailly and Quirion, 2006; Monjon, 2009; Fisher, 2009) that auctioning allowances for all sectors, combined with a border carbon adjustment, is the most cost-effective way of implementing a unilateral climate policy. This would, indeed, equalize the carbon costs while efficiently enabling the pass through of carbon costs throughout the whole value chain. The incentive to reduce CO_2 emissions remains, both through more efficient production and through substitution by products emitting less CO_2 in domestic consumption. However, such a mechanism raises concerns in terms of administrative costs, compatibility with international trade regulations (Branger, 2013) and equitable sharing of abatement costs (Böhringer, 2012). A border carbon adjustment mechanism could be seen as veiled green protectionism and could trigger a trade war, instead of incentivizing the implementation of similar climate policies.

In the case of Europe, the acquisition of allowances for importers according to Best Available Technologies carbon intensities, as well as recycling revenues raised for funding mitigation and adaptation in developing countries (Godard, 2009, Branger, 2013) is the most plausible solution to comply with GATT regulations (so called 'most favoured nation' and 'national treatment') while equitably distributing the revenue raised. However, this would not allow discriminating against the less carbon efficient producers worldwide, increasing the cost of the policy compared to an efficient outcome.

In light of the difficulties around implementing a border carbon adjustment, Demailly (2008), Quirion (2009) and Fisher (2004) suggest using output-based allocation, which is more efficient to combat carbon leakage than historical allocation currently applied in the EU ETS. Historical allocation, compensating carbon costs with a lump-sum, has

Table 2 - Comparison of various allocation mechanisms.

	Grandfathering	Benchmarking based on historical output	Output based (dynamic) allocation	Border Trade Adjustement
Leakage protection	-	-	+	++
Windfall profits and distorsions	- -	-	+	++
Incentive to carbon efficiency	- -	-	+	++
Price signal transmission	-	-	- -	++
Administrative costs	++	+	-	- -

Source: I4CE – Institute for Climate Economics 2015 based on Demailly 2008, Quirion, 2009, Monjon 2011, Fisher 2004.

a tendency to preserve industrial competitiveness, seen as the ability to generate profits. Output based allocation, by encouraging production, can better preserve competitiveness, defined as the ability to retain market share, and will thus be more effective to combat carbon leakages. However, the cost of the climate policy is likely to increase. On the one hand, the marginal carbon cost borne by installations will vary depending on sectors and benchmarks. This can give rise to inefficiencies in allocating abatement efforts, which may not occur when it is cheaper. On the other hand, as carbon cost at the margin decreases, the price signal passed through will be mechanically lower, which could lead to excessive consumption of polluted goods. In comparison with an optimal decarbonisation trajectory, this would entail the use of additional and more costly abatement options to achieve the same reduction target.

Sustainability and efficiency of free allocation through 2030: a scenario-based approach

The declining free allocation cap over Phase IV means that the free allocation budget is limited to 6.3 billion allowances, whereas allowances needs of industrial sectors are estimated at 7.6 billion[17] over this timeframe. The problem to be addressed is how to optimally allocate the free allocation budget to combat carbon leakage efficiently, while complying with specifications formulated by the European Council.

For this purpose, different scenarios are explored:

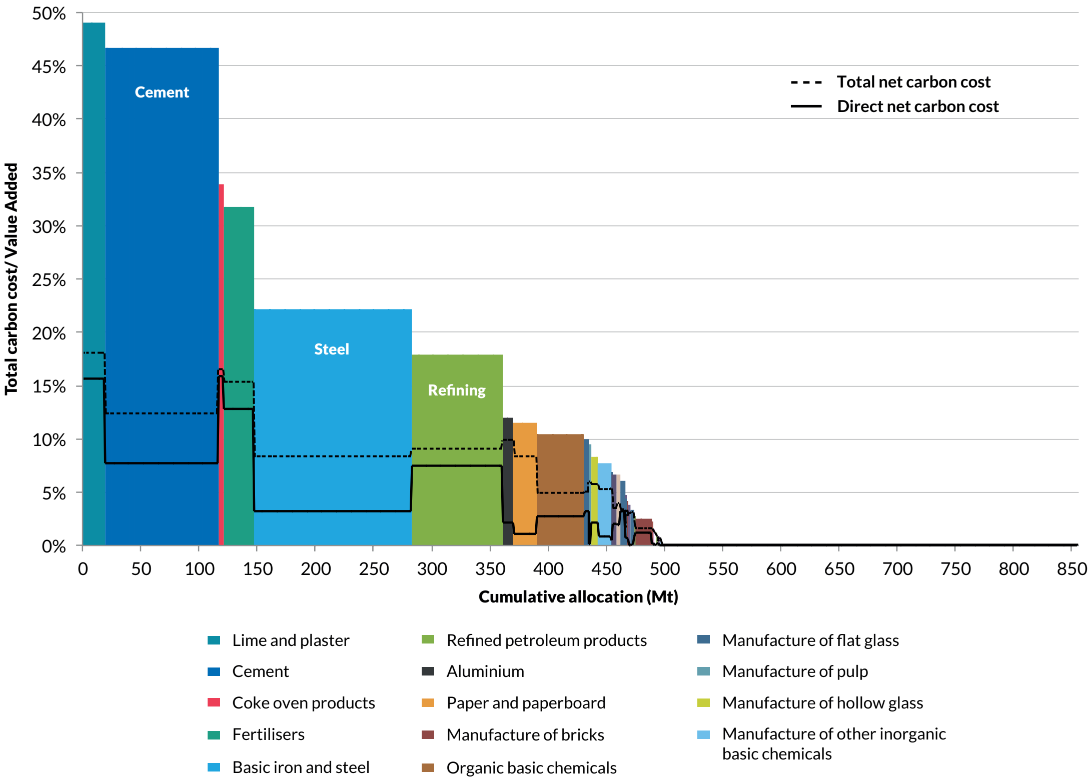
- **Scenario 1** extends the current free allocation mechanism until 2030;
- **Scenario 2** analyzes the implementation of more frequent updates of activity levels and benchmarks;
- **Scenario 3** building on the enhanced flexibility outlined in the second scenario, explores a targeted and gradual free allowances mechanism depending on exposure to the risk of carbon leakage.
- **Scenario 4** provides a first assessment of the European Commission's proposal for Phase IV.

Scenario 1: Continuation of current Phase III rules

The first scenario considers extending, current allocation rules until 2030. The underlying assumptions being that:

- The list of sectors deemed to be exposed to carbon leakages during the 2020-2030 period remains identical to those identified for 2015-2019;

Figure 6 - Carbon costs in 2030 assuming continuation of current rules and a carbon price of €30/tCO_2e.



Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

17. Assuming a 1.4% annual growth of activity level, and a 1% annual efficiency gain from 2013 onwards.

- The preliminary allocation attributed to an installation is equal to the benchmark multiplied by the unchanged historical output level;
- Benchmark values are assumed to be constant,
- The Carbon Leakage Exposure Factor decreases linearly and stops in 2027;

In this scenario, the adjustment of free allocation to the free allocation cap by applying the Cross-Sectoral Correction Factor (CSCF) would be equal to 66% in 2030, entailing a 34% reduction of free allocation to all sectors, regardless of their actual exposure Sectors at risk may face undue carbon costs, while lesser exposed sectors would still benefit from significant amounts of free allowances. This distribution is not efficient to combat carbon leakages. The cement sector would face a net carbon cost on the same order of magnitude as steel, whereas it is not as exposed to international trade. Figure 6 outlines the allocation volumes to each sector, the gross carbon cost, and the associated net carbon cost[18] mitigated with free allocation.

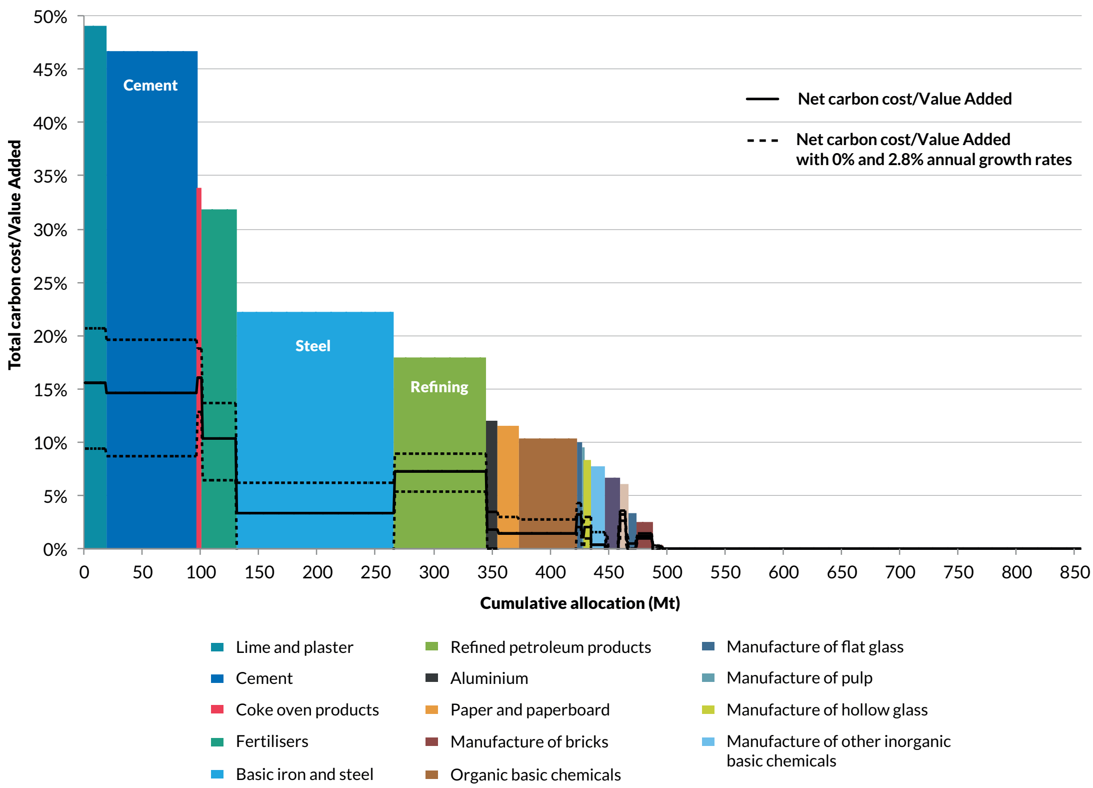
Scenario 2: Enhanced flexibility for activity levels and benchmarks

The second scenario considers updating activity levels and benchmarks until 2030. The underlying assumptions being that:

- The list of sectors deemed to be exposed to carbon leakages during the 2020-2030 period remains identical to those identified for 2015-2019;
- The preliminary allocation attributed to an installation is equal to the benchmark multiplied by the actual output level[19];
- Benchmarks are assumed to gradually decrease along with observed sectoral technological progresses (1% per year for industrial installations).

In 2030, the adjustment of the free allocation volume to the free allocation cap by applying the Cross-Sectoral Correction Factor (CSCF) would be equal to 71% entailing a reduction of free allocation to all sectors, regardless of their actual exposure.

Figure 7 - Carbon costs in 2030 with updates of activity levels and benchmarks.



Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

18. Total Net carbon cost= $\frac{\text{Emissions-Allocation}}{\text{Emissions}}$ × Direct cost + Indirect cost.

19. The output level of industrial installations is assumed to grow 1.4% per year, from 2013. The carbon intensity of installations is assumed to decrease by 1% per year.

Furthermore, this correction factor could be computed only ex post, when the aggregate level of activity is known. Assuming a 0% to 3% annual growth rate of activity levels, the CSCF would be between a 62% to 84% range in 2030. This would lead to an uncertainty concerning the net carbon cost on the order of magnitude of 10% of value added as outlined in Figure 7.

Scenario 3: Tiered allocation to ensure more efficient distribution of the free allocation budget

The third scenario implements a set of thresholds and corresponding allocation rates, so that free allocation volumes received by installations better reflect their real exposure to carbon leakage. Installations with carbon cost and trade intensity higher than the "high exposure" thresholds would still receive 100% of benchmark-based allocation volume. Medium and little exposed sectors would receive only 70% and 30%.

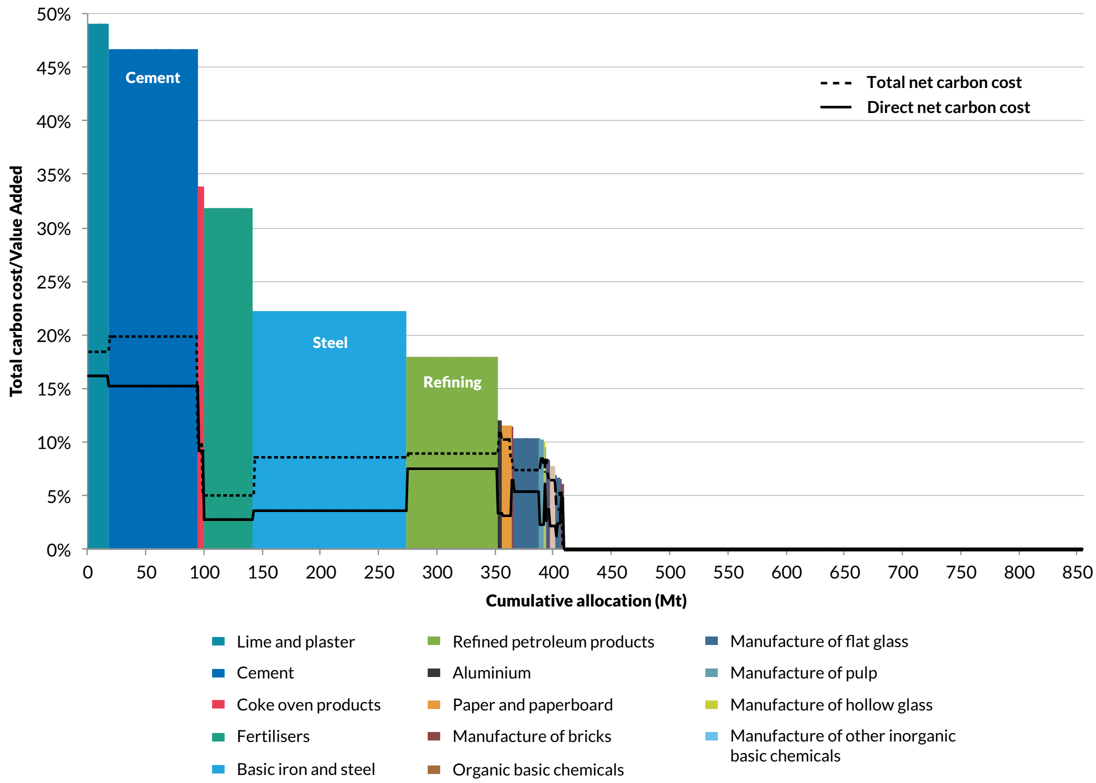
With this example of thresholds, a tiered allocation would amount to the distribution of only 400 million free allowances in 2030, which is below the allocation cap. As such, no ex post correction would be necessary, as long as average annual growth remains below 2%. This allocation method would be more efficient to combat carbon leakages and volumes allocated per unit of output would not be subject to uncertainties.

Scenario 4: The proposed revision to the Directive

The Commissions decision could lead to a 35% uniform reduction of allocation volumes by 2030, with levers to make free allocation more targeted to exposed sectors.

In the proposal, benchmarks are reduced 1% per year from 2008 onwards. This will lead to a decrease of free allocations to each sector, regardless of their exposure to carbon leakage.

Figure 8 - Carbon costs in 2030 with updates to activity levels and benchmarks, and a tiered allocation.



Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

Table 3 - Example of thresholds and rates for tiered allocation.

Exposure	Carbon cost	Trade Intensity	Allocation rate
High	25%	15%	100%
Medium	15%	5%	70%
Low	5%	0%	30%

Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

> *The Commissions decision could lead to a 35% uniform reduction of allocation volumes by 2030, with levers to make free allocation more targeted to exposed sectors.*

This automatic update of benchmarks is equivalent to applying a uniform correction factor of 85% during the 2021 to 2025 period, and of 80% during the 2026 to 2030 period. As such, it does not enable the distribution of free allowances to those sectors most at risk, and does not improve the efficiency of the allocation method.

With the carbon leakage list proposed, a 1.4% annual growth until 2022 (reference year for the update of activity levels in the period 2026 to 2030), a 1% annual decrease of benchmark values, the preliminary allocation[20] is estimated to be on the order of magnitude of 608 million allowances in the 2021-2025 period, lower than the free allocation budget[21], and thus no CSCF would be needed. Then the preliminary allocation is estimated to be 620 million allowances in the 2026-2030 period, higher than the free allocation cap. This would entail a CSCF decreasing from 98% in 2026 to 81% in 2030. This CSCF would come on top of the uniform reduction of 20% of the benchmarks. As such, the allocation would be uniformly reduced by 35% in 2030, and the allocation rate would be of 65% in this time frame. With a 0.5% revision of all benchmarks, the CSCF reaches 73% in 2030, but in the end, the allocation rate remains 65%. With a 0% revision of benchmarks, the CSCF is estimated to be 65% in 2030.

As a result, free allocation does not seem to be targeted enough to the sectors most exposed sectors which might face high carbon costs in the 2030 horizon.

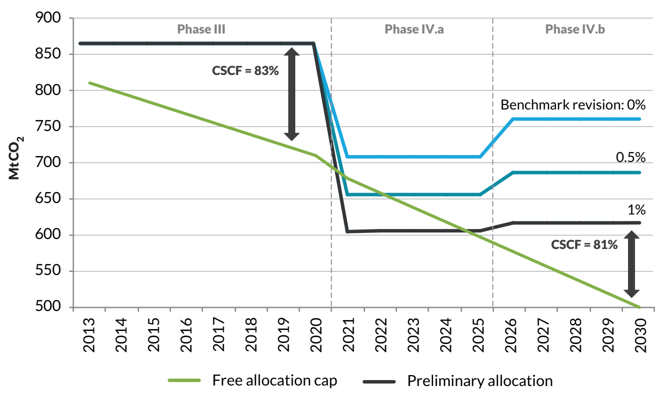
Building on the European Commission's proposed mechanism, a more focused carbon leakage list could be implemented. With a carbon leakage list coefficient of 0.8, instead of 0.2, the list would only cover 78% of 2013 emissions (Figure 12).

One possible method to make free allocation more targeted would be to differentiate the rate at which benchmarks are updated. However, details on how sectors can provide evidence to apply for a 0.5% yearly benchmark decrease are missing, leading to uncertainty concerning allocation levels. An alternative would be to propose an update based on real data for sectors likely to undergo yearly carbon efficiency gains below 1%.

The current proposal offers little progress regarding flexibility in the supply of free allowances, but the NER could play a pivotal role in improving it properly implemented.

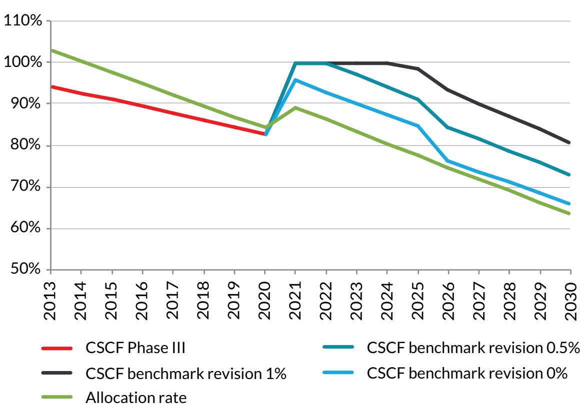
There has been strong support for enhanced flexibility in the supply of free allowances to improve the effectiveness of the protection, and to provide a clear incentive to improve carbon efficiency.

Figure 9 - Preliminary allocation and the free allocation cap until 2030.



Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

Figure 10 - CSCF values and the rate of free allocation for industrial sectors.

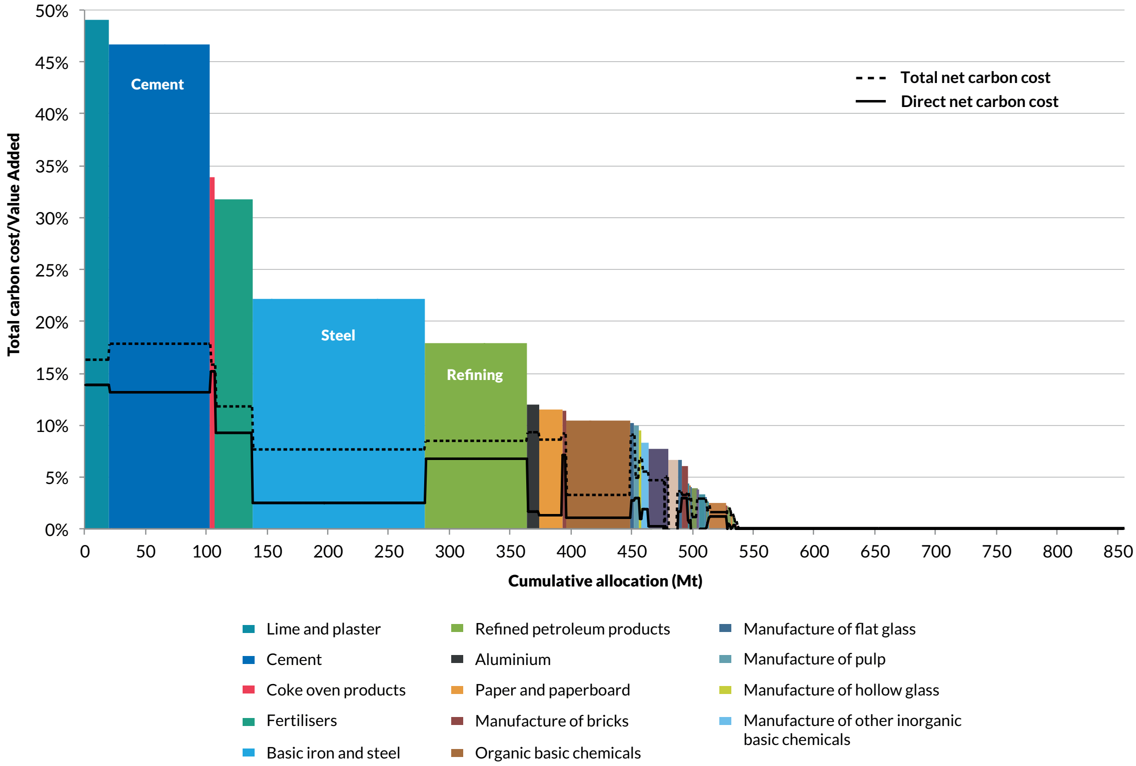


Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

20. The preliminary allocation corresponds to the benchmark based allocation, multiplied by 30% for sectors not deemed to be exposed, and 100% for exposed sectors.
21. Free allocation to the heat sector is assumed to be constant as of 2021 and is subject to the free allocation cap and the application of the CSCF.

