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Effects of Interactions between EU Climate and Energy Policies

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In brief

The CARISMA case study analysis on energy and climate policy interactions aims to complement existing literature on policy interactions by addressing a set of aspects of policy interactions related to: the policy levels at which interactions may occur (EU, national or regional levels), inter-temporal interactions (*e.g.*, short term versus long term policy interactions), and interactions that occur if stakeholders are indirectly affected by a policy instrument (even if they are explicitly excluded from the policy).

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Working Documents are not formal deliverables of CARISMA, but highlight preliminary findings of the project for discussion. Working Documents are not as extensively reviewed as formal project deliverables.

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Innovation for Climate Change Mitigation

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University of Piraeus Research Center
JIN Climate and Sustainability
Wegener Center
UNI GRAZ
ZEW Zentrum für Europäische Wirtschaftsforschung GmbH
SEI Stockholm Environment Institute
CEPS Centre for European Policy Studies
UNEP DTU Partnership
I4CE Institute for Climate Economics
ENVIROS

Abbreviations

APRAISE	Assessment of Policy Interrelationships and Impacts on Sustainability in Europe, an EU funded project in the 7th Framework Programme
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
€	Euro
EC	European Commission
EED	Energy Efficiency Directive
EEO	Energy Efficiency Obligation scheme in Greece
EPBD	Energy Performance of Buildings Directive
ETS	EU Emissions Trading Scheme
EUA	EU allowance
FiT	Feed-in-Premiums
FiT	Feed-in Tariff scheme
g	gram
GDP	Gross Domestic Product
GHG	Greenhouse gas(es)
Gt	Gigatonne
GW	Gigawatt
INTERACT	Interaction in EU Climate Policy 2001-2003, an EU funded project in the 5th Framework Programme
Ktoe	kilo tonne oil equivalent
kWh	Kilowatt hour
kWhel	Kilowatt hour electricity production
MSR	Market Stability Reserve
Mt	Megatonne
Mtoe	Million tonne oil equivalent
MWh	Megawatt
NECP	National Energy and Climate Plans
NREAP	National Renewable Energy Action Plan in Austria
PPC	Public Power Corporation (Greece)
RES	Renewable Energy Sources
t	tonne
TWh	Terawatt hour
NLCS	French National Low-Carbon Strategy
RED	Renewable Energy Directive

1. Introduction

This report analyses case studies of environmental and climate change policy making with a specific focus on how the results of chosen policies have been influenced by other policies. The reason for focusing on policy interactions is the realisation that policy making takes place within complex systems, where stakeholders are confronted with multiple other policies. Should policy making take place in isolation from other policies, policy makers could use their best available knowledge of the efficacy of policy instruments to achieve a policy target, given the assumed response of targeted stakeholders to these instruments. In the real world, however, policies are formulated and implemented in a complex environment where multiple climate, environmental and energy policies co-exist. Policy interactions may occur as a targeted stakeholder may act differently when confronted with multiple policies than in case of being targeted by just one policy.

Policy interactions can be discussed from at least two perspectives. From the first perspective, the design features of policies in a policy mix are analysed to identify (positive or negative) overlaps. The INTERACT project[1] with its focus on potential interactions between the EU Emissions Trading Scheme (ETS) and other climate and energy policy instruments in the EU and its Member States was among the first studies to analyse how policies could interact within a policy mix, and how policies could influence each other's effectiveness through such interactions (Sorrell, et al., 2003). Other studies have analysed policies individually in terms of their targets and policy instruments and then compared them to see whether their target setting and instrument choices were consistent (IEA, 2011a; IEA, 2011b; Oikonomou, et al., 2011; Oikonomou, Flamos, & Grafakos, Is blending of energy and climate policy instruments always desirable?, 2010; Spyridaki & Flamos, 2014; Duval, 2008; Jensen & Skytte, Interactions between the power and green certificate markets, 2002; 2003).

The second perspective complements this analysis by considering aspects that are typically related to the contexts for the policies, such as economic development, technology development, people's awareness and preferences and policy implementation aspects. Understanding policy contexts is important because consistent policies 'on paper' could in practice have negative interactions if, for example, the policy implementation is different from what was anticipated, if the response of stakeholders to a set of policy instruments is different from the assumed response to each individual policy instrument, or if public acceptance of a policy is lower than anticipated. Consequently, while policy makers may know and understand policy interactions based on theory and experience with similar policy mixes in the past or elsewhere, this knowledge of policy instruments and how they are likely to interact under a range of observed conditions is of limited use if the present

[1] Interaction in EU Climate Policy 2001-2003, an EU funded project in the 5th Framework Programme

context (the current timeframe a policy instrument operates in) is different from the past context or a context elsewhere.

When analysing interactions between energy, environmental and climate policies (and their policy instruments), the EU-funded project APRAISE (7th Framework programme) particularly focused, using extensive case study analyses, on the behaviour of stakeholders and their direct and indirect responses to multiple policy instruments, to explain why actual policy results differed from expected results (APRAISE, 2012). Figure 1 illustrates the approach taken by APRAISE, thereby assuming four policies which target two stakeholders. Stakeholder 1 is targeted by policies 1, 2 and 3, while policy 4 targets stakeholder 2. The behaviour of targeted stakeholder 1 is thus determined by three policies at the same time, instead of just one policy. Thus, the stakeholder's behaviour may differ from what the policy makers of the individual policies had expected. Moreover, APRAISE (2012) also explained situations where a stakeholder who is targeted by just one policy, may still behave differently than expected, because of interactions (e.g., collaboration or competition) with other stakeholders whose behaviour is affected by other policies. In terms of Figure 1, there could be interaction between policy 4 and policies 1, 2 and 3 through the interaction between both stakeholders.

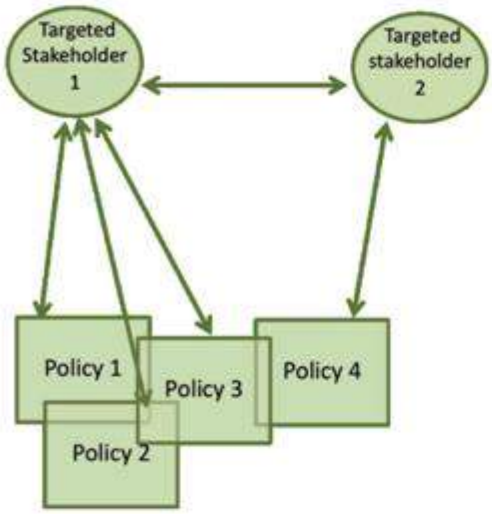

Figure 1. Policy interaction through the behaviour of directly and indirectly targetted stakeholders

The example also shows that policy interactions can take place in different ways. Policies can focus on separate policy areas but interact as they target the same stakeholders. This can result in a negative interaction between the policies (strong or moderate), positive interactions (strong or moderate policy synergies between policies) or neutral (despite the interactions, stakeholder behaviour is in line with what policy makers expected for their individual policies).

Policy interaction can also take place when policies overlap. For example, as is explained elsewhere in this report, policy makers for climate change mitigation, energy efficiency improvement and renewable energy support often realise that their goals and targets may overlap. For greenhouse gas (GHG) emission reductions, among others, low- or zero-emission energy technologies are needed, which are also the focus of energy efficiency and renewable energy policies. As the case studies in this report illustrate, such overlaps can be justified if policies reinforce each other or when policies focus on different aspects, such as one policy focussing on current climate goals and another policy focussing on developing energy technologies that will be needed for future climate and energy goals. In this report, both interactions of 'separate' and overlapping policies will be considered for analysis of policy interactions.

Understanding policy interactions is important as these could have positive or negative impacts on the eventual effectiveness of a policy. Moreover, policy interaction could increase or decrease efficiency of a policy or a policy mix, especially when overlaps occur between policies (i.e. the achieved policy goals could have been achieved with fewer government resources). At the same time, as is illustrated elsewhere in this report for a case study in Austria, situations could occur where a loss in efficiency is accepted as the policy instruments chosen are politically the most acceptable. These three criteria – effectiveness, efficiency and political feasibility – have been identified by, among others, Del Rio (2014), Edenhofer et al. (2014) and Fischer (2010). They explain how, in practice, the most efficient policy instrument may be politically unfeasible.