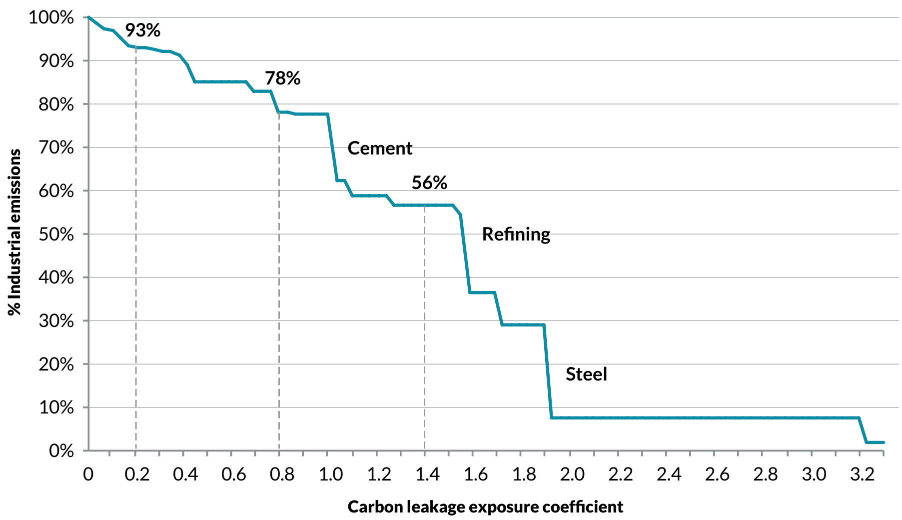
In this regard, the revision of production only once every five years (instead of eight years in Phase III) in combination of the application of concrete thresholds to adapt to important output fluctuations differs very little from the provisions of Phase III. Therefore, the incentive for carbon efficiency in the production processes might be blurred as was the case in the first years of Phase III. However, the introduction of a New Entrants' Reserve that can increase supply allowances in case of increased production, and not only increased capacity, could make a major difference. If activity levels increase beyond certain thresholds, it is proposed to adjust allocation volumes symmetrically to downwards adjustments for partial cessations. Thresholds are expected to be updated through a delegated act. Current values of 50%, 75% and 90% that apply to partial cessations of operations in Phase III can't offer the necessary flexibility. The NER could play an important role only

Figure 11 - Estimated carbon costs in different sectors.



Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

Figure 12 - Emissions covered by the carbon leakage list for different coefficients.



Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

if the intervals between thresholds used are closer. The 15% value mentioned in the proposal seems unlikely to sufficiently reduce the rigidity of supply. With closer threshold values (e.g. every 5%), the NER could enhance the flexibility in the supply, providing better protection to efficient installations and preventing gaming of the rules. This NER could also be used to smooth the effect of the CSCF and other uniform reductions in supply. Allowances could be released from the reserve as the free allocation cap declines.

With a 1% yearly update of benchmarks, the NER could eliminate the need to apply a CSCF during Phase IV. From 2021 to 2024, we estimate that in the case of a 1.4% growth of activity levels, 160 million allowances would add up in the reserve, and 410 million would be released from 2026 to 2030 preventing the application of a CSCF. In 2030, there would still be 150 million allowances left for Phase V.

In the case of a 0.5% update of benchmarks, the NER would release 420 million allowances from 2023 to 2028, preventing the CSCF from being applied. The NER would then be depleted, and a CSCF of 73% would need to be applied in 2030.

There is a need to address the issue of the transmission of the carbon price signal.

The issue of the pass through of the carbon cost by producers of carbon intensive materials producers should be carefully addressed to enhance the efficiency of the free allocation supply. If carbon pass through turns out to be high for certain sectors, it means that free allocation is not efficient at combatting carbon leakage and should be removed for those sectors. In our view, there should be clear provisions in this regard, as well as the definition of a robust methodology to review pass through rates.

Figure 13 - Using the NER with 1% flat rate update of benchmarks.

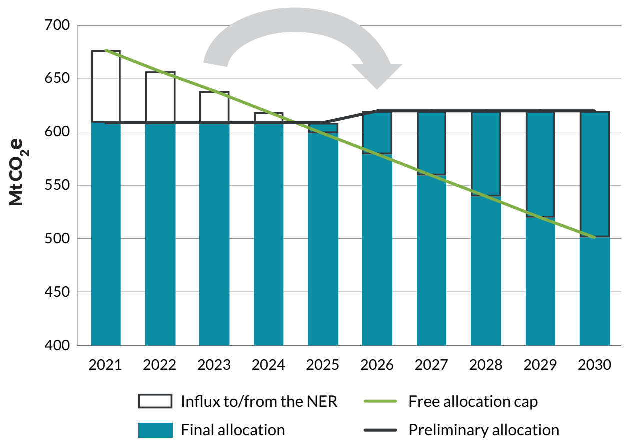


Figure 14 - NER volume and CSCF values with 1% flat rate update of benchmarks.

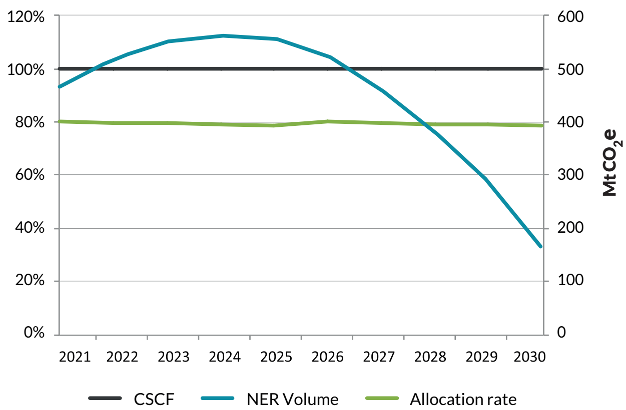


Figure 15 - Using the NER with 0.5% flat rate update of benchmarks.

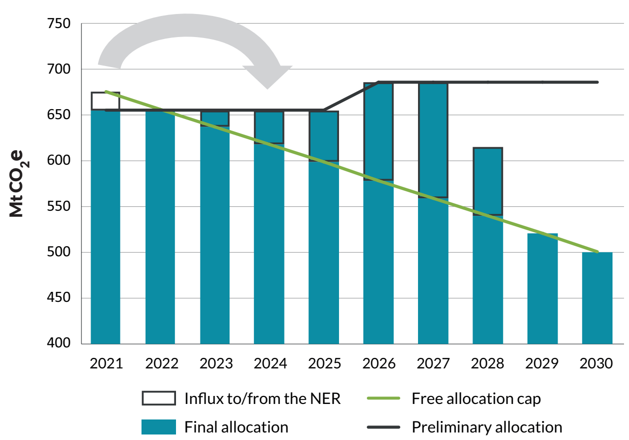
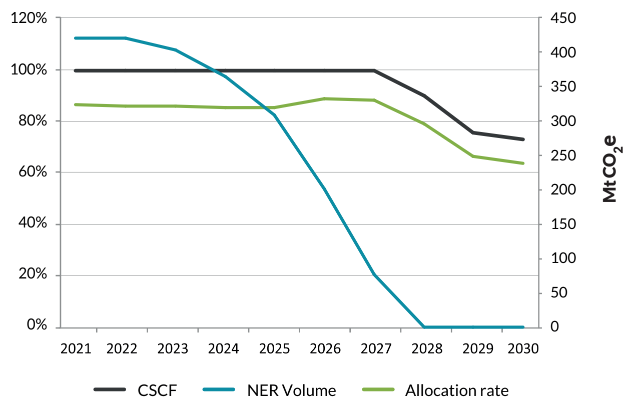


Figure 16 - NER volume and CSCF values with 0.5% flat rate update of benchmarks.



Source: I4CE – Institute for Climate Economics based on European Commission data, 2015.

Conversely, if there is no pass through of carbon cost, some mechanisms to enhance the CO_2 price visibility to intermediate and final consumers is necessary to spur innovation for carbon efficient products along the value chain.

Conclusion: Carbon leakage could be combated more efficiently through flexible and targeted allocations

The issue of carbon leakages has to be considered with attention in preparation for Phase IV of the EU ETS. Carbon leakages can bring the legitimacy of a climate policy into question: emission reductions would not be effective and they could potentially have negative impacts on the economy. Empirical studies tend to show that carbon cost only plays a minor role in international trade flows compared to other overriding factors. However, in order to strengthen the ambition and credibility of the EU ETS as well as conveying a long term price signal, effective mechanisms to mitigate carbon leakage risks are necessary.

With no prospect for border carbon adjustments in the years to come and an array of uneven climate policies worldwide, the European Council have agreed to pursue free allocation after 2020 to mitigate the carbon cost to rick exposed sectors. It is widely acknowledged that the current allocation mechanism cannot be pursued post 2020 as it is not likely to drive innovation and carbon efficiency adequately, gives rise to economic inefficiencies, and over-allocation – threatening the credibility and legitimacy of the EU ETS. Moreover, given the dwindling free allocation budget, continuing this method would entail high carbon costs for some highly exposed sectors as shown in the development of scenario 1, while moderately exposed sectors would still enjoy large allocation volumes. Implementing more flexible allocation, based on recent production data would be a more effective way to combat carbon leakage. It would provide an adequate incentive to reduce emissions per unit of output, rather than inciting reduced domestic production.

Furthermore, distortions and windfall profits entailed by excess allocation and pass-through of carbon cost would be largely mitigated. Combined with continued update of benchmarks reflecting the gradual improvements of sectoral carbon intensities, the allocation should be more focused, incremental, and contingent on actual exposure to carbon leakage. For this purpose, defining of a more targeted list of sectors which would be allocated according to thresholds depending on carbon cost and trade intensity could be a solution that has also been implemented as part of the California Cap-and-Trade (ETS). This method allows, under reasonable growth assumptions, to maintain the allocation volume under the cap induced by Point 2.9 of the European Council stating that the share auctioning allowances should remain constant. As a result, neither CSCF nor any ex post correction would be necessary in this framework.

This more flexible allocation method would however water down the transmission of price signals along the value added to the consumer. Some additional mechanisms may be warranted to create markets for low carbon materials, and steering more efficient use of steel and cement through better coordination along the value chain.

It has been advocated[22] that an inclusion of consumption in EU ETS through a consumption charge could play this role. A thorough analysis would be necessary to confirm that the additional costs of such a mechanism would not outweigh the benefits. However, non-price barriers may prevail for consumption efficiency as is the case for energy efficiency (lack of information, split incentives). Labels certifying that the materials embedded in the end-products are low carbon could be a lever to enhance stronger coordination throughout the value chain. Going forward, standards could also be implemented. A closer relationship between materials producers and intermediate consumers would in turn help low carbon producers to differentiate their products and retain market shares even in case of higher input costs, further mitigating the risk of carbon leakage.

The administrative cost related to implementing output-based allocation could be high. Applying the mechanism to the top ten energy-intensive sectors which are most exposed to the risk of carbon leakage could be relevant. These sectors would indeed represent 85% of free allowances in 2030, but only 18% of industrial installations. Annual monitoring of their output data would thus be simplified.

The current proposal seems close to the status quo and is unlikely to forge a credible framework for the decarbonisation of industrial sectors. However, building on the proposal, there is room to substantially improve the supply of free allocation:

22. Climate Strategies - Inclusion of consumption in the EU ETS.

by designing the NER thresholds properly to give the adequate dynamicity to the mechanism, by increasing the stringency of carbon leakage thresholds and by differentiating benchmark revisions as a way to target free allowances.

3. EUROPEAN INDUSTRY COMPETITIVENESS UNDER THE EU ETS: RESULTS BASED ON THE POLES MODEL

General context of the reference scenario

The COPEC reference scenario COPEC GHG includes a single objective of GHG emissions reduction in Europe by 40% in 2030 compared to 1990 levels. Beyond its achievement, simulation results (see Chapter 1) have shown that the share of renewable energy sources in gross energy consumption is raised to 28.6% in 2030 (vs. 27% objective of the European Commission), and that 23% energy efficiency is achieved compared to the 27% target.

On the demand-side, the COPEC GHG scenario leads to a decline in European energy demand (Figure 17), in line with the estimations derived from the GHG40 scenario of the European Commission's Impact Assessment (see EC, 2014).

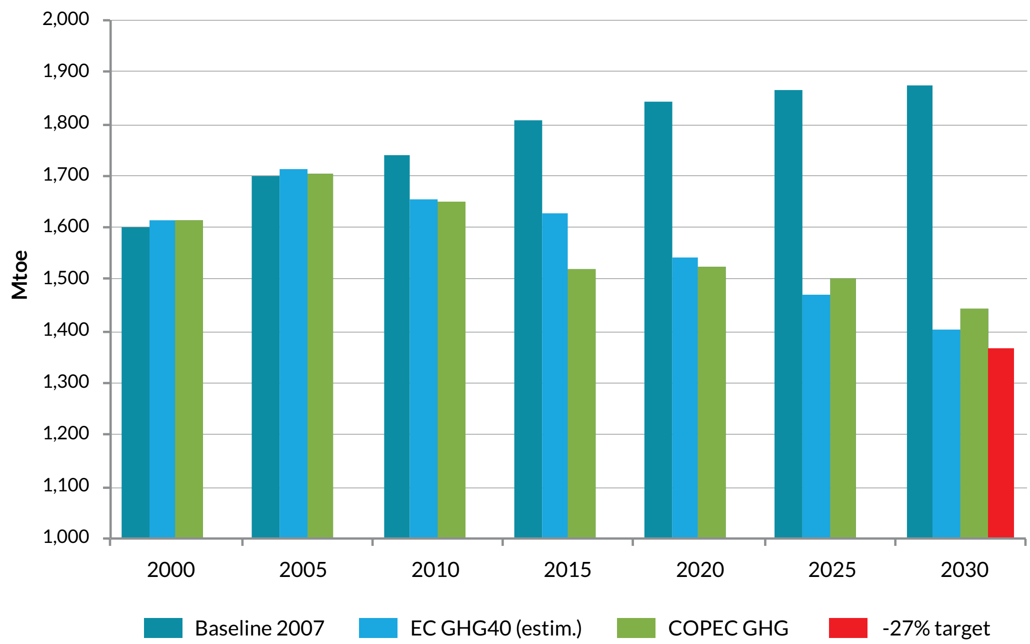
The objective and demand reduction efforts are compared to the Baseline 2007, i.e. the demand evolution scenario calculated in 2007 with the PRIMES model and used as a reference by the EU (EC, 2008). The main differences observed for 2015, lie in the historical data used (2013 for POLES, 2010 for PRIMES), for 2030, they lie in more ambitious implicit energy efficiency policies within the EC GHG40 scenario.

Methodology for assessing competitiveness

To analyze competitiveness, results from the POLES reference scenario are used and further detailed according to Figure 18 and the equation below. The value added being a fixed input of the simulation, the objective is twofold:

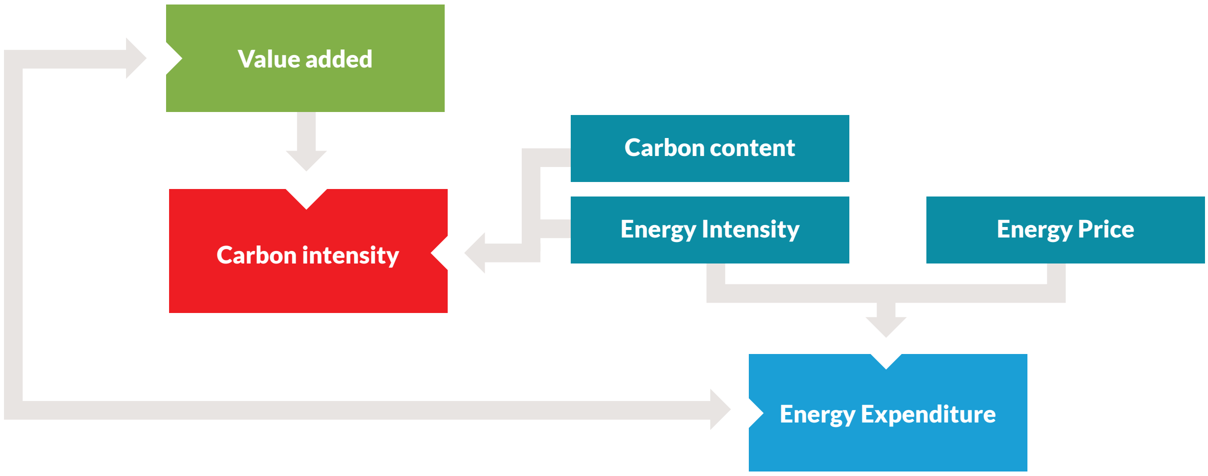
- to understand the evolution of carbon intensity in the European industry as well as in some European countries, relative to non-European countries; this will help clarify to what extent specific factors (emissions, energy demand) contribute to the decarbonisation of the European industry;
- to understand the evolution of EU industry competitiveness in relation to the indirect costs incurred by the EU-ETS (energy costs).

Figure 17 - Evolution of final energy demand in the COPEC GHG scenario.



Source: POLES-Enerdata model, 2015.

Figure 18 - Overview of methodology for analysing competitiveness.



Source: POLES-Enerdata model, 2015.

Carbon intensity is the ratio between emissions and value added, so that it can be explained as the product between carbon content and energy intensity. Analyzing those two factors and their evolution over time in the countries considered helps to understand possible differences between countries in and outside the ETS.

$$\text{Carbon Intensity} = \frac{\text{Emissions}}{\text{Value Added}}$$

$$= \frac{\text{Emissions}}{\text{Energy Consumption}} \times \frac{\text{Energy Consumption}}{\text{Value Added}}$$

$$= \text{Carbon Content} \times \text{Energy Intensity}$$

In addition, an economic indicator, called energy expenditure intensity, is built as the ratio between energy expenditure and value added of the industry to provide further indications on industry's competitiveness among countries.

Impacts of the EU ETS on EU industry competitiveness

To analyze the effects of the ETS on industry's competitiveness, the methodology described above is applied to the EU as a whole, France and Germany, and Turkey as a country outside the permit trading system.

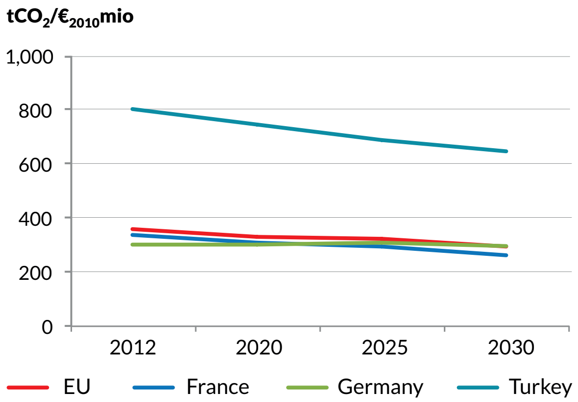
Figure 19 shows the evolution over time of carbon intensity in those countries. The large gap existing between Turkey and European countries in 2012 (442 $tCO_2/€_{2010}$mio) is reduced significantly over time; the reduction reaches 20% in 2030.

The method suggested aims to split carbon intensity into two variables, namely carbon content and energy intensity, as illustrated in Figure 20. The 20% drop observed in carbon intensity between Turkey and the European average is explained by:

- a 5% gap reduction of carbon content, i.e. the ratio between emissions and energy consumption of the industry;
- a 16% gap reduction of energy intensity, i.e. the ratio between energy consumption and value added.

The gap reduction observed in carbon intensity between the EU and Turkey is mostly driven by the change occurring in energy intensity. In particular, energy consumption of industry is keeping relatively stable in the EU while a significant increase is expected in Turkey (+56% over 2012-2030).

Figure 19 - Carbon intensity of selected countries against the European average.



Source: POLES-Enerdata model, 2015.

But the value added of the Turkish industry is likely to increase by over 80% over the same period vs. only 18% for the European industrial sector. In total, this leads to a sharper decrease in energy intensity in Turkey than in the European average. To assess the economic impact of the EU ETS in more detail, the evolution of "energy expenditure intensity", as defined above, is shown in Figure 21.

Intensity of energy expenditure provides an estimate of how expenditure for energy, i.e. final consumption multiplied by energy price, covering all fuels in all industrial sectors, is related to the industry's value added.

Energy expenditure represented respectively about 11% of industry's value added in Turkey and 8.3% in Europe in 2012. This 2.7 percentage point gap might progressively increase until 2020 if the carbon price in Europe remains at a relatively low level.

The CO_2 price resulting from the reference scenario is internalized in energy prices, as shown exemplarily for the electricity price in Figure 22.

The price differential observed between Turkey and the European average is therefore increasing accordingly, from about €$_{2010}$13/MWh in 2020 to €$_{2010}$21/MWh in 2030.

After 2020, the carbon price resulting from the EU ETS to meet the 2030 objective increases European energy expenditure so that their intensity is raised from 7.6% in 2020 to 10.5% in 2030, whereas Turkish energy expenditure remain quite stable at 11.6% of value added during the period 2020-2030. As a conclusion, the competitive advantage held by European industry is analyzed here in terms of energy expenditure intensity, as defined above. This advantage, measuring the impact of the ETS' indirect costs (impacts on energy costs), could be reduced by approximately 3 percentage points between 2020 and 2030.

Figure 20 - Carbon content (left) and energy intensity (right) of selected countries against the European average.

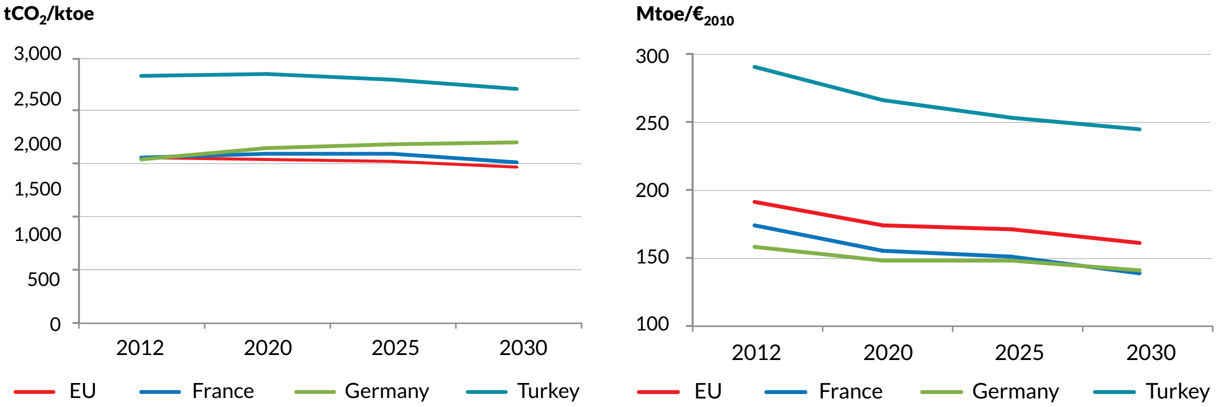


Figure 21 - Intensity of energy expenditure in selected countries against the European average.