In CARISMA, policy interaction is analysed through four case studies which have been selected with the objective to explore potential interactions of climate policies with energy efficiency and renewable energy support policies. Interactions between these three policy areas are particularly interesting because they form the three pillars of the EU Climate and Energy Package (European Parliament and the Council (2009), renewed in 2014). During the design of the package, possible interactions were considered by European policy makers, but it remained to be seen how these interactions would work in practice. For example, the co-existence of the EU ETS and policies implemented by Member States under the EU Renewable Energy Directive (RED) was justified as this would stimulate two policy goals:

1. the EU ETS would contribute to complying with current and near term climate policy targets, while,
2. the RED-based policies could support further development of renewable energy technologies which are not yet commercially viable but which will be needed for complying with future climate policy targets.

Policy makers realised that accelerated introduction of renewable energy technologies and energy efficiency support would lead to lower GHG emissions for EU ETS-covered installations in the electricity sector and possibly surplus allowances in this sector, but it was assumed that these surpluses would be absorbed by installations in other ETS sectors (Fischer, 2015).

However, the example of ETS and RED policy interaction also demonstrates the importance of policy context. In their design of a policy mix with the ETS and the German feed-in tariff system, policy makers in Germany had not anticipated the economic crisis after 2008 and its consequences for the performance of both policy instruments. Because of the economic crisis, industrial production dropped so that industrial sector installations covered by the ETS required fewer allowances to cover their actual emissions and therefore did not absorb the allowance surpluses in the German power sector. In other word, as Fischer (2015) and Mulder (2016) conclude, while the interaction between RED and ETS was foreseen and considered manageable, the ETS and RED-policy design has often not been ready for handling an external shock such as the economic crisis.

The relationship between the German feed-in tariff for stimulation of renewable energy technologies and the response of German electricity sector stakeholders to that has also been topic of a PhD research at the University of Groningen (Mulder, 2016). The study concludes that the performance of the EU ETS has been seriously undermined by the interaction with 'parallel instruments', *i.e*. other energy and climate instruments that operate in parallel to the EU ETS and affect the CO_2 emission levels of ETS installation. Mulder (2016) finds that these interactions has lowered the ETS allowance price by €5 by 2030 (a 14% lower price) compared to a scenario without both parallel instruments. For the EU as a whole, a similar, though stylised, simulation was performed, leading to the conclusion that all parallel instruments currently in place in Europe are expected to lead to a 50% reduction of the allowance price by 2030 (€20; compared to €40 in a scenario without parallel instruments). Furthermore, in case of stagnating economic growth, a carbon price below €10 would remain probable even in 2030.

Like Fischer (2015), Mulder (2016) does not proclaim that renewable energy and emissions trading policies should not co-exist or should not interact. Co-existence of policies can be justified if a feed-in tariff for developing technologies would help develop technologies that will be needed for future climate targets. However, to avoid adverse interactions, Mulder (2016), for example, proposes the introduction of a price floor and ceiling in the ETS and/or limiting the use of parallel instruments.

The CARISMA case study analysis on energy and climate policy interactions aims to complement existing literature on policy interactions by addressing a set of aspects of policy interactions related to: the policy levels at which interactions may occur (EU, national or regional levels), inter-temporal interactions (*e.g*., short term versus long term policy interactions), and interactions that occur if stakeholders are indirectly affected by a policy instrument (even if they are explicitly excluded from the policy). For that, the following four case studies have been analysed:

- **France**: Impact of the implementation of the RED and energy efficiency measures on GHG emissions in in the electricity sector under the EU ETS.
- **Austria**: Interaction between energy efficiency policy measures at the levels of the federal and regional governments.
- **Greece**: Impact of the planned Energy Efficiency Obligation scheme in Greece on the GHG emissions in the Greek power sector covered by the EU ETS.
- **EU-level**: Implications of interaction between the EU ETS and the Renewable Energy Directive.