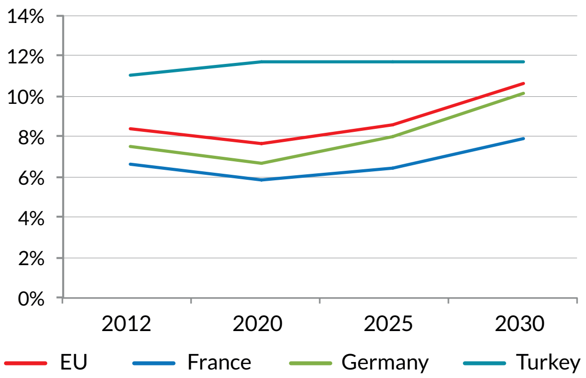
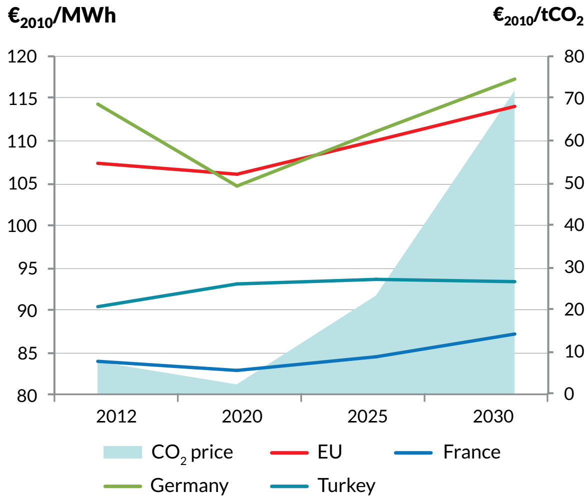


Figure 22 - Internalising the CO_2 price in electricity prices.



Source: POLES-Enerdata model, 2015.

4. ETS DESIGN BEYOND EUROPE: TACKLING CARBON LEAKAGE

All emissions trading systems feature some form of legal provision to protect industry competitiveness, and avoid emissions leakage. The ETS design features that tackle competitiveness issues differ depending on a range of national and international circumstances. A common strategy used to avoid leakage and competitiveness issues is to allocate all, or a percentage of allowances for free to participants who are deemed to be *energy intensive and trade exposed* (EITE) and therefore at high risk for carbon leakage. Carbon leakage risks are generally estimated by performing quantitative tests that determine the carbon cost incurred by market participants and exposure to international trade, and by performing qualitative tests. Using emissions, value added, market, imports data the respective regulatory authorities are able to estimate and classify an industry, sector, or process into varying levels of risk to leakage. These methodologies help to inform the level of free allocation a covered entity should receive in order to ease competitiveness concerns and avoid emissions leakage.

Table 4 - Trading tackling carbon leakage beyond Europe.

	California ETS	US Waxman-Markey ETS bill (project)	New Zealand ETS
% Industry CO_2e emissions covered by ETS	5.18% (process emissions, 2012).	30.35% (overall industrial emissions, 2009).	8.78% (process emissions, 2012).
Free Allocation Methodology	Benchmarking: Product based.	Average CO_2 emissions from industry.	Benchmarking: Intensity based.
% Free Allocation	Allowances for each sector will be close to the average emissions computed from recent data, at about 90% based on an efficiency benchmark for each industry.	75% of allowances were to be freely allocated through 2026. (Between 2012-2050, 40% of the total available allowances will be auctioned and 60% will be freely allocated).	90% of 2005 emissions for agriculture and emissions intensive industry.
Quantitative indicators	**Emissions intensity** $\frac{\text{Emissions}}{\text{Value Added}}$	**Carbon costs** $\frac{\text{Indirect costs + fuel costs}}{\text{Value of shipments}}$ $\frac{\text{direct + indirect emissions x } PCO_2}{\text{Value of shipments}}$	**Emissions intensity** $\frac{\text{Emissions}}{\text{Revenues}}$
	Trade intensity $\frac{\text{imports + exports}}{\text{production + imports}}$	**Trade intensity** $\frac{\text{imports + exports}}{\text{production + imports}}$	All sectors deemed trade exposed.
Thresholds determining exposure to carbon leakage	**Emission intensity** • High: > 5,000 • Medium: 4,999 - 1,000 • Low: 999 - 100 • Very low: less than >100	Carbon costs over 5%	**Emissions intensity** • High: 1,600 (or 4% of revenue) • Moderate: 800 (or 2% of revenue)
	Trade intensity • High: >19% • Medium: 10-19% • Low: less than 10%	**Trade intensity** • 15% or more	
Level of free allocation to exposed industries	**High Risk** • 100%: 2013-2020 **Medium Risk** • 100%: 2013-2014 • 75%: 2015-2017 • 50%: 2018-2020	Compensation determined using ex-post production data.	**High Risk** • 90% **Medium Risk** • 60%

Source: I4CE – Institute for Climate Economics, 2015.

REFERENCES

Böhringer CC, Carbone J, Rutherford T, 2012a. *Unilateral climate policy design: Efficiency and equity implications of alternative instruments to reduce carbon leakage.* Energy Economics 34(Suppl. 2):208-17.

Branger, F, Ponssard JP, Sartor O, and Sato M, 2014.*Distortions from Activity Level Thresholds in the EU-ETS. Evidence from the Cement Sector.* Grantham Working Paper 169, 2014.

Branger et al, 2013. *Carbon leakage and competitiveness of cement and steel industries under the EU ETS : much ado about nothing*, Working Paper n°53, CIRED

Branger F, Quirion P, 2013. *Climate policy and the 'carbon haven' effect*, WIREs Clim Change, 5: 53–71. doi: 10.1002/wcc.245

Calel and Dechezlepretre (2012). *Environmental policy and directed technology change: evidence from the European carbon market,* Grathman working paper N°75.

California Air Resources Board (CARB) (2006), *Assembly Bill 32: An act to add Division 25.5 California Global Warming Solutions Act (commencing with Section 38500) to the Health and Safety Code, relating to air pollution*, Sacramento, CA, 27th September.

Costantini and Mazzanti, 2011. *On the green and innovative side of trade competitiveness? The impact of environmental policies and innovation on EU exports.*

Climate Strategies 2014 - *Including consumption in the EU ETS, Administrative implementation of a consumption based charge.*

Demailly, Quirion, 2006. *CO_2 abatement, competitiveness and leakage in the European cement industry under the EU ETS: Grandfathering vs. output-based allocation*.

European Commission:
- 2015, *Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments.*
- 2013, *Commission Decision concerning national implementation measures for the transitional free allocation of greenhouse gas emission allowances in accordance with Article 11(3) of Directive 2003/87/EC of the European Parliament and of the Council.*
- 2011, *Decision 2011/278/EU - determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC*
- 2014, *Commission Decision determining, pursuant to Directive 2003/87/EC, a list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage, for the period 2015 to 2019 - 2014*
- 2009, *Commission Decision determining a list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage*
- 2009, *Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community*

European Council, 2014, *Results of carbon leakage assessments for 2015-19 list (based on NACE Rev.2)* as sent to the Climate Change Committee on May 5th 2014. Available at: http://ec.europa.eu/clima/policies/ets/cap/leakage/docs/carbon_leakage_detailed_info_en.pdf

European Council, 2014, *Conclusions* (23 and 24 October 2014). Available at: http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/ec/145397.pdf

Fisher C, Fox A, 2004, *Output-Based Allocations of Emissions Permits Efficiency and Distributional Effects in a General Equilibrium Setting with Taxes and Trade*

Godard O, 2009, *L'ajustement Aux Frontières, Manœuvre Protectionniste Ou Pivot D'un Nouveau Régime International?* Regards Croisés Sur L'économie. 6:214. doi: 10.3917/rce.006.0214.

Jalard M. and Alberola E, 2015, *Free allocation in the EU ETS : identifying efficient mechanisms through to 2030*, I4CE – Institute for Climate Economics, Report n°51, September 2015.

Monjon S, Quirion P, 2010, *How to design a border adjustment for the European Union Emissions Trading Systems , Energy policy,* 38, pp. 5199-5207.

New Zealand Ministry for Environment, *Climate Change Response (Moderated Emission Trading)* Amendment Act, December 2009.

Pollitt H, Summerton P, Klaassen G, 2015, *A Model-Based Assessment of the First Mover Advantage,* Environmental Economics and Policy Studies, Volume 17, Issue 2, pp 299-312.

Porter ME, van der Linde C, 1995, *Toward a new conception of the environment-competitiveness relationship,* The journal of economic perspectives, p.97-118.

Quirion, 2008, *Historic versus output-based allocation of GHG tradable allowances: a comparison*, Climate Policy; 9(6):575-592. DOI: 10.3763/cpol.2008.0618

Sato M and Dechezleprêtre A, 2015, *A symmetric industrial energy prices and international trade.* Centre for Climate Change Economics and Policy Working Paper No. 202.

Schleicher S, Koppl A a,d Marcu A, 2015, *Scanning the options for a structural reform of the European Union Emissions Trading Scheme,* CEPS.

Waxman and Markey, 2009, H.R. 2454 (111th): *American Clean Energy and Security Act of 2009.* Available at: https://www.govtrack.us/congress/bills/111/hr2454/text

Zachmann G, Ndoye A and Abrell J, 2011, *Assessing the impact of the EU ETS using firm level data,* Brugel working paper n°2011/08.

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.

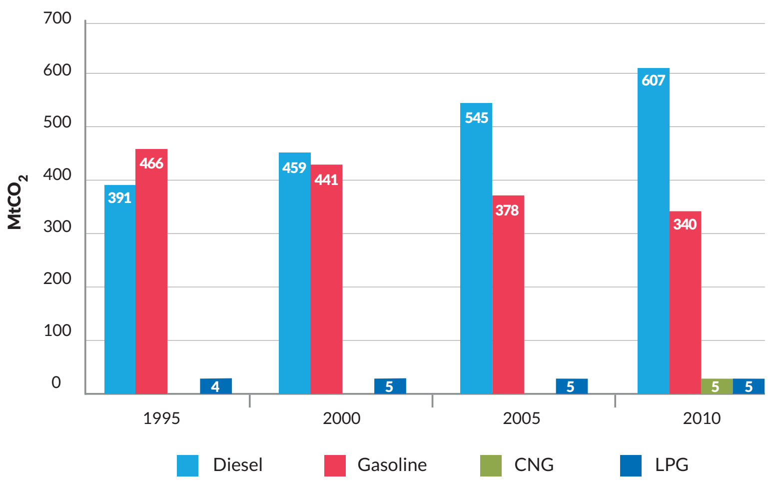
If road transport was to be included, it would likely be positioned as a complementary policy to the current policies regulating the sector, rather than replace them.

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]

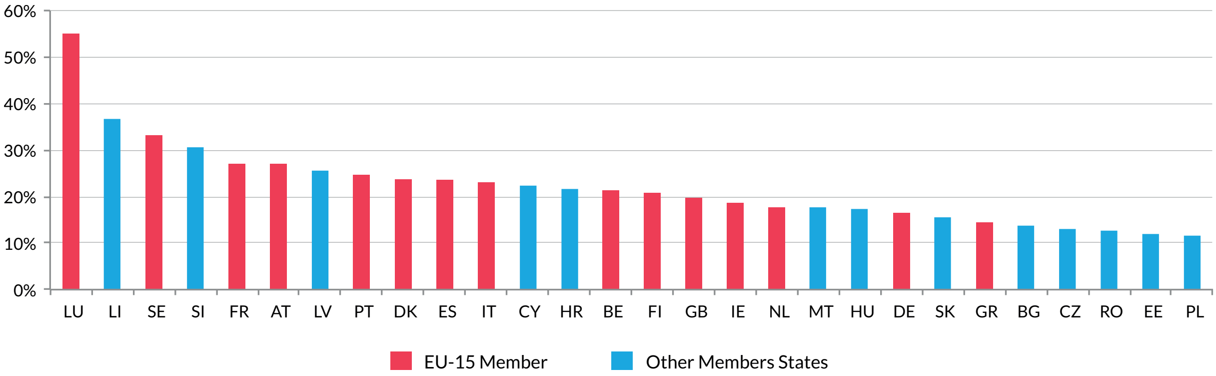
The majority of GHG emissions are derived from the use of gasoline and diesel in the road transport sector. GHG emissions from compressed natural gas (CNG) and liquefied petroleum gas (LPG) constitute a negligible share (Figure 1). Since the year 2000, the relative share of GHG emissions from gasoline 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]:

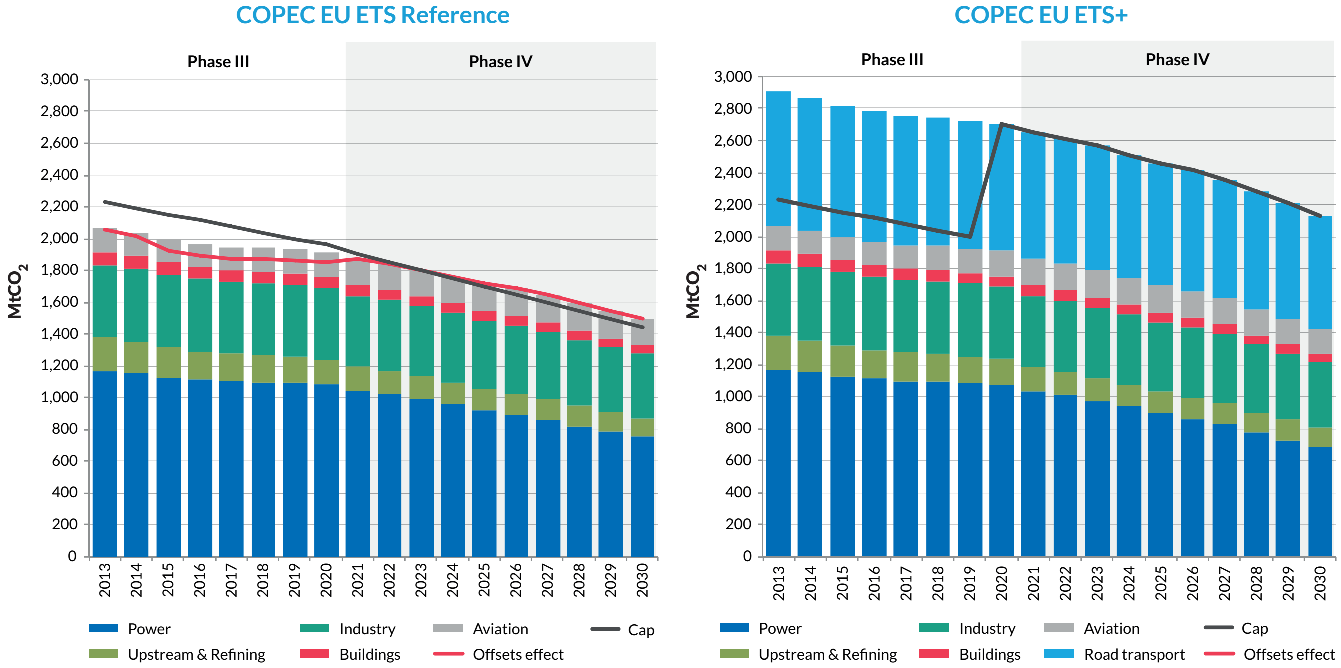
- **COPEC EU ETS Reference:** this scenario is equivalent to the reference scenario examined in Chapter 1. The level of surplus available is taken from the reference case (I4CE – Institute for Climate Economics, 2015 and the EU Commission, 2014, see Chapter 2 for more details) and the 2030 EU GHG emission 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.

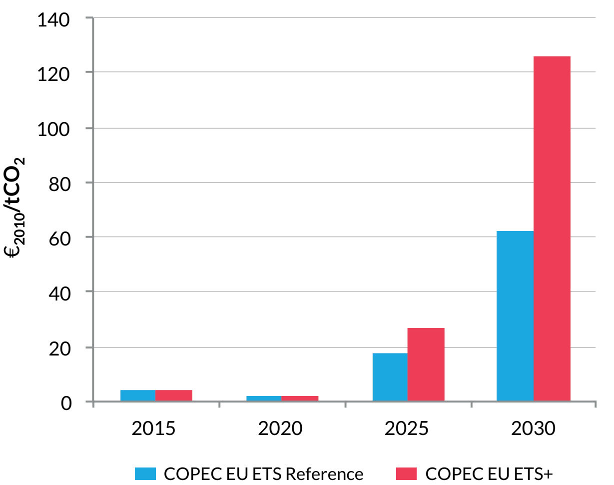
Figure 3 - Emissions in EU ETS sectors with (right) and without (left) including road transport.



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 (€$_{2010}$/tCO_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 (€$_{2010}$/tCO_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/tCO_2) than outside the EU ETS (€598/tCO_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.

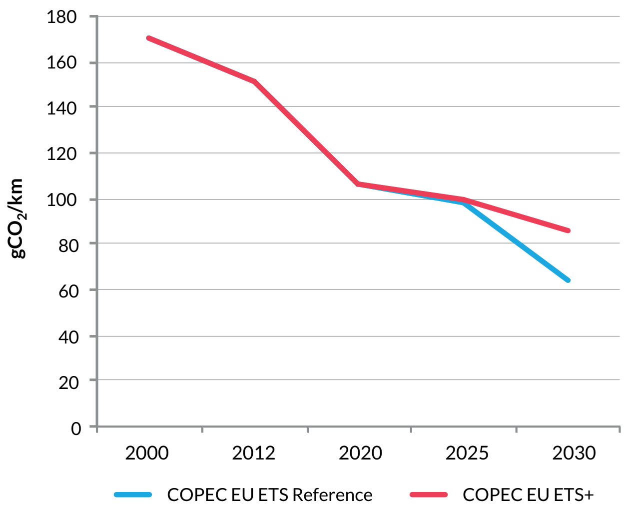
Furthermore, the road transport sector is significantly more efficient, in terms of emissions per kilometer, when it is not included in the ETS, as illustrated in Figure 5. With road transport kept outside the EU ETS, higher fuel prices, including for conventional cars due to the internalization of a higher carbon constraint, contribute to an increase in the average efficiency of new vehicles (64 gCO_2/km in 2030 in the Reference case-blue line, as shown in Figure 5, leading to 86 gCO_2/km in the ETS+ case-red line). The carbon emissions standard target of 95 gCO_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

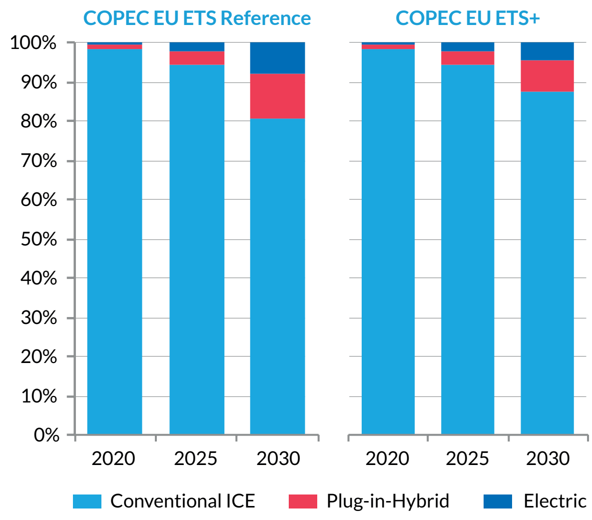
Source: POLES-Enerdata model, 2015.

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/tCO_2 vs €63/tCO_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 2tCO_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.

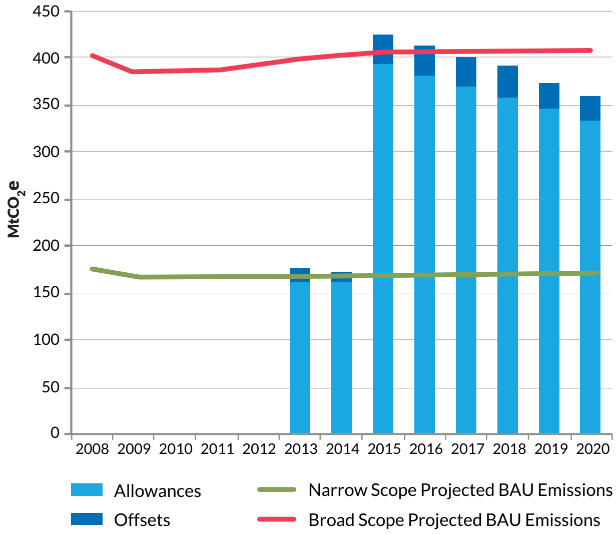
The second instrument is an Allowance Price Containment Reserve (APCR) which collects 4% of the annual allowances from auction each year and releases them if certain predetermined trigger prices are reached.[k] Only California emitters are eligible to purchase allowances from the APCR.

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.

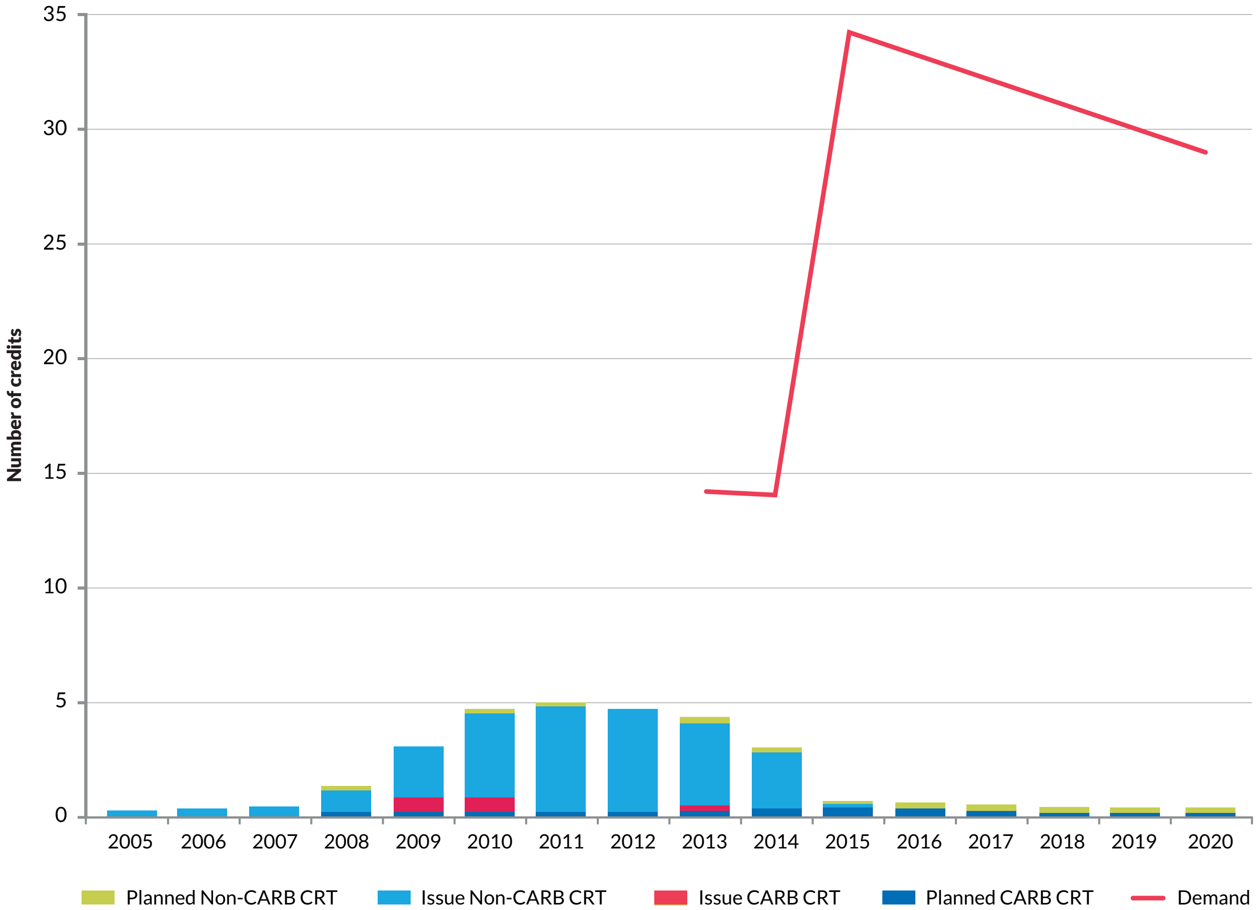
domestic offset credits. Offset projects are required to be located in the United States, United States territories, Canada or Mexico. Since offsetting emissions can effectively represent a release from compliance obligations, with the inclusion of the transport sector, the number of available offset 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 **Voluntary:** large fuel retailers if they use: • >10 million litres per year of jet fuels or, • >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 • ARB offsets credits (Six offset protocols) • Linked offset credits (Québec offsets credits) • International sector-based offset credits (limited to 2%)	• Early reduction credits • Offsets credits (three offset protocols) • Linked offset credits (California offset credits)	• Pre-1990 forestry offsets
Cost-containment and volatility provisions	**By price**	• **Floor price:** US$12.10 • **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 • **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. • **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. • **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 • **Diesel:** US$0.028 - 0.14	CA$0.01- 0.03	• **Petrol:** NZ$0.031 • **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_2e emissions from the road transport sector that takes into account all complementary climate and energy policies that lead to CO_2e 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_2e 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_2e 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_2e, 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_2e, 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.

REFERENCES

Air Resources Board, ARB, California:

- ARB, 2011, Final Regulation Order Article 5: California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms to Allow for the use of Compliance Instruments Issued by Linked Jurisdictions adopted 2011 (ARB Cap-and-Trade, 2011) last updated January 2015,
- California Greenhouse Gas Emission Inventory for 2000-2013, April 24th 2015,
- First update to Climate Change Scoping Plan, May 15th 2015,
- California Senate, Pavley amendements of AB 32, June 1st 2015,
- California Assembly, Assembly Bill 1288 California global warming solutions Act of 2006: regulation, June 3rd 2015
- Annual Allowance Price Containment Reserve Notice - California Cap-and-Trade Program Greenhouse Gas Allowance Price Containment Reserve Sales. Issued December 2nd 2014.

European Commission

- EC 2003, Directive establishing a scheme for greenhouse gas emission allowance trading within the Community, October 13th 2003
- EC 2006, *Building a global carbon market*, November 13rd 2006
- EC, 2007, *Results of the review of the Community strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles Impact assessment*, February 7th 2007
- EC, 2008, *Proposal to improve and extend the greenhouse gas emission allowance trading system of the Community, Impact assessment*, January 23rd 2008
- EC 2008, *Amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community*, January 23rd 2008
- EC 2009, *Directive as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions*, April 23rd 2009, Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31998L0070
- EC, 2012, *The state of the European carbon market in 2012*, November 14th 2012
- EC, 2013, *Options for structural measures to strengthen the EU Emissions Trading Scheme: Main outcomes of the public consultation*
- EC, 2014, *A policy framework for climate and energy in period from 2020 to 2030*, 28th January 2014
- EC, 2015, Key note speech by Commissioner Miguel Arias Cañete at the "*Driving road decarbonisation forwards*" conference, 18th June 2015
- EC, 2015: *Reducing CO_2 emissions from passenger cars*, Available at: http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm

European Climate Change Programme (ECCP) working group, 2007, Final report of the first meeting of the ECCP working group on emissions trading on the review of the EU ETS, March 2007

European Council, 2014, European Council conclusions, October 24th 2014

European Parliament, Department for Economic and Scientific Policy, 2007, The Future of the EU Emissions Trading Scheme

European Environment Agency, 2014, Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014, May 27th 2014

Kasten, P.; Schumacher, K.; Zimmer, W., 2015, "*Policy mix in the transport sector: What role can the EU-ETS play for road transport?"* Oko-Institut e.V.

Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC), Inventaire Québécois des émissions de gaz à effet de serre en 2011 et leurs évolutions depuis 1990.

New Zealand Parliamentary Counsel Office, 2008, Climate Change Response (Emissions Trading) Amendment Act, September 2008,

New Zealand Ministry for Environment, Climate Change Response (Moderated Emission Trading) Amendment Act, December 2009,

New Zealand Emissions trading scheme review panel, 2011, Doing New Zealand's faire share, final report, June 30th 2011,

New Zealand Environmental Protection Agency (NZ EPA),

- Report on the New Zealand Emissions trading scheme review 2011, June 2011
- ETS 2014 - facts and figures, 2015

New Zealand Ministry for the Environment,

- Climate Change Response (Emissions Trading and Other Matters) Amendment Act 2012, November 2012
- Obligations under the ETS, last update April 19th 2013,
- ETS 2012 amendments: forestry sector changes, April 2013,
- Sixth national communication December 2013,
- New Zealand's greenhouse gas inventory 1990-2013, April 10th 2015
- New Zealand's intended nationally determined contribution, July 7th 2015,

UNFCCC, 2014

- European national inventory report for the UNFCCC Convention, April 15th 2014,
- New Zealand National GHG inventory report for 2013, April 10th 2015.

END NOTES

1. European Commission, 2006, *Building a global carbon market*, November 13th 2006. Available at: http://www.europarl.europa.eu/registre/docs_autres_institutions/commission_europeenne/com/2006/0676/COM_COM(2006)0676_EN.pdf
2. European Commission, 2006, *Building a global carbon market*, November 13th 2006. Available at: http://www.europarl.europa.eu/registre/docs_autres_institutions/commission_europeenne/com/2006/0676/COM_COM(2006)0676_EN.pdf, p.7.
3. European Climate Change Programme (ECCP) Working group, 2007, *Final report of the first meeting of the ECCP working group pon emissions trading on the review of the EU ETS*, March 8-9th 2007. Available at: http://ec.europa.eu/clima/policies/ets/docs/report_1st_meeting_en.pdf, p.10
4. EU Commission, 2012, *The state of the European carbon market in 2012*, November 14th 2012. Available at: http://ec.europa.eu/clima/policies/ets/reform/docs/com_2012_652_en.pdf, p.9.
5. EU Commission, 2013, *Options for structural measures to strengthen the EU Emissions Trading Scheme: Main outcomes of the public consultation.* Available at: http://ec.europa.eu/clima/consultations/docs/0017/main_outcomes_en.pdf
6. EU Commission, 2014, *A policy framework for climate and energy in period from 2020 to 2030,* January 28th 2014. Available at: http://www.ipex.eu/IPEXL-WEB/dossier/document/COM20140015.do
7. *EU Commission, 2014, Impact Assessment of the Communication on a policy framework for climate and energy in period from 2020 to 2030.* Available at: *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0015&from=EN, p.234-235*
8. EU Commission, 2014, *Impact Assessment of the Communication on a policy framework for climate and energy in period from 2020 to 2030.* Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0015&from=EN, p.49
9. EU Commission, 2014, *Impact Assessment of the Communication on a policy framework for climate and energy in period from 2020 to 2030.* Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0015&from=EN, p.234
10. European Council, 2014 *European Council conclusions*, October 24th 2014. Available at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf, p.4
11. EUR-LEX,2003, 02003L0087-20140430, *Directive establishing a scheme for greenhouse gas emission allowance trading within the Community.* Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02003L0087-20140430, Article 24.
12. European Commission, *Driving road decarbonisation forwards Conference*, June 18th 2015. Available at: http://www.euconf.eu/driving-road-decarbonisation-forwards/en/registration/index.html
13. European Commission, 2015, Key note speech by Commissioner Miguel Arias Cañete at the *Driving road decarbonisation forwards conference*, June 18th 2015. Available at: http://europa.eu/rapid/press-release_SPEECH-15-5222_en.htm
14. European Environment Agency, 2014 *Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014.* Available at: http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014, p.IX
15. UNFCCC, 2014, *European national inventory report for the UNFCCC Convention*. Available at: https://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php
16. European Environment Agency, 2014, *Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014*. Available at: http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014, p.VII
17. European Commission, *Reducing emissions from transport*. Available at: http://ec.europa.eu/clima/policies/transport/index_en.htm, lastest update August 7th 2015.
18. European Environment Agency, 2014, *Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014.* Available at: http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014, p.15-18.
19. EU Commission, 2015, *Road transport: reducing CO_2 emissions from vehicles*, website updated on June 18th 2015. Available at: http://ec.europa.eu/clima/policies/transport/vehicles/index_en.htm
20. UNFCCC, 2015, New Zealand National GHG inventory report for 2013. Available at: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php
21. Air Resources Board, ARB, 2015, *California Greenhouse Gas Emission Inventory for 2000-2013*. Available at: http://www.arb.ca.gov/cc/inventory/data/data.htm and http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_2000-13_20150424_1.pdf
22. Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC), Inventaire Québécois des émissions de gaz à effet de serre en 2012 et leurs évolutions depuis 1990. Available at : http://www.mddelcc.gouv.qc.ca/changements/ges/2012/inventaire-1990-2012.pdf p.8
23. Ministry for the Environment, 2015, New Zealand's greenhouse gas inventory 1990-2013. Available at: https://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php, p.70
24. Ministry for the Environment, 2015, New Zealand's greenhouse gas inventory 1990-2013. Available at: https://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8812.php, p.70
25. New Zealand Parliamentary Counsel Office, 2008, *Climate Change Response (Emissions Trading) Amendment Act*. Available at: http://www.legislation.govt.nz/act/public/2008/0085/latest/DLM1130932.html
26. New Zealand Ministry for Environment, 2013, *Obligations under the ETS*, latest update April 19th 2013. Available at: http://www.climatechange.govt.nz/emissions-trading-scheme/obligations/
27. New Zealand Ministry for Environment, 2013, *Obligations under the ETS*, latest update April 19th 2013. Available at: http://www.climatechange.govt.nz/emissions-trading-scheme/obligations/
28. New Zealand Government, 2013, *New Zealand 2020 climate change target*, press release, August 16th 2013. Available at: http://beehive.govt.nz/release/new-zealand-commits-2020-climate-change-target
29. New Zealand government, 2015, *New Zealand's intended nationally determined contribution*, July 7th 2015. Available at: http://www.mfe.govt.nz/sites/default/files/media/New%20Zealand%20INDC%202015.pdf
30. New Zealand Ministry for the Environment, 2013, *Sixth national communication*. Available at: http://www.mfe.govt.nz/publications/climate-change/new-zealands-sixth-national-communication-under-united-nations-framework, p.71
31. New Zealand Emissions trading scheme review panel, 2011, *Doing New Zealand's faire share*, final report. Available at: http://www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/review-report.pdf, p.6.
32. NZ Ministry for the Environment, 2012, *Climate Change Response (Emissions Trading and Other Matters) Amendment Act*. Available at: http://www.legislation.govt.nz/bill/Government/2012/0052/latest/versions.aspx
33. New Zealand Environmental Protection Agency (NZ EPA), 2011, *Report on the New Zealand Emissions trading scheme* review 2011. Available at https://www.climatechange.govt.nz/emissions-trading-scheme/ets-amendments/ets-2012-amendments-key-changes-for-participants.pdf
34. NZ Ministry for Environment, 2014, *Climate Change information website, latest update on January 2014*, https://www.climatechange.govt.nz/emissions-trading-scheme/participating/

35. NZ Ministry for Environment, 2009, *Climate Change Response (Moderated Emission Trading) Amendment Act*. Available at: http://www.legislation.govt.nz/act/public/2009/0057/latest/DLM2381636.html

36. NZ Ministry for Environment, 2009, *Climate Change Response (Moderated Emission Trading) Amendment Act*. Available at: http://www.legislation.govt.nz/act/public/2009/0057/latest/DLM2381636.html

37. New Zealand Government, *NZEUR account holders access to Kyoto units*. Available at: http://www.eur.govt.nz/how-to/guides-hmtl/guides-pdf/NZEUR%20account%20holders%20access%20to%20Kyoto%20units.pdf

38. NZ Ministry of Environment, 2013, *ETS 2012 amendments: forestry sector changes*. Available at: https://www.climatechange.govt.nz/emissions-trading-scheme/ets-amendments/ets-2013-amendments-forestry-sector-changes.pdf

39. New Zealand Environmental Protection Agency, 2015, *ETS 2014 - facts and figures*. Available at: http://www.epa.govt.nz/e-m-t/reports/ets_reports/annual/Documents/2014%20NZ%20ETS%20Facts%20and%20Figures%20final.pdf, p.2

40. NZ Ministry for the Environment, 2012, *Climate Change Response (Emissions Trading and Other Matters) Amendment Act 2012*. Available at: http://www.legislation.govt.nz/bill/Government/2012/0052/latest/versions.aspx

41. Air Resources Board, ARB, 2015, *California Greenhouse Gas Emission Inventory for 2000-2013.* Available at: http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_2000-13_20150424_1.pdf

42. Air Resources Board, ARB, 2015, *First update to Climate Change Scoping Plan*, May 15th 2015. Available at: http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf, p.93.

43. California Senate, 2015, Pavley amendements of AB 32, June 1st 2015. Available at: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32

44. Air Resources Board, ARB, 2015, *First update to Climate Change Scoping Plan*, May 15th 2015. Available at: http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf, p.93.

45. ARB, 2015, *First update to Climate Change Scoping Plan*, May 15th 2015. Available at: http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf, p.93.

46. California Assembly, 2015, *Assembly Bill 1288 California global warming solutions Act of 2006: regulation*, June 3rd 2015. Available at: http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB1288

47. ARB, 2011, Final Regulation Order Article 5: California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms to Allow for the use of Compliance Instruments Issued by Linked Jurisdictions adopted 2011 (ARB Cap-and-Trade, 2011.) last updated January 2015, Section §95841 Table 6-1. Available at: http://www.arb.ca.gov/cc/capandtrade/ctlinkqc.pdf

48. ARB, 2011, Cap-and-Trade, Section §95911(b)(6).

49. European Environment Agency, 2014, *Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014.* Available at: http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014, p.VII

50. European Environment Agency, 2014, *Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014*. Available at: http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014, p.1084.

51. European Environment Agency, 2014, *Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014*, May 27th 2014, Available at: http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2014, p.VII

52. European Commission, 2007, *Results of the review of the Community strategy to reduce CO_2 emissions from passenger cars and light-commercial vehicles Impact assessment.* Available at : http://www.uni-mannheim.de/edz/pdf/sek/2007/sek-2007-0060-en.pdf, p.11-12

53. European Parliament, 2007, Department for Economic and Scientific Policy, *The Future of the EU Emissions Trading Scheme.* Available at: http://www.europarl.europa.eu/meetdocs/2004_2009/documents/dv/ip_a_itre_st_2007_08_eu_e/ip_a_itre_st_2007_08_eu_ets.pdf, p.44, and European Commission, 2008, Proposal to improve and extend the greenhouse gas emission allowance trading system of the Community, Impact assessment. Available at: http://ec.europa.eu/clima/policies/ets/docs/sec_2008_52_en.pdf, p.54

54. EUR-LEX, 2009, 32009L0028, *Directive on the promotion of the use of energy from renewable sources.* Available at: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32009L0028, article 17.

55. EURLEX, 2015, *European Directive amending the Directive relating to the quality of petrol and diesel fuels and amending Directive on the promotion of the use of energy from renewabe sources*, September 9th 2015. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015L1513&from=FR Art.7b.

56. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

57. European Council, 2014 *European Council conclusions*, October 24th 2014.
Available at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf, p.1
and European Commission, 2014, *Communication on a policy framework for climate and energy in the period from 2020 to 2030,* January 22nd 2014. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0015&from=EN, p.5.

CHAPTER

5 THE EU ETS AND LOW-CARBON FUNDING MECHANISMS

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KEY MESSAGES

- ***Financing the transition to a low carbon economy*** **-** Finance is one of the key issues that must be addressed to ensure that emissions reduction targets, which limit global warming to 2°C, are met. One of the main results of the January 2014 Impact Assessment is that the cost of the energy system will rise from 12.8% of GDP in 2010 to 14% in 2030.

- ***Funding mechanisms in the proposal for a revised EU ETS directive*** **-** The European Commission have defined funding mechanisms to transform and modernize the EU energy system. Some of these mechanisms have been based on previous designs with minor adjustments while others are new: transitional free allocation, the Modernisation Fund, the Innovation Fund, auction revenues, auctioned allowances for solidarity amongst Member States.

- ***Auctioning revenue forecasts in Phase IV*** **-** According to the Institute for Climate Economics' research, Member States will auction close to 15 billion EUAs from 2013 to 2030 (EU ETS Phase III and IV). In its Phase III, the EU ETS generated auction revenues worth €74.12 billion. Assuming a gradually increasing carbon price, revenues could total between €230-320 billion from 2015 to 2030. This is roughly equivalent to the energy investment gap (€313 billion between 2014-2035) to shift from the EU New Policies Scenario to an EU 2°C scenario. The scale of these revenues has the potential to contribute to the necessary low-carbon transition in an effective manner. Can we expect Member States to use auctioning revenues differently post 2020? While some provisions have been added to strengthen the proposal of the revised EU ETS directive, these provisions have limited legal force.

- ***Use of auction revenues in Phase III*** **-** Based on public information and on an Institute for Climate Economics survey amongst Member States, in 2013 and in 2014, direct spending of auction revenues have largely funded domestic mitigation actions: primarily for small-and medium-scale projects using mature technologies in the areas of renewable energy (38%) and energy efficiency (25%). A small proportion has been spent on climate action in developing countries and an even smaller share on adaptation efforts.

- ***North American revenue spending experiences*** **-** ETS Programs implemented in North America i.e. California, Québec and RGGI provide interesting case studies when examining the use of auctioning revenues and could offer useful insight to European Member States. California and Québec have developed detailed, customized, multi-annual investment plans that focus on long-term, low-carbon infrastructural investment, particularly on heavily emitting sectors. Inclusion of social criteria in decision-making channels investment to groups vulnerable to the low-carbon transition.

a. This chapter on the EU ETS low-carbon funding mechanisms is based on analysis developed in the workshop of the COPEC research program organized on 24th September 2015. The authors would like to thank the participants of the COPEC workshop for their feedback and Godefroy GROSJEAN (Potsdam Institute for Climate Impact Research (PIK)) and Christian FLACHSLAND (Mercator Research Institute on Global Commons and Climate Change (MCC)) for sharing their insight on the topic of utilisation of EU ETS auction revenues.

Financing the transition to a low-carbon economy will be one of the key issues in ensuring that emission reduction targets are met, and that global warming is limited to 2°C. In this chapter, section 1 identifies challenges to transitioning to a low-carbon economy on an EU level, the importance of finance to achieve this transition, and some funding mechanisms that can help facilitate this shift, that are derived from the EU ETS. Section 2 examines the usage of ETS revenues accrued by Member States, particularly which sectors benefit from the revenues allocated and pinpoints some lessons that can be learned from Member States' decision-making. Lastly, section 3 focuses on the experiences of ETS revenue spending models in North America (California, RGGI and Québec) and leverages some of their best practices to provide recommendations that could improve the potential of Member States' EU ETS revenues as a financing mechanism to support the low-carbon transition.

1. LOW-CARBON FINANCING IN THE EU COMMISSION'S PROPOSAL FOR A REVISED EU ETS DIRECTIVE BY 2030

Challenges to financing the EU low-carbon transition by 2030

The European Union's low-carbon pathway was unveiled in the 2050 roadmap[1] in March 2011 wherein milestones for achieving 80-95% emissions reductions by 2050 are defined. In order to achieve the proposed GHG emissions target by 2030[2], according to the 2030 Energy and Climate Communication Impact Assessment (January 2014)[3], significant investments will be needed before 2050 to transform and modernise the energy system. In particular:

- Total investment in clean and energy-efficient technology would require an investment of €270 billion over the period 2010-2050.[4]
- Full implementation of the Strategic Energy Technology plan[b] could require additional investment of €50 billion over the 2011-2020 period. It highlights the use of auction revenues and cohesive policies as instruments that could be used to achieve this transition.[5]

One of the main results from the Impact Assessment (January 2014) is that the cost of the energy system will rise in both the Reference and GHG 40 scenarios, from 12.8% of GDP in 2013 to 14.3% in 2030. Differences between the costs incurred in these two scenarios are not significantly different. This is largely due to ageing energy infrastructure which will need to be replaced during this timeframe. However, in the case of higher renewable and energy efficiency targets, the annual costs of the energy system would increase by nearly €0.4 billion (between the Reference and GHG40, EE30/RES30 scenarios) between 2011-2050, as described by Table 1.

Overall, the macroeconomic impact of different targets depends on the assumptions made in terms of carbon revenues recycling. In the context of revenue recycling to consumers, and with both ambitious energy efficiency and renewable targets, the E3ME model[6] outlines an increase in employment with 568,000 jobs in 2030 compared to the GHG40 scenario. Another model (GEM E-3), focusing on employment related to investments in the power sector and energy efficiency, estimates an increase of 219,000 jobs in the GHG40 scenario compared to the reference scenario in 2030, and 83,000 additional jobs in the case of the GHG40/EE/RES30 scenario compared to the GHG40 scenario. Comparatively, more ambitious targets can yield higher GDP growth in the long run. As a result, more ambitious targets concerning energy efficiency and renewable energy give rise to substantial macro-economic benefits in the long term, while less ambitious targets are cheaper in the short-to-medium term. The Impact Assessment study outlines that choosing EE and RES targets encourage policy makers to find the right balance between these two facets.

In consequence, the issue of financing the low-carbon transition is deeply complex, as it involves an array of sectors and a multitude Member States. Nevertheless, careful financial planning for future investments is of paramount importance to ensuring an achievable and cost effective sustainable development pathway in the EU.

However, serious considerations for the following issues will need to be accommodated in future planning to achieve an EU-wide low carbon future:

b. The SET-Plan, adopted by the European Union in 2008, aims at establishing an energy technology policy for Europe. It is the principal decision-making support tool for European energy policy. The SET-Plan has two major timelines: for 2020, the SET-Plan provides a framework to accelerate the development and deployment of cost-effective, low-carbon technologies in line with the 2020 energy and climate package; for 2050, the SET-Plan is targeted at limiting climate change to a global temperature rise of no more than 2°C, in particular by matching the vision to reduce EU greenhouse gas emissions by 80-95%.