Together, the case studies provide an illustrative pallet of policy interaction examples, while it is acknowledged that the overview should not be considered fully representative for all types of policy interactions that may occur because of implementation of the Energy and Climate Package in the EU and the Member States (European Parliament and the Council, 2009). For example, no case study was conducted on the above-described situation in Germany as it has already been widely discussed in several literature sources (including Fischer (2015) and Mulder (2016)). The EU-level case performs a similar analysis on ETS and renewable energy interaction, but its geographical focus is broader. As policy context aspects and analysis is covered by other tasks in the CARISMA project, the case study analysis in this report does not systematically explore contextual factors in relation to policy results, but where case study analysis touches upon specific local circumstances determining policy interactions, these will be discussed.

2. Case study analysis approach

The case studies have been analysed as follows:

- **Introduction**: What are the policies for which interaction is analysed?
- **Short background**: What are interactions between the policies addressed by the case study and how can these influence the results of the policies (impact on policy effectiveness)?
- **Analysis of policy interactions**: What has been/will be the impact of the policy interactions on the policy outcomes?
- **Lessons and recommendations**

Stakeholders in the case study contexts have been invited to share their knowledge for the analysis, via personal communication, interview and requesting reviews of draft texts. Table 1 presents an overview of the case studies, with indications of the policy areas covered per case study and analysed for interaction.

Table 1. Overview of CARISMA case studies for policy interaction analysis

Case study country	Interaction level	EU ETS	Renewable energy	Energy efficiency
France	National-regional level interaction (*ex post* analysis)	X	X	X
Austria	National-regional (*ex post* analysis)			X
Greece	National level interaction (*ex ante* analysis)	X	X	X
EU as a whole	EU-level interaction (*ex post* analysis)	X	X	

3. Introduction to the EU Directives covered by the case studies

3.1. The Energy Efficiency Directive (EED*)*

In October 2012, the European Commission adopted the Energy Efficiency Directive (EED) with a goal to reduce consumption of primary energy by 20% by 2020 and enhance energy efficiency beyond 2020. Member States must adopt national targets and notify these to European Commission, which will undertake progress assessments and recommend further measures, when needed (Article 24 of the Directive). The European Commission will particularly monitor the impact of the EED on the EU ETS.

3.2. The EU Emissions Trading System

The EU ETS was established in 2005 to regulate GHG emissions of all major industrial and power plants in the 28 EU Member States, Norway, Liechtenstein and Iceland. In total, it covers about 11,000 installations, which account for half of total CO_2 emissions in Europe. The ETS is a 'cap and trade' system, which allows installations to emit a certain amount of CO_2 per year. These allowances can be traded in the ETS market. Since 1 January 2013, allowances have been largely auctioned, instead of freely distributed, as was the case during the first two ETS phases.

3.3. The Renewable Energy Directive

The Renewable Energy Directive (2009/28/EC) focuses on the promotion of using energy from renewable sources (*e.g.,* biomass, geothermal, hydrothermal, hydropower, ocean energy, landfill gas, sewage treatment plant gas, biogases, biofuels, solar and wind). For that, the directive contains a mandatory target of a 20% share of renewable energy sources in the EU by 2020. The scope of this directive includes renewable energy sources in several sectors, such as built environment[2] (both including new and renovated buildings) and transport (using biofuels, boosting the use energy efficiency technologies, etc.), and is focussed on heating and cooling installations[3] (Official Journal of the European Union, 2009, pp. 11, Art.1) as well as production of electricity from renewable energy sources.

2 Many countries have already included a renewable energy quota for use in buildings. http://www.rehva.eu/eu-regulations/renewable-energy-sources-directive-res.html

3 New infrastructures and more effective installations should be built for heating (also district heating) and cooling services based on RES to achieve the 2020 target.