Table 1 - Comparison of Reference scenario and concrete EE measures scenario.

Indicators	Reference Scenario		GHG40/EE/RES30 Scenario	
	2030	2050	2030	2050
Total system costs in bn €'10 (annual average 2011-30/2031-50)	2,067	2,520	2,089	2,891
Total system costs as % of GDP (annual average 2011-30/2031-50)	14.30	13.03	14.45	14.95
Total system costs as % in 2030/2050 (2010 value: 12.76%)	14.03	12.30	14.56	15.35
Investment expenditures in bn €'10 in Reference and change compared to Reference (average annual 2011-30/2031-50)	816	949	63	384
Industry	19	30	18	122
Residential and Tertiary	50	38	34	183
Transport	660	782	2	59
Grid	37	41	3	6
Generation and boilers	50	59	5	13

Note: 'Reference' refers to a scenario with no additional climate and energy policies relative to the trajectory of the 2020 objectives; 'GHG40' refers to the scenario with a 40% GHG target, 'RES30' refers to the scenario with a 30% EU-level renewable energy target in the final energy consumption. 'EE' indicates the presence of explicit energy efficiency policies (at various levels of ambition) in the scenario, whereas the absence of EE means that the scenario does not include such energy efficiency policies but are based on "carbon values" providing a price signal driving GHG reductions (also achieving higher levels of energy efficiency improvements or RES deployment than Reference).

Source: I4CE – Institute for Climate Economics, based on EU Impact Assessment of "A policy framework for climate and energy in the period from 2020 up to 2030", January 2014.

- **Present EU policies are insufficient to reach long-term climate goals** (in the context reducing 80-95% of emissions by 2050, relative to 1990 levels). On comparing the needs between the reference conditions (that will not produce required emissions reductions)[7] and enabling conditions (that will produce required emissions reductions), and despite ongoing investment, more funding will need to be channeled into energy efficiency and RES to meet 2°C scenario conditions. Furthermore, current policy initiatives and regulatory frameworks are insufficient in creating assurances for the post-2020 period that would encourage greater levels of investment. Careful policy planning to develop an overall low-carbon strategy and create credible and complementary investment signals to promote low-carbon technology investment needs to be undertaken.[8]

- **Due to the long investment cycles of energy infrastructure and technological transitions** in industrial and building sectors, investment decisions taken now will have far-reaching effects beyond 2030. In view of this, a strong policy framework that fosters positive investment signals is essential throughout the planning period. Part of this investment shift has already begun materialise since the 2013 EU Reference scenario. However, the projected energy roadmap scenarios indicate that a much larger shift is needed. In view of current policies, a relatively low EUA carbon price, a surplus of allowances, and increasing debate over the inclusion of non-ETS sectors, the current investment climate evokes a level of uncertainty that could delay necessary investments. Delaying the necessary investment that could transform current infrastructure to be more energy efficient and less carbon intensive can lead to larger investment costs in the future. Some of these risks can be mitigated by the current MSR control process and by the projected increase in EUA prices towards 2030. However, the carbon price signal is still too low to encourage development of non-mature technologies such as Carbon Capture and Storage (CCS).[9] This could mean that they remain less attractive to investors and will stay underdeveloped in the short and medium-term.

- **Planning investments for an effective transition should take into account an increase in energy costs and facilitate access to affordable energy especially to vulnerable groups.** Over the 2010-2030 period, average electricity prices are on an upward trend (increasing till 2020 and then stabilising), and are projected to increase by 31%, from €131/MWh to €172/MWh. If the increase in energy prices are not matched by the same level of fuel savings (through energy efficiency investments), costs will effectively be passed through to households and installations, and could have negative impacts on vulnerable groups in both divisions.

To summarise, it is in the interest of the European Union to establish a long term climate policy framework that can facilitate a positive investment climate that incentivizes investments in renewable and energy-efficiency infrastructure. At the same time, these policies must account for vulnerable groups and other potential conflicts in the redistribution of carbon revenues. Based on the 2030 energy and climate framework Impact Assessment current policies will be insufficient at catalyzing the necessary energy shift required to limit warming to 2°C. Current policies fall short of meeting the level of investment required to achieve the necessary emissions reductions. While the 2050 roadmap provides key pathways and options that can facilitate a practical transition, an appropriate climate policy framework that is compatible with the 2050 goals needs to be put in place to overcome the potential for shortfalls.[10]

Low-carbon technology funding mechanisms at the EU level

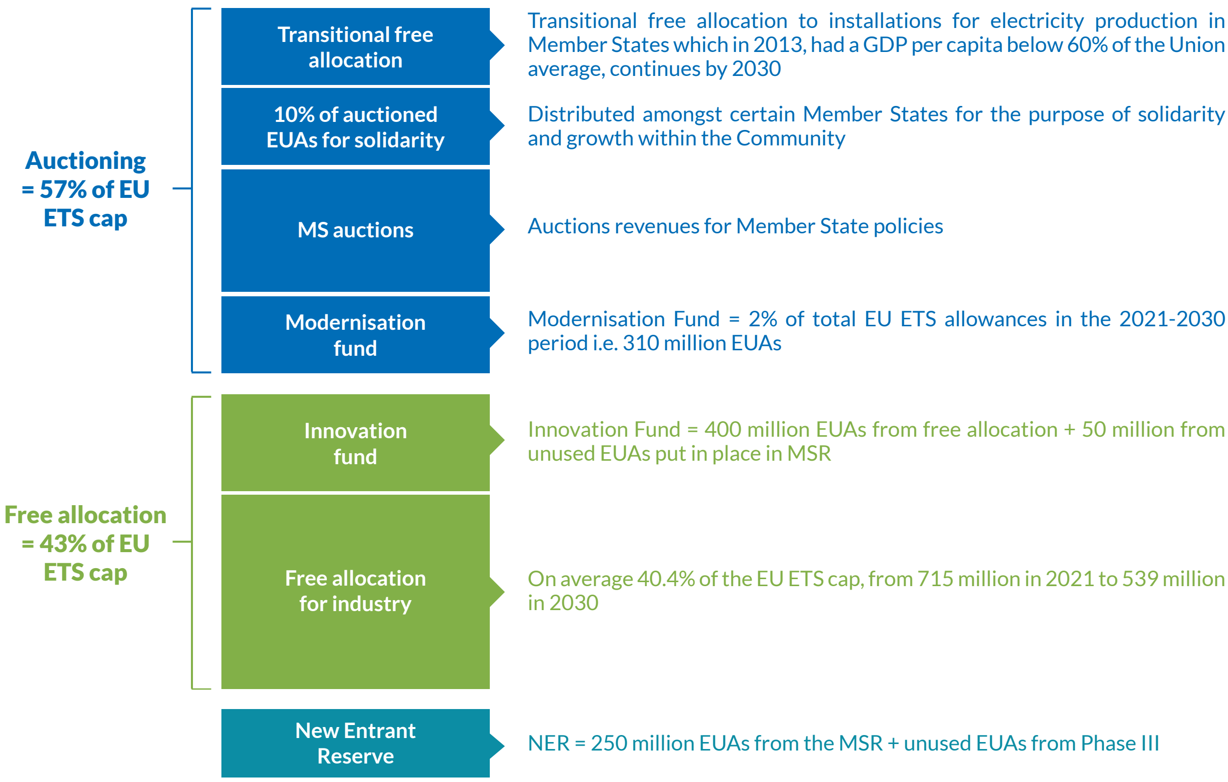
In the proposal for a revised EU ETS directive,[11] the European Commission defines new funding mechanisms based on previous mechanisms supplemented with some new arrangements.

The (re)designed Innovation Fund

The Innovation Fund[12] is an extension of the NER 300 fund, as described by the October 2014 EU Council, and promotes "innovation in low-carbon industrial technologies and processes and support for demonstration projects for the development of a wide range of CCS and innovative renew able energy technologies that are not yet commercially viable". This fund will be furnished with 450 million allowances: 400 million allowances will be extracted from the free allocation budget and 50 million will be derived from allowances that remain unused between 2013 and 2020 (which otherwise would have been placed in the Market Stability Reserve in 2020).[13] The Fund would be available to projects in all Member States and target primarily, large-scale projects.[14]

In the third Phase of the EU ETS, the NER 300 was funded by the New Entrants' Reserve (NER) using 300 million auction allowances. In the first and second round of proposals, the NER 300 financed 38 projects worth €2.1 billion, out of which €2.86 million was raised from private capital, some of which was channeled towards CCS and renewable energy projects. The NER 300 is managed by the European Commission which draws

Figure 1 - EU ETS based funding mechanisms in the proposal of the EU ETS revised directive.

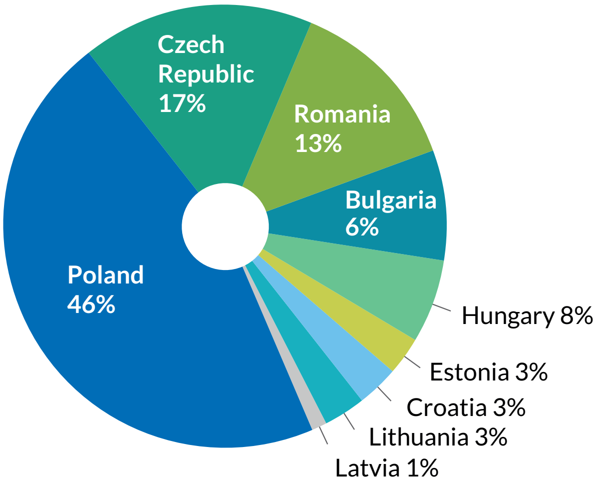


Source: I4CE – Institute for Climate Economics, 2015 based on EU Proposal for a revised EU ETS directive, 2015.

on the European Investment Bank's (EIB) expertise to evaluate project proposals submitted by Member States. The EIB, under the direction of the EC, also manages the sale of the allowances on behalf of the Member States among whom the revenues are then distributed for project implementation.

The rules that administer the Innovation Fund are still under development; however, some options for project funding have been described in the Impact Assessment.[15] Option 1 considers a more tailored approach for industry projects by examining the impacts of increased funding rates; however, more extensive market testing is needed for RES, CCS and industry. Option 2 suggests project funding be carried out through the support of a permanent financial body and by replacing the current performance-based grant system with other financial instruments.

Figure 2 - Distribution of the capitalisation of the Modernisation Fund up to December 31st 2030.



Source: EU Proposal for a revised EU ETS directive, Annex, 2015.

The new Modernisation Fund

The Modernisation Fund is a new fund[16] which will be established to support investments that modernise existing energy systems and improve their energy efficiency. The fund will be composed of 310 million EUAs which amount to 2% of total EU ETS allowances in the 2021-2030 period. The Fund will be applicable to the ten lowest-income EU States with a GDP per capital of less than 60% of the EU average in 2013. The fund is managed by beneficiary Member States with the European Investment Bank overseeing project selections[17]; criteria for project eligibility will be reviewed in 2024. While the Innovation Fund targets (a priori) large-scale energy projects, the Modernisation Fund will target small-scale investment projects in the energy and energy efficiency sectors. To this end, the investment board should develop guidelines and eligibility criteria specific to such projects. The proposal by the European Commission specifies that criteria for eligibility will be determined using data that combines two elements: a 50% share of verified emissions and a 50% share of GDP.

Similar to the Innovation Fund, several options have been considered in the Impact Assessment on governing the Modernisation Fund.[18] In all three options, the Commission helps in administration and the EIB performs due diligence. Option 1 affords large discretion and responsibility to beneficiary Member States so that the Fund can be tailored to specific national needs. A Steering Board comprised of these beneficiary Member States would define eligibility criteria and projects. Option 2 is a more cooperative approach in which investment guidelines are agreed upon by a Steering Board of all Member States and the Commission. The EIB plays an enhanced role as a fund manager and is accountable to the Steering Board. In option 3, a pipeline of projects to be funded is identified by beneficiary Member States using financial instruments which must conform to eligibility criteria set in the implementing legislation.

Transitional free allocations for the power sector in low-income Member States

To aid in the modernization of the energy sector, transitional free allocation[19] to electric power installations (in Member States with a 2013 GDP per capita below 60% below the EU average) will continue through 2030.[20] To select projects that will be financed using free allocation, the European Commission recommends Member States to organise a competitive bidding process for projects that will be worth an investment total exceeding €10 million. Among the eligibility criteria, such as the additionality of the energy project, Member States are also expected to select projects based on a cost-benefit analysis to achieve maximum CO_2e emissions reductions.

By June 30th 2019, Member States are expected to publish a detailed national framework setting out the competitive bidding process and provide selection criteria for public comment. Lastly, transitional free allocations will be deducted from the quantity of auctioned allowances for Member States. The total free allocation will not amount to more than 40% of the allowances which the beneficiary Member State receives in the period 2021-30.

For optional free allocation, the main aspects assessed[21] are selection of investments and reporting, volume and timing of allowances to be auctioned. Based on these aspects, three options are considered. Option 1 proposes a streamlined approach with more consistent rules and procedures, limiting delays for investments and number of reports published by the Commission. This approach aims to reduce differences in methodologies adopted by Member States while maintaining core principles. Option 2 proposes changes that focus on a competitive and open selection of investments. Open competition reduces the potential risk of market distortion for large investments. Smaller investments could be approved under a possible general block exemption for state aid rules in the future. Auctioning of unused allowances can be delayed by 1 or 2 years. Lastly, option 3 proposes a high degree of standardisation by providing a fixed percentage of free allocation on an annual basis. This approach helps enhance market predictability and the selection of all eligible investments would be done through open competition based on value for money. There are trade-offs in the options considered and the European Commission has no apparent preference at the current stage of the proposal.

Auctioned allowances for enhanced solidarity amongst Member States

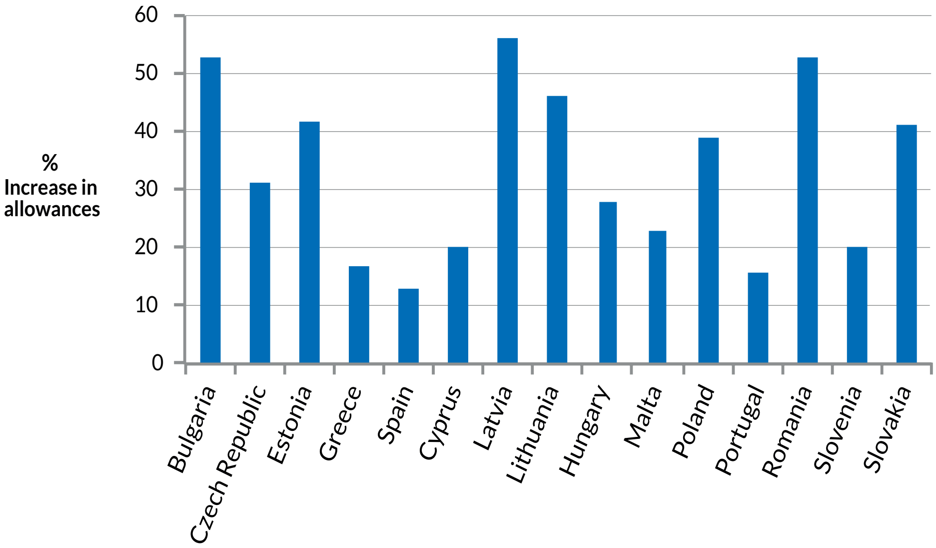
10% of the total quantity of allowances to be auctioned will be distributed amongst certain Member States as a means by which to enhance the prospect for greater solidarity and growth within the Community.

Key issues to be addressed to enhance the effectiveness of low-carbon funding mechanisms

The Impact Assessment identifies three issues or inter-linkages that require special attention from European Commission so that the effectiveness of low carbon technology funding mechanisms can be enhanced.

The first issue is related to the monetisation of each fund. The Impact Assessment highlights the need for timely monetisation of allowances from the Innovation Fund and the Modernisation Fund to avoid creating adverse impacts on the EU ETS supply-demand balance. Member states are currently calling specially for early monetisation of the Modernisation Fund seeing as high investments are needed to achieve 2030 energy and climate targets. Indeed, monetising the Innovation Fund early would reduce the period in which no-support is being provided for investments in Phase IV. Thus, in this case, frontloading of allowances might be needed to collect money for projects. However, this could undermine the effect of the Market Stability Reserve that aims to restore short-term scarcity of allowances. The Impact Assessment emphasises that a spread in monetisation over a longer time period can minimise price risk as well as price impact.

Figure 3 - Increases in the percentage of allowances to be auctioned by Member States for the purpose of solidarity and growth in order to reduce emissions and adapt to the effects of climate change.



Source: European Commission, Proposal for a revised EU ETS directive, Annex, 2015.

The second issue relates to the scope of investments for each low-carbon funding mechanism. Similarities exist in potential investments made under the Modernisation Fund and optional free allocation to the power sector (i.e. energy efficiency and energy modernisation). Therefore, there is a need to widen the scope of targeted investments to avoid potential accumulation of funds among certain industries. The third issue is the potential impact caused by transposing and implementing these rules on beneficiary Member States.

Auction revenues

The third source for low carbon technology funding leverages carbon revenues from Member States via EU ETS auction proceeds. The next section will address this source of funding more carefully, analyzing its potential and the current utilization of these revenues by Member States. The proposal for a revised EU ETS directive strengthens some previous orientations for the use of auction revenues and introduces new (non-binding) provisions such as:

- **Indirect cost compensation** - The other potential use of ETS revenues discussed in the revision of the EU ETS Directive, was indirect cost compensation. According to this mechanism, a portion of auction revenues could be used in compensating installations for the indirect costs they have incurred as a result of the EU ETS.
- **Supporting jobs development during the energy transition** - In achieving a decarbonised economy, the economic and energetic transition should not have adverse impacts on vulnerable sectors and groups. To this effect, using auction revenues to promote skills development, reallocation of labour and close coordination of efforts with social partners are being discussed.
- **Scaling up finance for international climate action** - The issue of auction revenues supporting international finance was highlighted in the recently revised EU ETS directive. With the upcoming COP21 conference in Paris, EU leaders are eager to demonstrate action to reach a successful climate agreement. One of the key issues in the negotiation process for determining the COP21 text has been that while pledges for climate finance funding have been made, developed countries have yet to prove that they will be able to match these funds in practice. The figure that needs to be matched by the international community is $100 billion per year by 2020. The EU share of this $100 billion is estimated to be one-third or $33 billion per year by 2020.[22]

The estimated annual EU-wide auctioning revenues from 2016 onwards are projected to be €23 billion, reaching €25 billion in 2020 and €52 billion in 2030. Despite falling short of the $33 billion target a share of these annual figures could still contribute significantly to funds supporting international climate change action. The advantage of utilizing EU ETS revenues as a financing mechanism is that they are a guaranteed source of annual revenue to Member States. The primary issue in allocating revenues for international climate aid however, remains the unpredictable variability in the flow of auction revenues. A guaranteed revenue sum needs to be established on an annual or other fixed-term basis to ensure that planning activities for international climate finance can continue without uncertainty or interruption. A solution offered by the European Parliament in the past was to secure and allocate a percentage of a Member States' auction revenues towards use for international climate finance. This would help fulfill some part of national obligations towards international climate action.

The analysis on the use of revenues by Member States in 2013 can be useful insofar as providing recommendations to improve the efficiency of this revenue source towards low-carbon investments.

2. EU ETS REVENUES IN PHASES III AND IV: LESSONS FROM MEMBER STATES' FIRST EXPERIENCES

During Phase II of the EU ETS, Member States auctioned about 3.5% of their allowances while the rest were freely allocated. In Phase III, auctioning became the main tool to distribute allowances among sectors that were not exposed to the risk of carbon leakage.

In 2013 and 2014, the EU ETS has generated auction revenues worth €74.12 billion. According to our estimates, Member States will auction close to 15 billion EUAs from 2013 to 2030 (EU ETS Phase III and IV). Assuming a gradually increasing carbon price, revenues could total between €230 billion-€320 billion[23] from 2015 to 2030. This amount is roughly equivalent to the energy investment gap (€313 billion between 2014-2035) needed to shift from the EU New Policy Scenario to an EU 2°C scenario.[24]

Due to the scale of these proceeds, revenue sources such as these have been strongly acknowledged as a potential financial mechanism to fund climate action and contribute to the billions needed annually to transition the economy to a lower-carbon future.

Table 2 - Phase III auction revenue forecasts.

	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Average and forecasted carbon price (€)	5	6	8	10	13	15	17	19	
Total revenue (billion €)	3.5	3.1	5.3	7.7	12.6	14.6	12.9	14.5	**74.2**
Allowances to be auctioned*	902	531	659	763	969	976	758	766	**6,322**

* forecasts of allowances exclude those allowances that are are distributed through transitional free allocation under Article 10c.

Source: I4CE – Institute for Climate Economics, 2015.

EU ETS revenue spending guidelines: a lenient framework

Current guidelines of the EU ETS directive (2003/EC/97, Article 10) already encourage Member States to invest their revenues on a low-carbon economy. Specifically, the EU guidelines recommend that Member States spend at least 50% of auction revenues on reducing GHGs. The recommended applications for revenues described in the directive are quite general and non-binding. It features a variety of mitigation and other options: from conservation to investing in renewables, energy efficiency, adaptation in developing countries etc. At present there are no guidelines that recommend minimal contributions towards a specific action e.g. minimum spending on climate action in developing countries. There are also no guidelines that help to evaluate or determine the estimated GHG reductions coming from these investments. Overall, the framework guiding Member States' spending decisions is quite lenient. Ultimately, it is up to the countries to decide how and where to spend their auction revenues.

It is worth noting that originally, in 2008, the environmental committee of the EU Parliament attempted to legally mandate[25] that *all* auctioning revenue be used for climate action, with at least 50% being used to finance *international climate action* and the remaining to fund domestic European actions. However, determining the best use of auctioning revenues was and still is a complicated issue that has stimulated much political debate. Many of the newer EU states and some countries like the UK opposed it while the EU Council of Finance Ministers expressed a strong aversion to hypothecation of auction proceeds.[26] This finally led to the Commission declaring that the use of these revenues would be left to the discretion of Member States, in accordance with their budgetary and constitutional needs.

As mentioned previously in this section, the scale of these revenues is indicative of their potential and useful contribution in funding the European transition towards a low-carbon economy. In view of this, it is pertinent to ask, what direction and shape will this financial mechanism take in the future? At this stage, all that can be expected is that this question will become increasingly relevant as revenues continue to accrue between 2020 and 2030. To this effect, the EU ETs is projected to raise revenues of approximately €205.17 billion in Phase IV as shown in Table 3 and Figure 4. In order to inform better decision making in the future, it is important to explore Member States experience and learn from existing practices. For this purpose, I4CE – Institute for Climate Economics identified some questions to guide the examination of this issue:

- Do countries allocate revenues differently?
- What quantity of ETS revenue is being used to fund climate action?
- What sectors within the climate action sphere are receiving the most support?
- What are the motivations behind decision making among Member States?
- Are countries using this revenue to leverage other sources of investment? and finally,
- How can the auction revenue be used more effectively towards enhancing climate action?

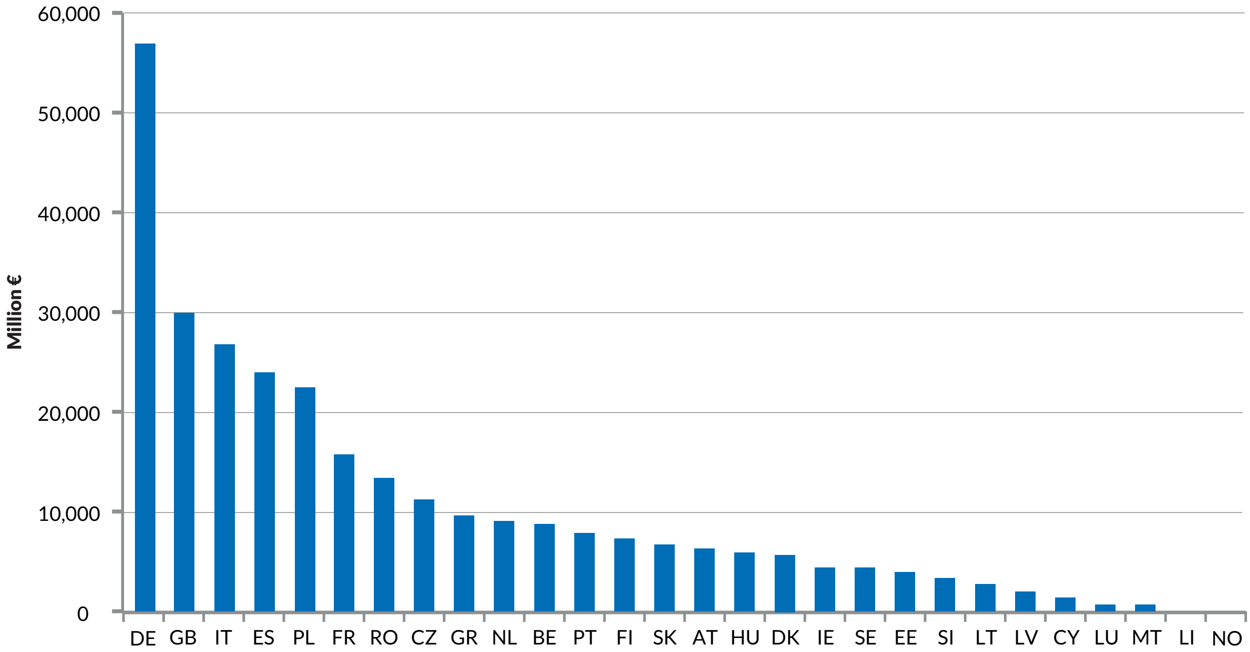
Table 3 - Phase IV auction revenue forecasts.

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL
Forecasted carbon price (€)	20	21	23	24	25	26	27	29	30	31	
Total revenue (billion €)	16.6	17.2	17.7	18.2	18.8	19.4	20	23.1	23.2	23.3	**198**
Allowances to be auctioned*	823	802	783	767	752	740	728	809	780	751	**7,734**

* forecasts of allowances exclude those allowances that are distributed through transitional free allocation under Article 10c.

Source: I4CE – Institute for Climate Economics, 2015.

Figure 4 - Forecasts of 2015-2030 auction revenues of EU Member States.



Source: I4CE – Institute for Climate Economics, 2015.

Auction revenue spending in Phase III: lessons from Member States' first experiences in 2013

Categorising Member States into Non-Earmarkers and Earmarkers

The revenue decisions are examined according to two groups of Member States: Earmarkers and Non-Earmarkers.

- Earmarkers are the countries that have planned in advance, how and where their auctioning revenues will be spent. Countries that partially earmark their revenues will be referred to as earmarkers for the purpose of this study. These revenue allocation decisions are usually enshrined in law, or distributed through a dedicated fund or plan (such as Flanders' Climate Policy Plan or the Environmental Fund of Slovakia wherein auction revenue usage is managed). Under such laws or funds, in the case of EU Member States, beneficiaries are generally those engaged in climate action. Earmarker Member States usually have separate and specific decision-making processes or criteria that direct monies to a predefined climate action. Since the money has been earmarked and thus safeguarded for climate action, there is some level of guarantee that funds will be available for such a use in future years as well.
- In the case of non-earmarkers, the money is directly channeled into the general budget. In this case, no distinct decision making process or criteria exist for spending auction revenues specifically. Resultantly, there is less of a guarantee that the same proportion of money will be safeguarded towards the targeted objectives.

Member States use diverse decision making practices to allocate revenues

While the EU provides guidelines for ETS revenue spending on climate action, ultimate decision-making rests with the sovereign choices of Member States and no specific coordination with the EU Commission is required to justify their national strategies.

Most countries make these decisions based on multi-ministerial discussions and the final decision is voted by the Parliament. However, this process can vary across each country. The UK has chosen to appropriate all revenues towards the General Budget and do not conduct any earmarking. France has committed all revenues to fund one public authority (on housing) through a multi-ministerial decision led by the Ministries of Environment and supported by Ministries of Finance and Economics. Germany allocates revenues to a specific fund (the Energy and Climate Fund). The decision making process involves multiple ministries, but the final authority

Methodology of the study

The Institute for Climate Economics conducted a study regarding the use of auction revenues. While some countries have collected auction revenues between 2011-2012 of Phase III, the analysis is focused on auction revenues earned in 2013. This period of time was chosen due to two reasons: only few countries participated in the auctions before 2013 and thus, relatively less money and allocation decisions are available for examination. The second reason is the availability of allocation reports. In 2014 (most of the) Member States reported on their allocation of 2013 ETS revenues for the first time under the EU Monitoring Mechanism Regulation (M.M.R). This is an annual reporting requirement which is used to publish a summary of EU auction revenues spending in the ***Kyoto and EU 2020 progress report****.*

The Institute for Climate Economics research analyzed the submitted country reports to examine which sectors and types of programs are being supported. In addition, a survey was distributed to Member States. Finally, some interviews were also conducted to understand the motivations behind state decision-making in different countries. All in all, 12 country responses were collected through the survey and 7 interviews were conducted. The interviewees included five member states (Belgium, Czech Republic, France, Germany, and Slovakia), a member of the California Environmental Protection Agency (CalEPA) and the French National Housing Agency (ANAH) which is the sole beneficiary of all of France's auction revenues.

lies with the Ministry of Finance. The Ministries of Economy, Environment and Development play a supporting role and receive the disbursements of auction revenues. Through the special fund, these ministries receive funds for their climate projects. Belgium has three decision-making processes for the national revenues, which are distributed amongst the three regions (Brussels, Flanders and Walloon) whose regional governments vote how revenue is to be allocated.

The information provided through EU annual reports only describes how the money has been spent in the past year and not the planned use of revenue in the future (even by countries' that perform earmarking). If there are separate national, public communications justifying the use of revenues or informing the metrics used for selection of beneficiary programs, no reference to this information is provided in the EU reports. This could largely be due to the fact that countries have only been reporting on auction revenues since 2014. Indeed, in 2014, some countries were still in the initial stages of decision-making and parliamentary approvals of finalizing a revenue spending plan. However, according to the I4CE – Institute for Climate Economics survey, the majority of surveyed countries reported not having any national communications on the allocation of their auction revenues, whether current or future.

Non-earmarker and earmarker revenues spending: which sectors benefit the most?

Non-earmarkers: reported spending largely benefiting international climate efforts

Out of the 28 EU Member States which form the basis of the EU ETS, nine countries do not earmark their ETS revenues; these revenues are directed into their respective national treasuries. These non-earmarker countries are Austria, Denmark, Finland, Greece, Ireland, Netherlands, Poland, Sweden and the UK.

Figure 5 represents *reported* auction revenue spending and not actual non-earmarkers spending. The choice of reported sectoral spending is representative of the expectations set by the EU revenue spending guidelines (i.e. to spend it on climate action). Figure 5 reflects the sum of expenditures whose monetary value forms a share or whole of the sum of auction revenues earned.

From the 2013 reports, it can be deduced that the sector receiving the majority of auction revenue is international aid (mostly through established Funds). In this sector, most revenues reportedly come from the UK (80%); other countries that allocate revenues towards international support include Denmark, Austria and Finland. Most (re-ported) funding is channeled through internatio-nal funds such as the Green Climate Fund (GCF), Least Developed Countries Fund (LDCF), Climate Investment Funds (CIFs) etc. International climate support is an important issue, particularly for the higher income EU nations in the context of the COP21 international climate negotiations. Thus far, developing countries have been lobbying for developed countries to establish concrete means for raising the required levels of finance for the low carbon transition. Developing this flow of revenue to developing countries could be a key to unlocking greater participation among developing in terms of signing an effective international climate treaty.

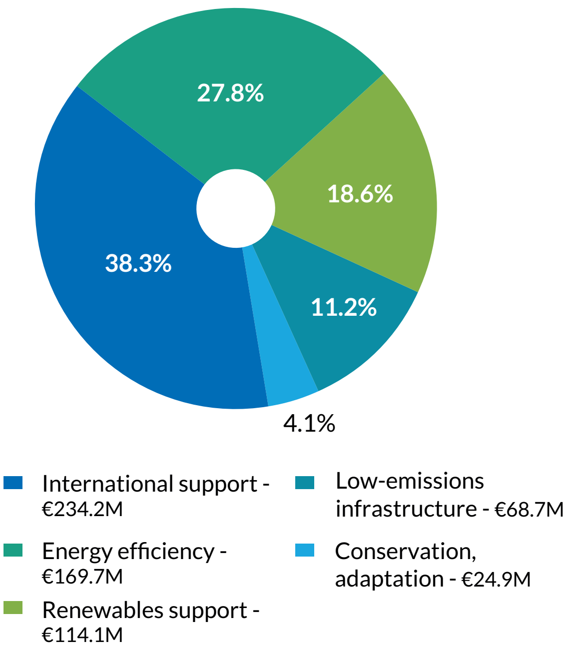
After supporting International aid, non-earmarking nations seem to favour funding is energy efficiency measures, in particular programs based on the housing sector, with some support for industrial energy efficiency in Sweden.

Earmarkers: domestic mitigation and household support are the largest beneficiaries of auction revenues spending

For the other 18 earmarking countries[c], the main sectors receiving auction proceeds are the renewables sector and the energy efficiency sector. Overall, the majority of support goes towards domestic mitigation on small-scale projects using mature technologies, predominantly aimed at supporting household GHG reductions.

Of the support going to renewables, most countries choose to provide support to the household sector in the form of rebates and subsidies. However, most spending, which is conducted by Spain (60% of the €628.2 million), is in the form of RES generation compensation given to utilities. Among most earmarking countries, the energy efficiency sector receives 80% of spending, which is largely directed towards improving energy efficiency in the housing sector. The choice to direct the majority of ETS auction revenues towards households is interesting insofar as the fact that this trend can also be observed in North America. One of the reasons to account for this trend could be that energy efficiency retrofitting is recognized as low-hanging fruit in terms of achieving cost effective GHG reductions. Another explanation could be that there is usually public support for using public carbon revenues towards tangible economic benefits to households. Many household energy efficiency programs also focus on helping low-income households; this kind of spending allows states to mitigate the adverse effects of a low-carbon transition on socio-economically vulnerable groups.

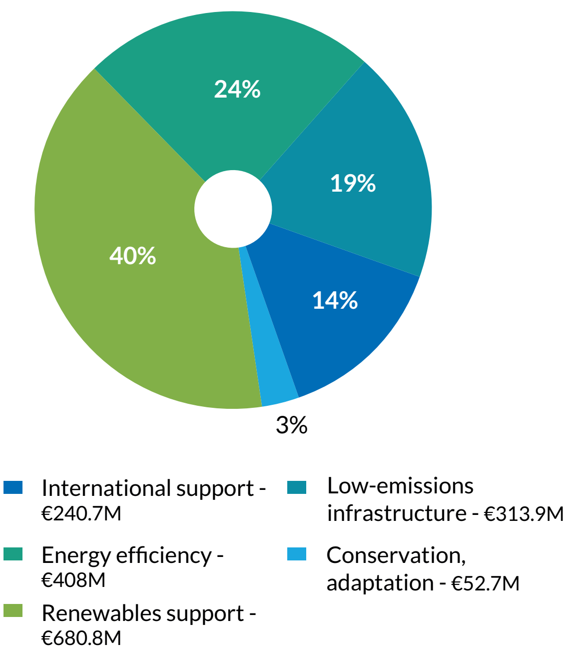
Figure 5 - 2013 Sectoral spending: non-earmarkers.



Not accounted for: Denmark's non-sector specific research and development efforts, Greece and Netherlands (no sector-specific efforts mentioned), Poland's information.

Source: I4CE – Institute for Climate Economics, 2015.

Figure 6 - 2013 sectoral spending: earmarkers.



Not accounted for: Belgium, Croatia, Italy, Latvia and Luxembourg who have not disclosed 2013 revenue allocations in the EU reports (either because revenue allocation decisions had not been made or information could not be provided at the time of submission) and some funds whose sector-specific spending could not be ascertained.

Source: I4CE – Institute for Climate Economics, 2015.

c. Earmarker countries include Belgium, Bulgaria, Cyprus, Czech Republic, Estonia, France, Germany, Hungary, Italy, Latvia, Lithuania, Luxembourg, Malta, Portugal, Romania, Slovakia, Slovenia and Spain. These countries have either already earmarked revenues or are in the process of doing so. Croatia has not yet decided on their revenue allocation method.

It is important to mention as well that Figure 6 below is not necessarily representative of all earmarking nations' spending behaviour. For example, despite international support claiming a 14.5% share of 2013 revenues spending, only two countries actually earmarked revenues for international climate action; Germany (99% or €240.7 million) and Portugal (the remaining 1%).

What is also important to note is that, in 2014 and 2015, international climate support has received significantly less share of auction revenues in Germany; subsequently, the current share of international spending from auction revenues is quite low.

Key questions on EU ETS auction revenue spending

After analyzing these of auction revenues by Member States in 2013, some key questions emerged that address the issue of improving the current revenue spending system.

Should earmarking be a legally enforceable guideline in the EU ETS directive?

There is a valid case for earmarking in that it facilitates traceability of ETS revenues in that it provides the opportunity to track ETS proceeds spending behaviour over time. It also ensures continued and pre-prescribed investment for climate action. Earmarking of revenues usually requires setting metrics or having project selection criteria which could improve how these public revenues are spent in the future. However, it is also important to note that many non-earmarking countries allocate funds towards climate action that exceed the sum of revenue proceeds.

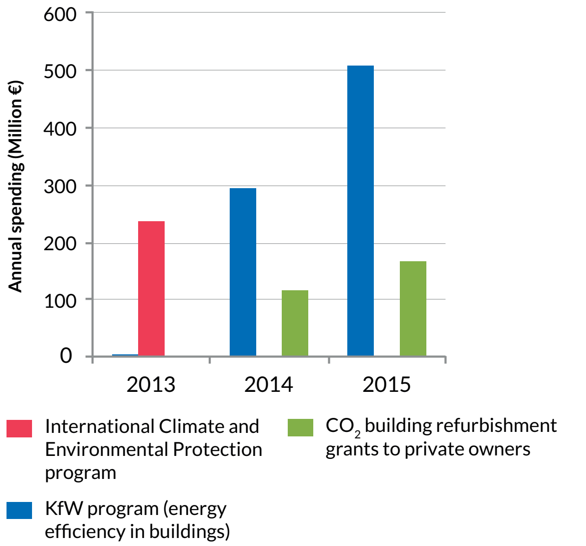
In view of the aforementioned points and the fact that there are strong Member State opinions against hypothecation of revenues, at this time, it would be unrealistic and infeasible to enforce a legal mandate on all Member States to earmark revenues towards climate action. Current guidelines, even in non-legally binding form, have inspired many (in fact most) EU countries to allocate a sizeable share of their revenues toward climate action. In view of the current instability of carbon prices a legally binding framework to guide revenue spending may be more relevant in the future, when carbon prices and revenues streams can be predicted more accurately.

Variability in revenue allocations: an obstacle to long-term planning?

There are two forms of uncertainties creating variability in revenue spending. The first form of uncertainty is dependent on external factors (the EU ETS), in particular carbon prices, that impacts annual revenue from year to year. This variability was directly observed in the case of France in 2013 when a legal decision assigned auction revenues up to €590 million to L'Agence National de l'Habitat (ANAH) or the National Housing Agency. Due to market fluctuations the total actual revenue earned however, was much less than what was forecasted; furthermore, the auction revenues formed a large part of ANAH's revenue sources. ANAH only managed to secure a sum nearly half of what it planned to receive (€219 million). Due to the long-term nature of housing renovation projects supported by ANAH, and the organization was forced to seek alternative funding to compensate for this shortfall and ensure the continuation of its projects. To this effect, the Cour des Comptes (the French Court of Auditors) published a report in 2013 wherein they commented on the vulnerability of ANAH to fluctuations in carbon markets.

The second type of uncertainty creating variability enters when revenue spending decisions are changed from year-to-year. This variability can result in an increased or decreased level of spending allocated to projects. It is useful, for the purposes of project planning, to have some certainty as to the sum of revenues that can be expected. For instance, as shown in Figure 7, the International

Figure 7 - Variation in annual spending through EKF budget, 2013-2015.



Source: I4CE – Institute for Climate Economics, based on the EKF Budget Report, 2015.

Climate and Environmental Protection program (IKI) that received the largest share of Germany's 2013 auction revenues (allocated through the Energy and Climate Fund (EKF)) was no longer to be supported by these funds in 2014 and 2015. While this program is being supported through other means, variability in earmarked revenues on a year-to-year basis presents an obstacle to planning longer-term program spending.

Inconsistencies in reporting: how can EU-level reports be improved?

Currently, various inconsistencies in the scope and content of the information countries report exist. For example, Germany's country report shows that the main recipient of funding is the Energy and Climate Fund (EKF). However, we are unable to ascertain which sectors the money is being allocated to exactly and on what type of projects; only a general description of the Fund's broader objectives are provided. In another example, Poland's (a non-earmarking country) report for 2013 spending provides around 200 examples of uses of the auction revenue in Polish with no translation available. In some cases, figures on reported spending on climate action (in the EU MMR reports) do not correspond to the percentage of total revenues claimed to be spent on climate action (as reported in the Kyoto Preparedness document). Improving reporting guidelines and public communications on revenue usage should be made with an objective to improve transparency of country decisions. This could also help governments make more informed spending decisions in the future.

Should there be more specific guidelines on how to spend revenues?

The current key focus on revenue spending is on small-scale support and to the household sectors. While there are no minimum guidelines or recommendations to direct revenue spending by Member States, there are some areas that could benefit from EU-level guidelines. One such area is support for vulnerable groups such as low-income households. By including minimal social support guidelines, better support could be afforded to groups susceptible to the adverse effects of energetic transition (e.g. rising energy costs). Such social support standards have already implemented in the North American ETS through their revenue spending guidelines (see section 3).
Another area that could benefit from minimal spending guidelines, and was alluded to in the recent proposed EU ETS revision is international climate action support. As mentioned previously, raising climate finance (towards developing countries) is a key issue in the COP21 negotiations for which developed countries must demonstrate action. Also, simple project selection guidelines, despite the issue of enforcement, could offer simple a way to measure the effectiveness of certain investment at reducing GHGs. Such minimal guidelines could assist countries in making optimal decisions on how best to recycle their carbon revenues.

Baring in mind the EU ETS experience and the key questions discussed earlier in this section, the next section will go on to explore the revenue spending allocation decisions of ETS' from North America. While difficult to compare any of these ETS' to the EU, the following analysis attempts to examine if the North American model encounters similar challenges to those facing the EU Member States and whether or not the North American experience offers any insight to overcoming these challenges.

3. LESSONS FROM NORTH AMERICAN AUCTION REVENUES SPENDING PLANS: CALIFORNIA, RGGI AND QUÉBEC EXPERIENCES

It can be useful to refer to the experiences of other emissions trading schemes when assessing funding mechanisms based on carbon pricing. Programs implemented in North America; California, Québec ETS and RGGI have had an interesting experience on the use of auction revenues that could be useful for the European Member States.

Examining the revenue spending experiences of California, RGGI and Québec

California: a comprehensive revenue allocation process supported by a dedicated Fund and an Investment Plan

California's climate change strategies are derived from the Global Warming Solutions Act (AB32), which has been in force since 2006. Financing the low carbon transition with the use of revenues from California's cap-and-trade system is also defined within this law; wherein the goal of the recycling of auction revenues is to reduce emissions or, in broader terms, to "further the objectives of AB32."[27] These objectives not only include climate change and air pollution mitigation but should also address the need to support of disadvantaged communities and economic growth in the state.

Table 4 - Design features of the revenue spending model in California, RGGI, and Québec.

	California	RGGI	Québec
Authority overseeing revenue allocation	Finance Department; State Legislature conducts the revenues allocation.	RGGI, Inc. oversees day-to-day but State Administrations responsible for collection and distribution of revenues.	Ministry of Sustainable Development, Environment And the Fight against Climate Change.
Investment criteria	Reduce GHG emissions (as per GHG reduction law), support for vulnerable groups and targeted towards long-term economic growth.	Consumer benefit and sustainable energy strategy purposes.	GHG emissions reduction is the primary indicator, but for projects that cannot be quantified in GHG reductions, other indicators are chosen.
Guarantees for revenues	The price floor acts as a minimum guarantee and is used to plan auction revenue spending.	Price floor in place; no mention of using it as a minimum guarantee for revenue. 25% of revenues should be spent on energy and consumer benefit.	The price floor acts as a minimum guarantee and is used to plan auction revenue spending. 100% of revenues go into Green Fund for sustainable development use.
Result (revenues reinvested in the compliance period, GHG reduction estimation from reinvestments)	$969M invested in GGRF from 2013-2015; GHG reductions from multi-year investments (past, present and future) for all projects estimated at 375,105MtCO_2.[d]	$1 billion from 2008- 2013 reinvested; 1.3MtCO_2 avoided to date, from reinvestment projects.[28]	C$107M invested in the Green Fund between 2013 and mid-2015[29] (Over C$3 billion to be invested in 2013-2020 fund); 5.3MtCO_2 estimated GHG reductions between 2006 and 2012 from reinvestment projects.[30]

Source: I4CE – Institute for Climate Economics, 2015.

The revenues spending process is comprehensive: the State Finance Department in consultation with other State Agencies, the California Environmental Protection Agencies (CalEPA) and the California Air Resources Boards (CARB) are responsible for putting forward a revenues spending plan. After public consultation and using the technical expertise of the agencies involved, a needs assessment allows the State to understand where ETS revenues can best be used to reduce GHGs. A gap assessment ensures that funds are allocated to projects that are not already supported by other State programs. The Investment Plan is triennial and the latest one was presented in 2013 for the 2013-2016 period. The next will be released in January 2016 for the next three-year interval.