4. Case study 1 – Interactions between climate and energy policies in the French electricity sector

4.1. Introduction

In France, interactions between climate and energy policies can potentially occur through the National Low-Carbon Strategy (NLCS), which aims at supporting the country's transition towards a sustainable, low-carbon economy. This new policy framework was released in November 2015 by the French ministry for Ecology, Sustainable Development and Energy. The strategy aims at reducing national GHG emissions by 75% in 2050 compared to 1990 levels. For the energy production sector, with an emission reduction goal of 96%, an almost complete decarbonisation is targeted.

The NLCS interacts with climate and environmental policy making at different levels. On the one hand, the strategy is designed within the context of EU climate policies, while on the other hand, it may have an impact on policy making at regional and local levels in France. Therefore, the case study analyses three types of policy interactions of the National Low-Carbon Strategy with:

1. Energy efficiency and renewable energy objectives in France;
2. The EU ETS; and
3. Governance at local levels.

In this case study, "policy interactions" refer to both interactions between objectives and measures. Interactions between EU and French policies are analysed for electricity generation in France.

4.2. Background and policy context

Historically, GHG emissions from electricity generation in France have been relatively low: 42 gCO_2eq per kWhel in comparison with the European average of 352 gCO_2eq per kWhel (CITEPA, 2015). Emissions are relatively low in France because of the large share of nuclear power in electricity production. In 2015, around three-quarter of electricity supply in France (546 TWhel) was generated from nuclear power, followed by hydroelectricity (11%), fossil fuels (6%), wind power (4%), solar power (1.5%) and bioenergy (1.5%) (RTE, 2016) (see Figure 2).

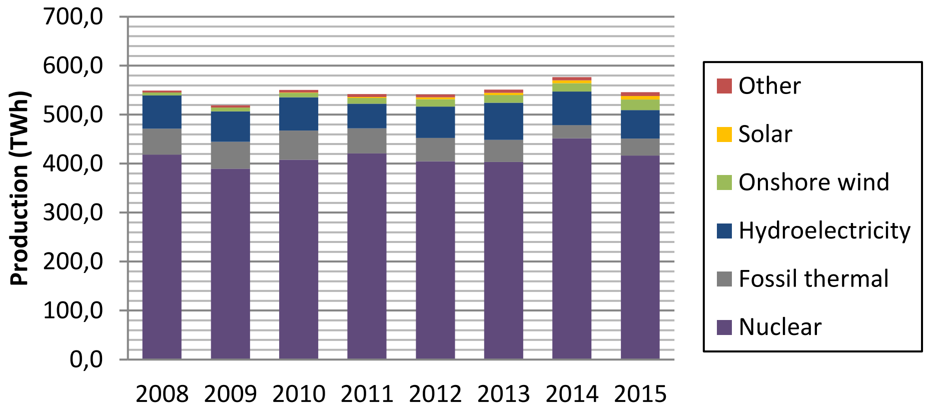

Figure 2: Electricity production in France (Source: I4CE based on data from RTE (2016))

Overall, GHG emissions from electricity generation amounted to 23 $MtCO_2eq$ in 2015 (Figure 3), which means that France has the lowest emission intensity in the world (calculated as tCO_2/GDP, Next 10, 2015).

Over the past 25 years, the French electricity sector has decommissioned coal power plants and invested in development of renewable sources of electricity, which resulted in a GHG emission reduction in the power sector of 27% (Figure 3). The relatively low emission level in 2014 was caused by the mild winter during that year.

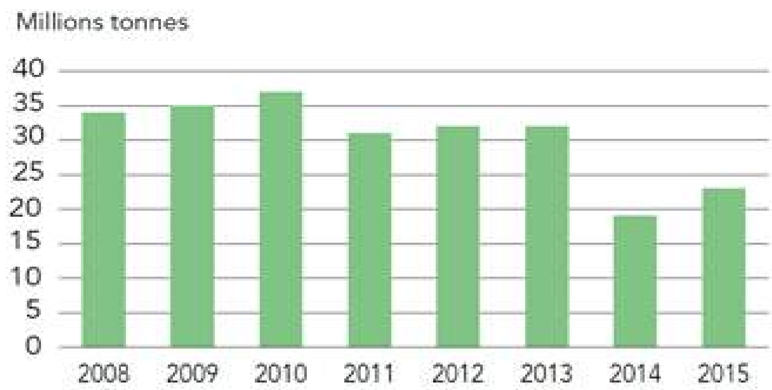

Figure 3: Evolution of emissions from the electricity sector in France (Source: RTE (2016))

The EU-level context for the French National Low-Carbon Strategy consists of the objectives in terms of renewable energy sources, energy efficiency and GHG emissions reduction. The main policy instrument for meeting emission reduction goals is the EU ETS. In France, 119 airlines and 1,183 industrial and energy production plants are covered by the scheme, which together represented around 100 $MtCO_2eq$ emissions in 2015 (EEA GHG data viewer). 40 installations from the French power sector were covered by the EU ETS in 2015, which together emitted 16 $MtCO_2$[4] (European Union Transaction Log, 2016).

The 2020 European objectives for both the deployment of renewable energy sources and climate change mitigation efforts (see Section 3) were translated in France in the "Grenelle" Laws (2009-2010). In 2015, following the updated EU goals for climate and energy (covering the period 2020-2030) (European Commission, 2014), the French government released the Energy Transition for Green Growth Act with five main objectives:

- 40% reduction of GHG emissions in 2030 compared to 1990 levels, in line with the strategy of the EU;
- 30% reduction of fossil fuel consumption in 2030 compared to 2012;
- Share of nuclear power in the electricity mix brought down to 50% by 2025;
- Share of renewable sources of energy brought up to 32% in the total final energy consumption by 2030;
- Decrease by half of the final energy consumption in 2050 compared to 2012.

For achieving these objectives, the above-mentioned NLCS has been launched, which aims, among others, at a GHG emission reduction from 552 $MtCO_2$ in 1990 to 358 $MtCO_2$ per year during 2024-2028 (amounting to a 35% reduction). To realise this, the NLCS will create nation-wide carbon budgets, both for ETS and non-ETS sectors. NLCS aims at an almost full decarbonisation of energy production and consumption (96% emission reduction compared to 1990 levels) in 2050, which will be supported by a planned halving of final energy consumption (in 2050 compared to 2012) and further deployment of renewable sources of energy.

While ETS-covered installations acquire emission allowances under the EU ETS, for non-ETS sector installations a carbon tax has been introduced in France in 2014. In 2016, the carbon tax amounts to €22 per ton of CO_2 to be increased over time to €56 by 2020 and €100 by 2050. For energy efficiency, France targets a 30% reduction in final energy consumption in 2030 compared to 1990. In terms of renewable energy, the national target is to achieve a 23% share in final energy consumption, which corresponds to a 27% share of renewable energy in electricity by 2020, to comply with EU's renewable energy goal. In 2014, 17% of electricity in France was generated from renewable sources, which was mainly based on hydroelectricity. For reaching future targets, wind and solar are the two most promising technologies with a potential increase from 15 GW in 2014 to 40 GW in 2023[5].

[4] This figure does not consider the fact that CHP (combined heat and power) plants have GHG emissions not related to electricity production. The emissions from electricity generation only are therefore lower.
[5] Arrêté relatif aux objectifs de développement des énergies renouvelables, Journal Officiel, April 2016

4.3. Analysis of policy interactions between French policies and EU ETS

Impact of French energy efficiency and renewable energy policies on EU ETS

Berghmans (2012) concludes that national renewable energy deployment policies contributed around 40% of total emission reductions within EU sectors during Phases II and III of the EU ETS (2008-2020). In addition, national EE policies have led to an emissions reduction of 500 $MtCO_2$ within the ETS. Though the impact of national EE and RE policies can be significant at the European level (see examples in Section 1), given the relatively low level of GHG emissions from electricity generation in France (23 $MtCO_2$ in 2015) compared to the total amount of allowances in the EU (about 2 $GtCO_2$ per year), French-level policies implemented in the national electricity sector are likely to have a minor impact on the EU ETS.