The auction proceeds are placed in the Greenhouse Gas Reduction Fund (GGRF) through which funds are allocated to State agencies and programs via a Budgeting process. After the Investment Plan is approved by the Legislature, different projects can apply for funding via the State Departments responsible for the related projects.

Guidelines governing spending

The distribution of proceeds in California's investment plans is strategically positioned to support low-carbon public transportation (high-speed rail, intercity rails) to meet the needs of a growing population. The effects of potentially rising energy costs or transport costs to vulnerable communities are lessened through investing in affordable housing, energy efficiency in housing and focusing rail lines development in socio-economically vulnerable parts of California. At least 25% of auction revenues are required to be used towards benefiting disadvantaged communities, with 10% of funds being focused on activities within those communities. California has also earmarked funds towards reforestation and waste diversion.

Tools that improve monitoring and the efficiency of the revenues expenditure

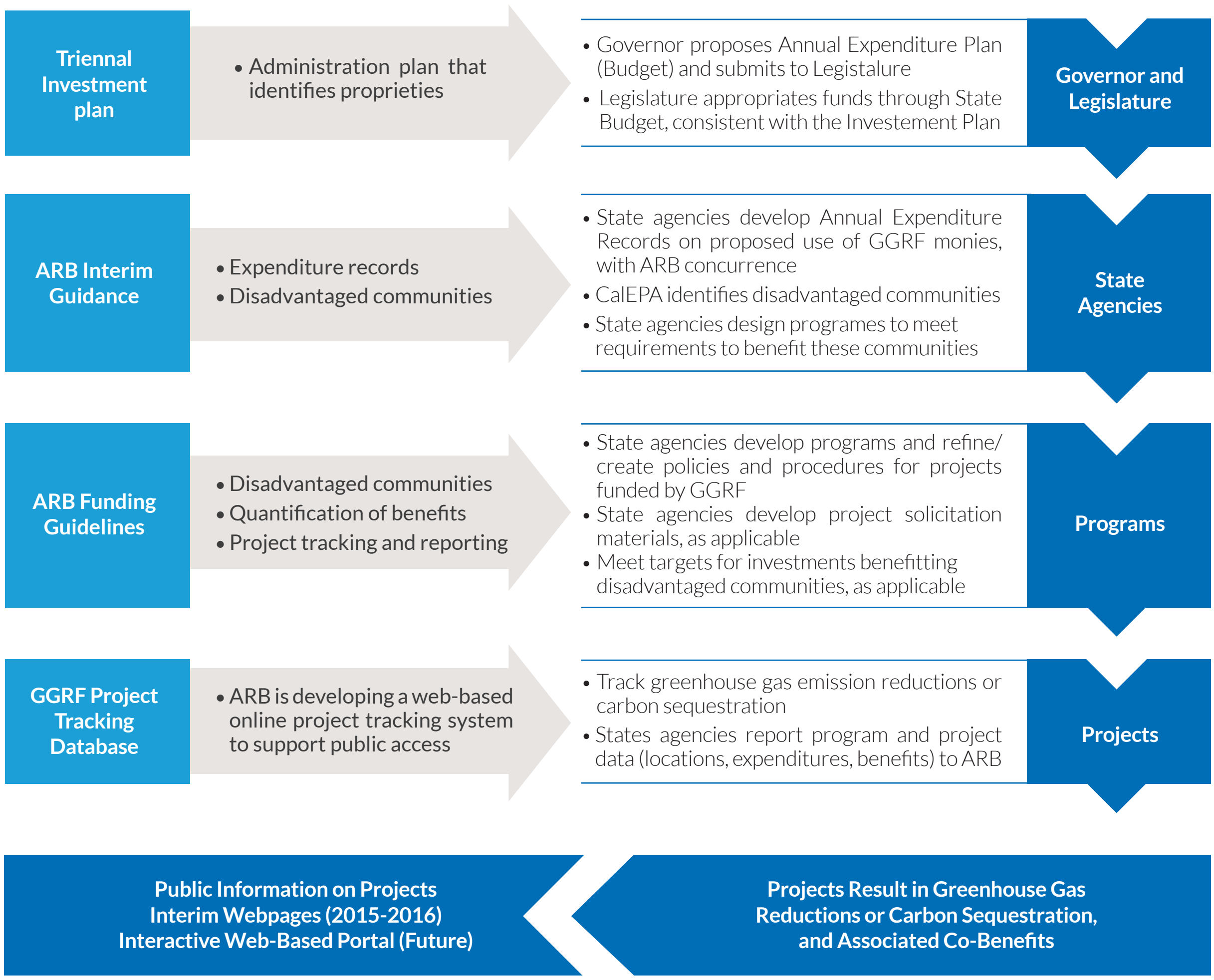
- **Project selection guidelines:** California's ETS revenue spending portfolio is highly customized to its needs and thus, it sets criteria that go beyond

d. According to the 2015 ***CARB Annual Report to the Legislature*** (page 36), this figure is indicative of reductions from past, present and future investments.

emissions reductions alone (such as employment growth, support given to disadvantaged communities etc.). To aid in selecting projects that fit this criteria, California uses simple metrics such as 'miles avoided' or 'kWh avoided' to evaluate projects according to their GHG reduction potential. In an innovative approach to the challenge of raising capital for the low-carbon transition, California also created a points system whereby a project is assigned greater points (thus increasing their chances of receiving ETS revenues) if they can prove they are able to further raise capital using private investment. Finally, California state agencies like CARB and CalEPA have created a tool that identifies where the most disadvantage communities are located. This tool helps to assess the potential of support projects can provide to such vulnerable communities. This tool was key to developing the maps for the High Speed Rail project which is primarily supported through the GGRF.

- **Reducing risks of variability in revenue allocations:** California's use of a carbon price floor serves as the primary measure to reduce the risk of revenue variability and ensures revenues can be estimated more accurately. In view of the fact that California spends revenues on long-term large-scale projects like infrastructure development and affordable community housing programs, revenue guarantees, on an annual basis, for such projects are important. California employs a system where 60% of revenues for the High Speed Rail, Transit and Intercity Rail, Low Carbon Transit Operations, Affordable and Sustainable Communities' Housing programs are ensured revenues. The first 60% of GGRF funds are allocated first to these programs. This significantly reduces uncertainty in the funding of such projects and allows for more reliable timelines for project completion. The remaining programs (that receive the other 40% of revenues) still face uncertainty in the sum of revenues they will receive.

Figure 8 - Greenhouse Gas Reduction Fund (GGRF) financing process.



Source: GGRF Annual Report to Legislature, 2015.

Finally, since the revenue spending plans are multi-annual (established every three years), projects are guaranteed revenues on a three year basis. The chances of projects continuing to receive this spending in subsequent Implementation Plans are relatively secure as long as their performance adheres to the standards and criteria for project selection.

- **Reporting and Communications:** California reports on its performance to the Legislature in an Annual report and uses the pre-set funding guidelines as a reference to why projects were chosen and how successful they have been. If a project no longer meets these criteria or fails to meet them, the Annual reports take note of this when deciding future allocation plans. California actively consults with the public and industry in drafting their Implementation Plans, which are publicly available. Between Implementation Plans, they continue public consultations to ensure that other sectors that require support will not be excluded.

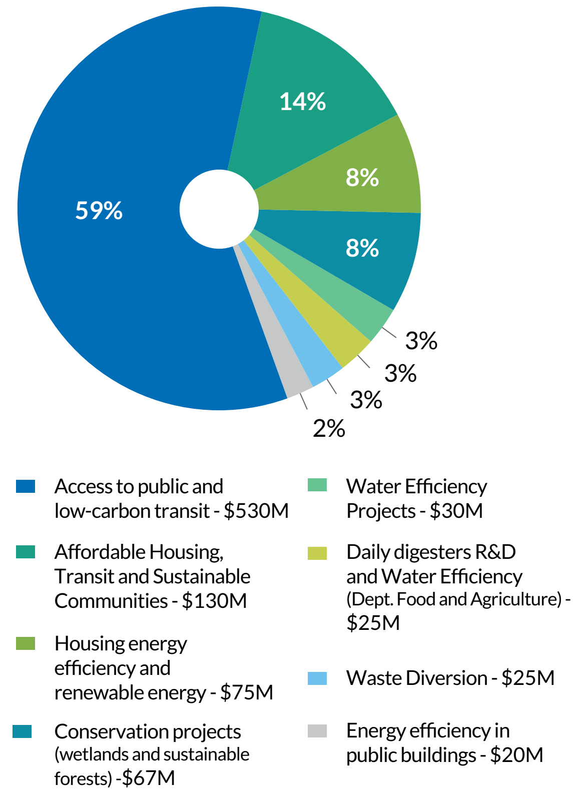
Regional Greenhouse Gas Initiative: strong guidelines supporting energy efficiency

RGGI, over its implementation period, is projected to save 48.7 million mmBTU (1 million British Thermal Unit, equivalent to 293.3kWh) of fossil fuels and 11.5 million kWh of electricity, resulting in the emission reduction of 10 million tons of carbon pollution (40% reduction since 2005).[31] As of 2015, RGGI states have participated in 27 quarterly auctions which have cumulatively accrued over $1.5 billion in auction revenues, out of which nearly $290 million has been reinvested.[32]

Guidelines governing spending

Guidelines for the use of auction revenues are detailed in the first Memorandum of Understanding (MOU) between participating states, signed on December 20th 2005, which implements the RGGI cap-and-trade program. Under the MOU, RGGI states are expected to allocate 25% of allowances for consumer benefit or strategic energy purposes (as advised in the RGGI Model Rule 8/15/2006, section XX 6.4). Consumer benefit purposes include allocations that would directly mitigate impacts to electricity taxpayers such as investing in energy efficiency. Strategic energy purposes include promotion of renewable or non-carbon emitting energy technologies and purposes that stimulate investment for innovative carbon reduction programs.

Figure 9 - California auction revenue spending (2013-2015).



Source: I4CE – Institute for Climate Economics, 2015 and California Air Resources Board, 2015

The remaining 75% of allowances can be auctioned or managed and used according to the State's discretion. However, the revenues generated must still be spent towards the aforementioned purposes. Each state has independent regulations governing the use of revenues that are based on the RGGI Model Rule. States are required to provide state-specific rules and regulatory certainty for the revenues spending.[33] RGGI states have allocated at least 67% of auction revenues towards energy efficiency between 2008-2013 as can be seen below in Figures 10 and 11.[34] Residential energy efficiency (29%), commercial energy efficiency (22%) and low-income efficiency projects (16%) form the 67% of energy efficiency spending share.

The more specific criteria under which all states' revenue spending is reported are divided into the following: energy efficiency, GHG abatement, clean and renewable energy, direct bill assistance, administration and RGGI, Inc. The establishment of this criteria allows for easy comparison between States' efforts whose revenues spending are reported in the same format in their publicly released report, 'Investment of Auction Proceeds Through 2013'.

Sectors receiving spending

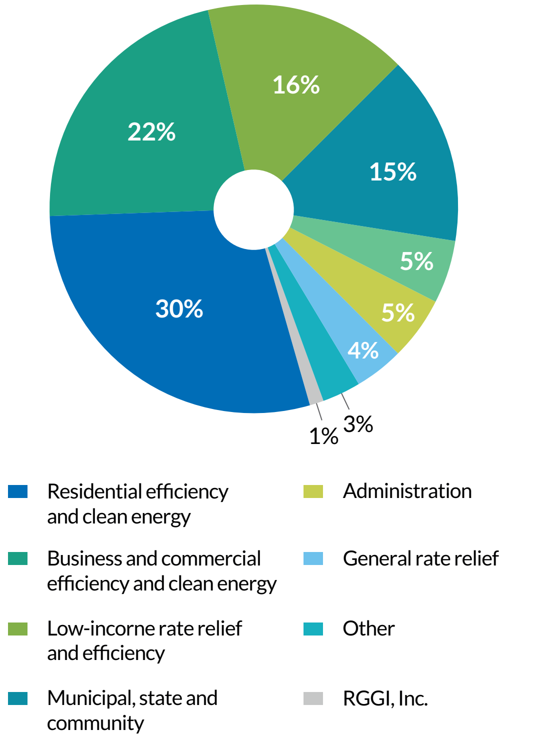
Energy efficiency criterion applies to programs that benefit participating households and businesses. Examples of programs include energy saving initiatives such as modernising heating and cooling appliances, upgrades to HVAC equipment, weatherizing and insulation of buildings and improvement of industrial processes. GHG abatement refers to research and development programs for advanced energy technologies, reduction of vehicular miles travelled and GHG reduction in other sectors. Clean and renewable energy funding is available in the form of grants or low-interest financing to businesses and homeowners that wish to install on-site renewable or clean-energy systems. Direct bill assistance aims to provide energy credits to consumers to offer 'rate relief' or some form subsidy on energy costs. Low-income families and small businesses are also specifically targeted by many programs under direct bill assistance.

Québec: comprehensive revenues spending process based on a dedicated Fund and a detailed spending Plan

The Ministry of Sustainable Development, Environment And the Fight against Climate Change (MDDELCC) are responsible for the Québec auctions and the redistribution of revenues. Like California, Québec releases a long-term investment plan (the Climate Change Action Plan or PACC) for usage of revenues and like California, it focuses on its highest polluting sector: transport.

Québec allocates all auction revenues directly to their Green Fund which issues proceeds according to a seven-year implementation plan that is set by the MDDELCC and is approved by the National Assembly. The criteria established by Québec are again, similar to that of California and focus on long-term sustainable growth, reductions in emissions and protection of vulnerable groups from negative economic impacts from this energetic transition. The PACC also recognizes that some projects cannot be quantified in potential GHG reductions and so have selected socioeconomic and other relevant indicators.[35] A detailed spending plan of Québec's auction revenues specifies a diverse range of programs from building public awareness on climate change to technology development and creating greener transit options. Breakdown of Quebecois revenue spending can be seen in Figure 12 below.

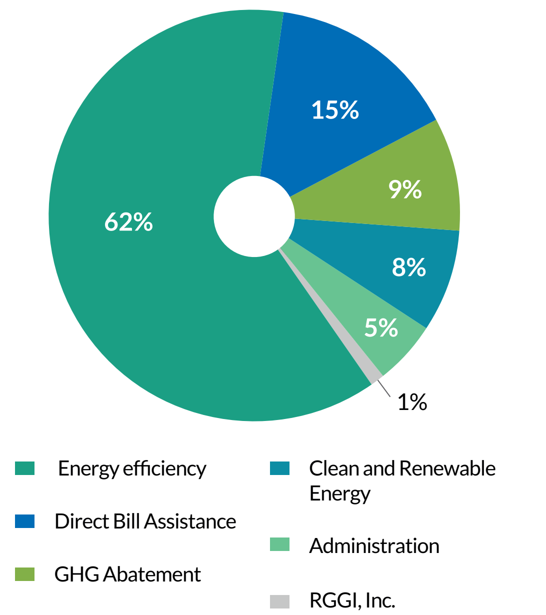
Figure 10 - RGGI investments by program type (2008-2013).



The categories of sectors have been taken from the official RGGI report of auction revenue distribution.

Source: Investment of RGGI Proceeds Through 2013, 2015.

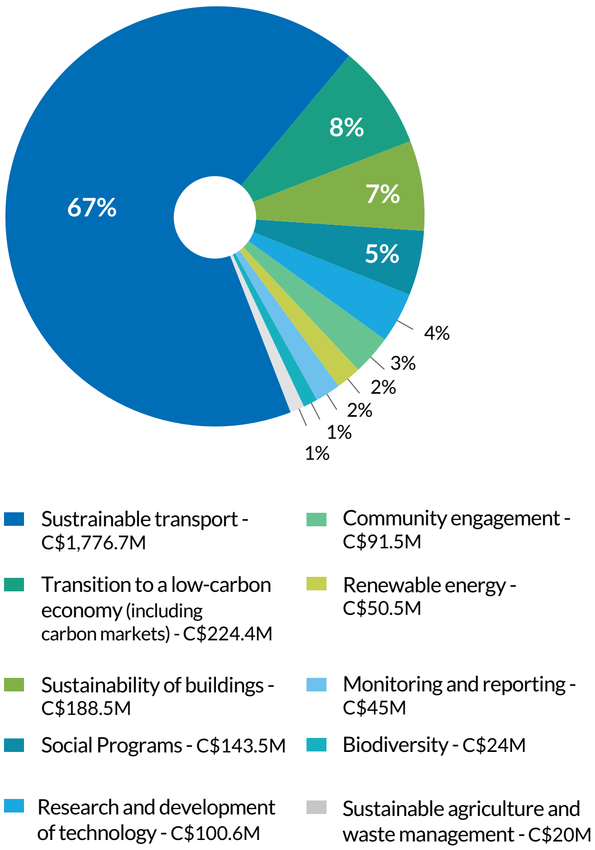
Figure 11 - RGGI investments by category (2008-2013).



The categories of sectors have been taken from the official RGGI report of auction revenue distribution.

Source: Investment of RGGI Proceeds Through 2013, 2015.

Figure 12 - Québec auction revenue spending plan (2013-2020).



The categories of sectors have been taken from the official Québec report of auction revenue distribution.

Source: I4CE – Institute for Climate Economics, 2015 and Québec MDDELCC.

Common trends in revenue spending models between California, RGGI and Québec

Based on the above examples of California, RGGI and Québec, we can observe some trends that differ to the EU ETS model:

- **Long-term planning strategies:** While many EU countries have variable or annual allocations for their Funds, North American Funds such as California and Québec have set long-term strategies (three-year and seven-year plans respectively). A reason for this is that these two States are using auction revenues to strategically fund low-carbon infrastructure for the future by investing in projects like the electrification of public transit.
- **Reporting and public information:** RGGI reports include simple, standardized infographics such as energy bill savings, tons of CO_2 avoided, workers trained and equivalent cars off the road. This facilitates measuring the impacts of the revenues spent with greater transparency. It also helps to determine if revenue spending is aligned with broader economic and environmental goals of the RGGI program. Through this reporting, we can observe that decision-making for auction revenues spending is largely justified through economic benefits and benefits to the public.
- **Criteria Focus:** there is a focus in the North American model to have set criteria that can justify to the public the rationality behind spending decisions. The criteria do not only allude to greenhouse gas emissions reductions but also emphasise the socio-economic benefits underpinning revenue spending decisions. Among EU Member States' reporting under the EU ETS, no justification is provided on why certain programs have been chosen. California uses specific criteria, to determine exactly which projects will receive funding and this decision-making is reported in its Assessment Reports.

Recommendations and conclusions

As the amount of EU ETS auction revenues is expected to increase by 2030, steps could be taken to ensure that auction revenues continue to effectively finance actions aligned with the low-carbon, climate resilient transition. From the areas of improvement identified in section 2, and from the lessons learned from other auction revenue planning systems in section 3, some key recommendations for the EU ETS revenue spending model can be identified. These recommendations can be organized into three main areas: i. addressing the variability of the carbon revenues to programs; ii. improving reporting standards and communication on use of revenues; and iii. leveraging private finance to enhance the potential of this public revenue resource.

- **Reducing the risk of variability of revenues:** While future ETS revenues are expected to be relatively more stable, variability in carbon prices and thus revenues could still affect project allocations. Firstly, the information on expected carbon prices should be better communicated between the EU and Member States as well as between Member States and program recipients. By effectively communicating carbon price forecasts between the EU and Member States and Member States and revenue, ministries and recipients can better prepare for potential shortfalls in revenue. Secondly, some form of "variability insurance" could be provided to programs. Some of these programs have multiannual commitments for which long-term certainty on expected allocations is essential. One type of variability insurance could be a minimal percentage guarantee on revenues, especially for long-term or large-scale projects. As seen in section 3, California has implemented this concept to assure revenues are first allocated to their priority projects (high-speed rail construction and affordable housing programs).

- **Improving transparency in reporting and communications:** Utilising auction revenue reporting in its current form provides a very general and sometimes vague idea of how countries are planning their energetic transitions. With better reporting and quality standards, the EU could have greater visibility in the planning decisions that are adopted using such public revenues. EU level guidelines could recommend that governments submit revenue spending reports and adequately communicate to the public on the rationale behind their decision making. To ensure that projects that reduce GHGs most effectively receive the most funding, a basic metrics system could be applied in the EU reporting guidelines that acts as a barometer against which GHG reduction efforts are assessed. As utilised by RGGI, even simple metrics such as 'kWh reduced', tons of GHGs avoided could allow (the EU) to compare efforts of programs across different Member States. Improved transparency on best practices and efficiency of euros spent for tons of GHG reduced could in turn, improve the broader alignment of the future revenue usage with the EU 2030 GHG reduction goals.

- **Leveraging private finance using public proceeds:** Public investment alone will not be able to fulfill the low-carbon transition demands for a 2°C scenario, both at the domestic and international level. Blending of public and private resources offers positive signals to encourage future investment and provides opportunities for new and innovative funding mechanisms for climate action. For instance, the NER 300 program has funded nearly 38 projects in innovative low-carbon technologies with €2.2 billion from auction revenues and €2.86 billion from private sources. The benefits offered by the ETS revenues to potential investors are that they are guaranteed annual revenue whose allocation is expected to be aligned with broader long-term, national policies, particularly on low-carbon investment. In this regard, ETS revenues offer row-risk investment opportunities for investors who want to fund national climate actions. As in California some incentives could be provided that encourage programs to leverage private capital and in doing so, increase their chances in being selected as auction revenue beneficiaries.

Table 5 - Standardised reporting units to measure impact of RGGI revenue investments.

Reporting Units	Result (2008-2013)
Participating Households	To date: 3.7 million
Participating Businesses	To date: 17,800
Workers Trained	To date: 3,700
Energy Bill Savings	To date: $395 million Lifetime: $2.9 billion
Megawatt Hours Saved	To date: 1.8 million Lifetime: 11.5 million
mmBTU saved	To date: 2.9 million Lifetime: 48.7 million
Short Tons of CO_2 Avoided	To date: 1.3 million Lifetime: 10.3 million
Equivalent Cars Off Road	To date: 254,000 million Lifetime: 1.9 million

Source: Investment of RGGI Proceeds Through 2013, 2015.

Moving forward, European discussions on how to use auction revenues should thus address these three issues -variability, reporting, and guidelines to support specific action- to efficiently and effectively, strengthen ETS revenues' role in funding the EU's low-carbon transition and fulfilling international commitments. Some lessons learned from other experiences can provide ideas and inspiration that would make the EU ETS revenue spending model more transparent and effective as a financial mechanism. In view of the current proposal to revise the EU ETS Directive, it is an opportune time to open this debate among EU Member states in order to maximise the potential of the EU ETS to succeed in meeting 2030 objectives.

REFERENCES

Air Resources Board, ARB, California:
- Cap and Trade Auction Proceeds Investment Plan 2013-14 through 2015-16
- Annual Report to the Legislature, 2015

I4CE – Institute for Climate Economics:
- The EU ETS by 2030, report forthcoming in September 2015
- Utilization of auction revenues by member states, report forthcoming in September 2015

Congressional Research Service, 2015, The Regional Greenhouse Has Initiative: Lessons Learned and Issues for Congress, July 2nd 2015

ETG UK Emissions Trading Group, 2008, WG5/6 *Sub-Working EU Emissions Trading Scheme - Auctioning Proceeds,* April 11th 2008

European Commission:
- EC 1998, Fuel Quality Directive 98/70/EC
- EC 2003, *Directive establishing a scheme for greenhouse gas emission allowance trading within the Community,* October 13th 2003
- EC 2011, *A Roadmap for moving to a competitive low carbon economy*, March 8th 2011
- EC 2014, A policy framework for climate and energy in period from 2020 to 2030, January 28th 2014
- EC 2014, Impact Assessment of the Communication on a policy framework for climate and energy in period from 2020 to 2030, January 28th 2014
- EC 2014, *Proposal for a Decision concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EU*, January 22nd 2014
- EC 2015, *Proposal for a directive amending directive 2003/87/EC*, July 15th 2015
- EC 2014, *Outcome of the October 2014 European Council, A policy framework for climate and energy in the period from 2020 up to 2030*, October 30th 2014
- EC 2015, *Update from the European Commission initiatives on Carbon Capture and Storage from the research and innovation perspective*, 11-12 May 2015
- EC 2011, *Commission Staff Working Document on Scaling up international climate finance after 2012*, April 8th 2011

IEA, 2014, *World Energy Investment Outlook*.

Müller, B.,Oxford Institute for Energy Studies, 2008, *To earmark or Not to Earmark*

Québec Ministry of Sustainable Development, Environment and the Fight against climate change:
- Revenus des ventes aux enchères versés au Fonds vert, 2015
- Plans d'action sur les changement climatiques, Bilan 2012-2013, Spring 2014

Regional Greenhouse Gas Initiative:
- Investment of RGGI Proceeds Through 2013, April 2015
- Memorandum of Understanding

END NOTES

1. European Commission, 2011, *A Roadmap for moving to a competitive low carbon economy*, March 8th 2011. Available at http://eur-lex.europa.eu/resource.html?uri=cellar:5db26ecc-ba4e-4de2-ae08-dba649109d18.0002.03/DOC_1&format=PDF, p.10.
2. EU Commission, 2014, *A policy framework for climate and energy in period from 2020 to 2030*, 28 January 2014. Available at: http://www.ipex.eu/IPEXL-WEB/dossier/document/COM20140015.do
3. EU Commission, 2014, *Impact Assessment of the Communication on a policy framework for climate and energy in period from 2020 to 2030*, 22 January 2014. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0015&from=EN
4. *Supra 1*.
5. *Supra 1*.
6. *Supra 3*, p.88-89.
7. *Supra 3,* p.44.
8. *Supra 3*, p.32.
9. *Supra 3,* p.30.
10. *Supra 3*, p.32-33.
11. EU Commission, 2014, *Proposal for a Decision concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EU*, January 22nd 2014. Available at : http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014PC0020
12. European Commission, 2015, *Proposal for a directive amending directive 2003/87/EC,* July 15th 2015. Available at: http://eur-lex.europa.eu/resource.html?uri=cellar:a556e9fb-5153-11e5-9f5a-01aa75ed71a1.0014.02/DOC_1&format=PDF, p.19.
13. *Supra 10*, p.10.
14. European Commission, 2014, *Outcome of the October 2014 European Council, A policy framework for climate and energy in the period from 2020 up to 2030*, October 30th 2014. Available at: http://ec.europa.eu/clima/policies/2030/docs/2030_euco_conclusions_en.pdf
15. European Commission, 2015, *Executive Summary of the Proposal for a directive amending directive 2003/87/EC*, July 15th 2015. Available at: http://ec.europa.eu/clima/policies/ets/revision/docs/swd_2015_136_en.pdf, p.5-6.
16. *Supra 11*, p.22.
17. European Commission, 2015, *Update from the European Commission initiatives on Carbon Capture and Storage from the research and innovation perspective*, 11-12 May 2015. Available at: http://conference.co2geonet.com/media/1065/open-forum-day-1-3_kougionas.pdf
18. *Supra 15*, p.6
19. *Supra 11*, p.19.
20. *Supra 11,* p.18.
21. *Supra 15*, p. 7.
22. European Commission, 2011, *Scaling up international climate finance after 20,* April 8th 2015. Available at: http://ec.europa.eu/economy_finance/articles/financial_operations/pdf/sec_2011_487_final_en.pdf, p.8.
23. Institute for Climate Economics - I4CE, 2015.
24. IEA, 2014, *World Energy Investment Outlook*.
25. Müller, B, Oxford Institute for Energy Studies, 2008, *To earmark or Not to Earmark*. Available at: http://www.accc.gv.at/pdf/EV43.pdf
26. ETG UK Emissions Trading Group, 2008, *WG5/6 Sub-Working EU Emissions Trading Scheme - Auctioning Proceeds*, April 11th 2008, Available at: http://www.etg.uk.com/documents/Auctioning%20Proceeds%20WG%20paper%2007042008%20final1.pdf
27. California Air Resources Board, 2013, *Cap and Trade Auction Proceeds Investment Plan 2013-14 through 2015-16*, May 14th 2013. Available at: http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/final_investment_plan.pdf
28. RGGI, April 2015, *Investment of RGGI Proceeds Through 2013*. Available at: http://rggi.org/docs/ProceedsReport/Investment-RGGI-Proceeds-Through-2013.pdf, p.7.
29. Québec MDDELCC, 2015, *Revenus des ventes aux enchères versés au Fonds vert*. Available at : http://www.mddelcc.gouv.qc.ca/changements/carbone/revenus.htm
30. Québec MDDELCC, Spring 2014, *Plans d'action sur les changement climatiques, Bilan 2012-2013*. Available at: http://www.mddelcc.gouv.qc.ca/changementsclimatiques/bilan-2012-2013/bilan-PACC-2012-2013.pdf, p.75.
31. *Supra 26*, p.3.
32. *Supra 26*, p.5.
33. RGGI, December 2005, *Official Memorandum of Understanding*, Available at: http://www.rggi.org/docs/mou_final_12_20_05.pdf, p.6.
34. Congressional Research Service, July 2015, *The Regional Greenhouse Has Initiative: Lessons Learned and Issues for Congress*. Available at: https://www.fas.org/sgp/crs/misc/R41836.pdf, p.12.
35. *Supra 28*, p.8.

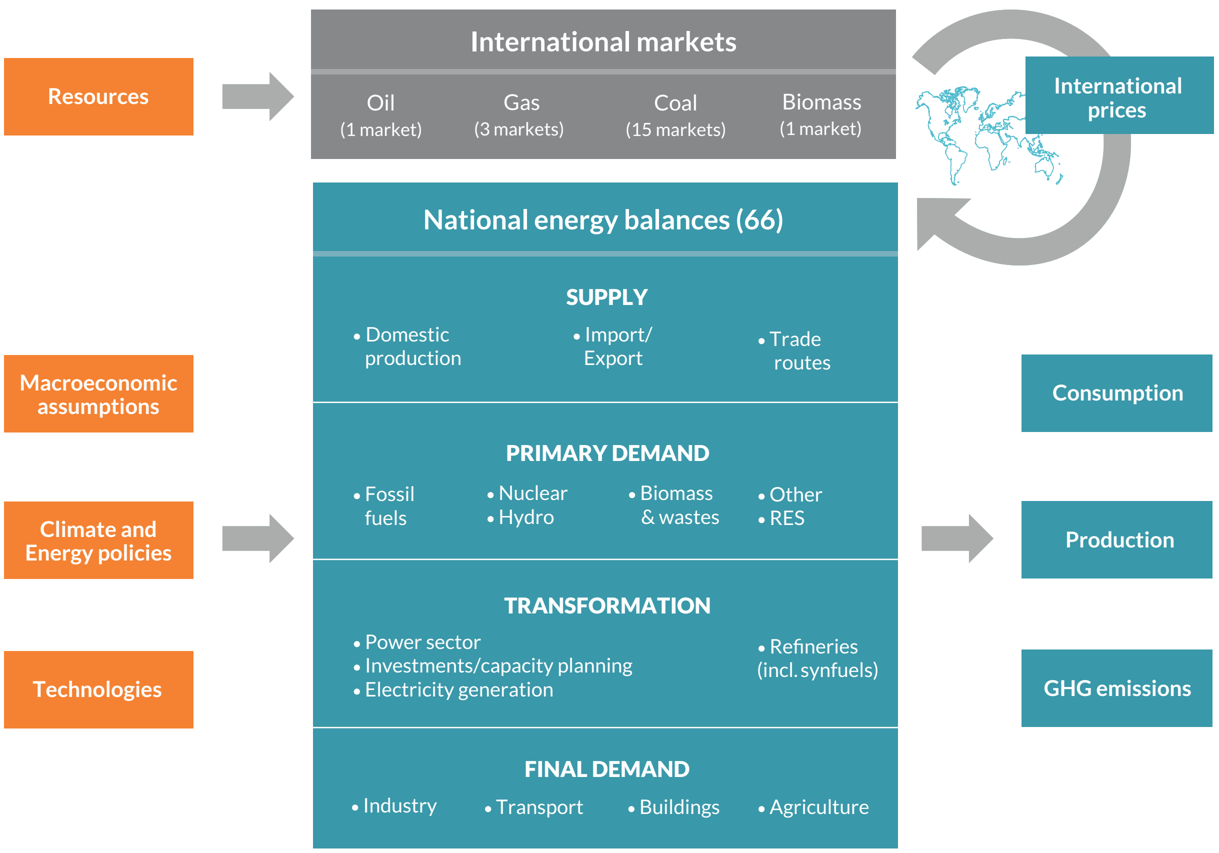
ANNEX

1. POLES-Enerdata model

Enerdata offers the world recognized POLES model to provide quantitative, scenario-based, empirical and objective analyses. As the POLES model is used by many members of the energy sector (industry, governments, European Commission, etc.), it is very well adapted to forecast the effects of different energy-related engagements (GHG emissions limitations, promotion of renewables and energy efficiency, energy security issues, etc.). In addition, with its global coverage and the endogenous calculation of demand, supply and prices of numerous energies including oil, gas, and coal, the POLES model is very relevant to capture all of the impacts of energy policies and climate change measures and to ensure that all the forecasts are coherent within the global environment.

POLES (*Prospective Outlook on Long-term Energy Systems*) is a world energy-economy partial equilibrium simulation model of the energy sector, with complete modelling from upstream production through to final user demand and greenhouse gases emissions. The simulation process uses dynamic year-by-year recursive modelling, with endogenous international energy prices and lagged adjustments of supply and demand by world region (see Figure 1), which allows for describing full development pathways to 2050.

Figure 1 - POLES-Enerdata model: overall model structure.



Source: Enerdata, 2015.

POLES is used and developed by Enerdata, the European Commission's JRC IPTS, and Université de Grenoble-CNRS (EDDEN laboratory). It is used to provide quantitative, scenario-based, empirical and objective analyses by many members of the energy sector (private companies, governments, European Commission).

The use of the POLES model combines a high degree of detail for key components of the energy system and a strong economic consistency, as all changes in these key components are influenced by relative price changes at the sectoral level. The model provides technological change through dynamic cumulative processes such as the incorporation of Two Factor Learning Curves, which combine the impacts of "learning by doing" and "learning by searching" on technologies' development. As price induced diffusion mechanisms (such as feed-in tariffs) can also be included in the simulations, the model allows for consideration of key drivers to future development of new energy technologies. One key aspect of the analysis of energy technology development with the POLES model is indeed that it relies on a framework of permanent inter-technology competition, with dynamically changing attributes for each technology.

Key Features

- Long-term (up to 2050) simulation of world energy scenarios/projections and international energy markets.
- World energy supply scenarios by main producing country/region with consideration of reserve development and resource constraints (88 producing countries/regions).
- Outlook for energy prices at international, national and sectoral level.
- Disaggregation into 15 energy demand sectors, with over 40 technologies (power generation, buildings, transport).
- Detailed national/regional energy balances, integrating final energy demand, new and renewable energy technologies diffusion, electricity, hydrogen and Carbon Capture and Sequestration systems, fossil fuel supply, and uranium (66 consuming countries/regions, see Table 1).

Table 1 - POLES-Enerdata model: country coverage.

Regions	Sub-regions	Countries (66 countries/regions)	Country aggregates (66 countries/regions)
North America		USA, Canada	
Europe	EU15	France, United Kingdom, Italy, Germany, Austria, Belgium, Luxembourg, Denmark, Finland, Ireland, Netherlands, Sweden,	
	EU25	Spain, Greece, Portugal Hungary, Poland, Czech Republic, Slovak Republic, Estonia, Latvia, Lithuania, Slovenia, Malta,	
	EU28	Cyprus, Croatia, Bulgaria, Romania, Iceland, Norway, Switzerland, Turkey	Rest of Europe
Japan - South Pacific		Japan, Australia, New Zealand	Rest of South Pacific
CIS		Russia, Ukraine	Rest of CIS
Latin America	Central America	Mexico	Rest of Central America
	South America	Brazil, Argentina, Chile	Rest of South America
Asia	South Asia	India	Rest of South Asia
	South East Asia	China, South Korea , Indonesia, Malaysia, Thailand, Viet Nam	Rest South East Asia
Africa / Middle East	North Africa	Egypt,	Rest of North Africa x2
	Sub-Saharan Africa	South Africa	Rest of Sub-Saharan Africa
	Middle-East	Saudi Arabia, Iran	Gulf countries; Rest of Middle East

Source: Enerdata, 2015.

- Full power generation system (and feedback effect on other energies).
- Impacts of energy prices and tax policies on regional energy systems. National greenhouse gas emissions and abatement strategies.
- Costs of national and international GHG abatement scenarios with different regional targets/endowments and flexibility systems.
- CO_2 emissions Marginal Abatement Cost Curves and Emission Trading System analyses by region and/or sector, under different market configurations and trading rules.
- Technology diffusion under conditions of sectoral demand and inter-technology competition based on relative costs and merit orders.
- Endogenous developments in energy technology, with impacts of public and private investment in R&D and cumulative learning experience. Induced technological change of climate policies.

Quality assurance and data updates

Regular updates of the historical database underlying the model are provided by Enerdata. Currently, the POLES database is updated twice a year; it includes data up to the past year in most cases (two-year delay in specific cases). Data updates are conducted by Enerdata's Global Energy Forecasting team (manpower of 7) and Enerdata's Market Research team (manpower of 4). Prior to being input into POLES, data benefit from the Market Research team's thorough quality assessment process. Updates for POLES involve frequent data checks and feedbacks that result in a higher quality of both of Enerdata's databases and of POLES as a forecasting tool.

In particular, all data are reviewed in-depth during Enerdata's annual EnerFuture exercise[1], which consists of a historical data update, a consolidation of changes in the modelling code over the past year and an update of forecast data to reflect real-world developments and different outlooks for the future (three scenarios). This exercise benefits from quality checks and feedbacks from Enerdata staff, scientific advisors and clients. The next EnerFuture update is planned for December 2015.

POLES is used by several independent partners: IPTS, EDDEN and Enerdata.

- With the frequent exchanges between these three entities, POLES benefits from the expertise and mutual feedback of many developers, ensuring that it is an energy-economy model of high quality and highly competitive with similar models.
- POLES is also used for several partners and clients of these three entities: private companies operating in the energy sector (power utilities, oil and gas producers, equipment manufacturers), public institutions (energy and environment ministries, energy agencies) and international bodies (European Commission, United Nations). With frequent exposure of the modelling methodology and modelling outputs to non-modelling experts, we ensure that POLES is found fit for purpose and up-to-speed with the needs of policy-makers and the business sector.
- All three entities participate to research projects and inter-model comparison exercises, either individually or collectively. The purpose of these projects is to critically assess the modelling and modelling outputs of different models by producing scenarios and setting up analysis protocols and relevant indicators for comparison. With these projects, the POLES developers stay abreast of modelling best practices and of innovative modelling developments, and ensure that POLES remains among the best energy-economy models across Europe and the world. POLES has participated in the Energy Modelling Forum of Stanford University (EMF[2] 24 and 27, 2010-2013), the Integrated Assessment Modelling Consortium (IAMC[3], since 2012) and the European research projects AMPERE[4] (2011-2013) and ADVANCE[5] (2012-2016).

1. http://www.enerdata.net/enerdatauk/knowledge/subscriptions/forecast/enerfuture.php
2. https://emf.stanford.edu/
3. http://www.iamconsortium.org/
4. http://ampere-project.eu/web/
5. http://www.fp7-advance.eu/

2. Carbon Market Tool

The Carbon Market Tool (CMT) has been developed by Enerdata to allow for detailed analyses of existing and future carbon markets worldwide. CMT is designed to facilitate climate negotiations, specifically related to carbon permit trading market design. To effectively support to negotiations, quantified estimates of the trade volumes and costs for different market configurations are generated with CMT for all of the major world countries/regions. Since the Conference of the Parties in Copenhagen, Denmark (COP 15), CMT has been continually developed and refined. The Danish Energy Agency has financially supported these developments, as well as provided valuable input on the types of issues and market mechanisms relevant to current climate negotiations.

Overall, CMT offers a straightforward tool for quickly assessing the country-level impacts from carbon permit trading.

Scope

CMT is based on Enerdata's POLES model and the marginal abatement cost curves generated from its long-term energy scenarios. The POLES model provides the MACCs used in CMT, covering most energy combustion and industrial emissions sources for 66 countries. These areas include: power generation, industrial fuel combustion and process emissions, upstream and refining, final fuel demand in residential, services, agriculture and transport. All of the Kyoto Protocol gases are covered for these sectors, including CO_2, CH_4, N_2O, SF_6, PFCs and HFCs.

Methodology

CMT is based on the theory that the equalization of marginal abatement costs achieves the lowest overall cost of emissions reductions. This lowest cost is as seen from society's point of view, and is therefore a useful measure for governments and public sector actors looking to reduce emissions.

The POLES hybrid model blends a top-down framework of endogenous fuel price calculation and demand feed-backs, with explicit technological detail in the power sector (and buildings and transport). The technological detail allows explicit representation of emission reduction options (mitigation technologies, demand reduction, production changes), offering a strong basis for generating MACCs in a coherent manner amenable to policy analysis.

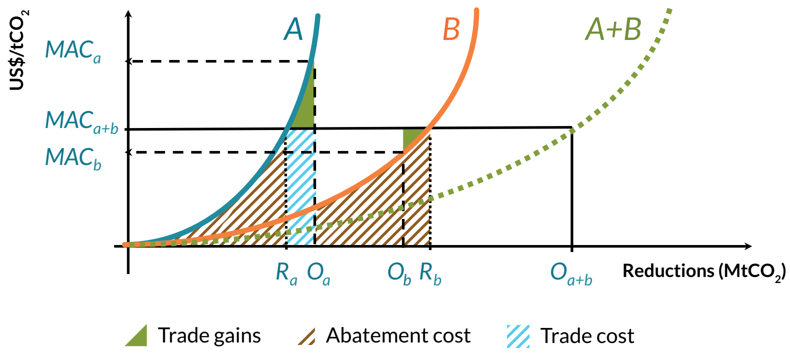
Scenarios in CMT allow analysis of carbon permit trading for a particular year based on MACCs derived for that year (i.e. a "snapshot" of mitigation reduction potentials in a long-term energy scenario). Several user settings can be saved and loaded, including features like methodology for reference emissions (IEA or UNFCCC), consideration of non-CO_2 gases, of LULUCF emissions, units, currency year, etc.

To operationalize the principle of equalizing marginal abatement costs across regions, a carbon permit trading system is modelled (Figure 2). Several market configurations can be designed from the user, e.g. the EU-ETS including country specific mitigation targets, non-ETS sectors, BRICS countries, etc. The user can choose whether the markets defined are allowed for trading or not. Mitigation targets and further design options can be set at different observation levels: whole market, country, category of sectors (e.g. power, industry, transport, etc.) or sector (e.g. steel, domestic air, etc.).

The design options modelled include e.g. the access to other markets, cost controls like a price floor or ceiling, international credit access, banked credits, mitigation targets, consideration of barriers to abatement potential, financing options.

Given all of the market definitions and constraints, CMT finds the market equilibrium and the resulting market prices and trade flows that minimize the total abatement cost across all markets. CMT uses MS-Excel's solver to minimize the total global abatement cost.

Figure 2 - Carbon Market Tool: equalization of marginal abatement costs across market participants.



Source: Enerdata, 2015.

Results

Results provided include the market prices in each market (i.e. marginal abatement cost), the domestic reductions performed in each market and the associated abatement costs, trade flows between markets (and the share of the total allowed trade that is used) and trade cost/revenue, and the overall net cost.

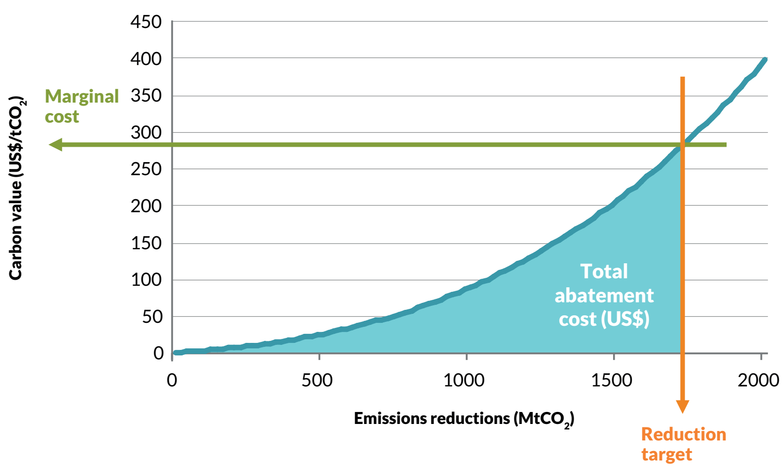
Results in CMT are available at most different scales of aggregation and include:

- Reduction objective, domestic reductions completed at the market price/marginal abatement cost, cumulative abatement cost (see Figure 3);
- Total net imports, net imports from other trading markets and net cost, imports from international credits and cost, banked credits;
- Emissions - target, at market price, baseline, and in reference years, percentage reduction below baseline and reference years;
- Abatement cost and MAC if trading was not allowed;
- BaU GDP and population, emission intensity and abatement cost per unit GDP and per capita (with and without trade);
- Co-benefits (net revenue);
- Financing costs (net cost spent), allocated funds, marginal abatement cost, reduction at MAC (with/without cap), reductions realized due to financing.

In addition, CMT provides an international credits trade matrix and the possibility of visualizing MACCs by market, country and sector.

All outputs are available for the different countries considered, different sectors and sub-sectors, and for various years of the analysis.

Figure 3 - Carbon Market Tool: marginal abatement costs and total abatement costs.



Source: Enerdata, 2015.

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Graphic design: Marine Longeanie