The EU ETS impact on French energy efficiency policies using auctioning revenues

Based on allowance auctioning, the EU ETS generates a public revenue stream for all EU Member States which can be invested into cost-effective mitigation opportunities and the development of low carbon technologies. In France, 90% of auction revenues are used to finance energy efficiency in the residential sector, through the French National Housing Agency (*Agence Nationale de l'Habitat*) (Chevaleyre & Berghman, 2013).

Impact EU ETS allowance price on French deployment of renewable energy in France

An intended impact of the EU ETS is to make fossil-fuel-based technologies relatively more expensive and low-emission technologies more competitive (Meng, 2015). However, it has been demonstrated that even if CO_2 emissions are duly priced in the power sector, specific incentives for supporting the deployment of renewable energy technologies are justified (Philibert, 2011). To further support deployment of renewable energy sources at the national level, France has invested €14 billion in renewable energy between 2005 and 2011 (possibly growing to €40 billion by 2020; Cour des Comptes (2013))[6]. This has resulted in an increased share of electricity produced from solar and wind power from 1% in 2008 to over 5% in 2015 (I4CE based on data from RTE (2016)). This was *a priori* driven by the national renewable energy support measures rather than the EU ETS, but in France, the EU carbon price was considered a policy signal to create a credible national framework for promoting renewable energy, hence resulting in a positive policy interaction between ETS and RE stimulation measures.

During the annual Environmental Conference in April 2016 in France, the French government announced that it would unilaterally set a carbon price floor of around

[6] Through feed-in tariffs, feed-in premiums and revenue complements

€30/tCO_2 on electricity generation activities, including ETS installations in the power sector, in 2017 (see also Reuters (2016)). With a carbon floor price a minimum price for CO_2 emission allowances is introduced in the market: "polluters must pay a minimum amount of money for the right to pollute" (Sandbag, 2016). Should the market price drop to a level below the floor price, companies with CO_2 emissions pay a 'tax' for the difference between the market and the floor price. As such, a situation is created that the costs of emitting CO_2 remain relatively high, so that it becomes easier for installations with low- or zero-emission technologies to compete in the market. Consequently, as argued by Hood (2011), a carbon price floor could increase certainty for potential investors in renewable energy and energy efficiency technologies (Trotignon, 2016). However, it remains to be seen whether a carbon price floor is sufficiently high to tip the scale to the advantage of clean energy producers in France, as it will barely be enough to encourage fuel switch from coal to gas. In an analysis for the UK carbon floor proposal, Sandbag (2016) concludes that due to the current oversupply of EU allowances in the market, a carbon floor price is not enough to support the use of clean energy technologies; without measures to tighten the caps on emissions, a floor price will not be effective. Therefore, the interactions between a carbon floor and renewable energy stimulation policies in France remain uncertain.

The impacts of interactions of energy support and ETS policies in France are summarised in Table 2Table 3.

Table 2. Summary of case study results France

Key variables	ETS, EE and RE interaction impacts	
CO_2 emission reduction in French electricity sector under ETS	minor	Due to low level of GHG emissions from electricity generation in France, French-level policies implemented in the national electricity sector are likely to have a minor impact on the EU ETS
National fossil-fuel based electricity generation	minor	
Energy and electricity demand/households	Decrease	Energy efficiency measures lead to a reduced consumption of electricity
Energy efficiency improvement	Increased, but slowing down	• 90% of auction revenues of EU allowances (EUAs) is used for energy efficiency improvement. • Due to lower EUA prices, renewable energy support funds become lower.
Renewable energy deployment	Increase	EU ETS was seen in France as a policy signal for creating a national investment framework for renewable energy promotion. A carbon floor price can add more certainty to renewable energy investors, but interaction between carbon floor and renewable energy stimulation remain uncertain

4.4. Findings

In this case study on policy interactions in the French power sector, the following conclusions can be drawn:

- *Energy efficiency and renewable energy stimulation policies implemented by the French government in the electricity sector are unlikely to have a significant impact on the EU ETS*. This moderate policy interaction is mainly due to the relatively low GHG emissions of the French electricity companies covered by the ETS. Thus, French-level policies implemented in the national electricity sector are likely to have a minor impact on the EU ETS.
- *The EU ETS impacts energy efficiency improvements in France using auctioning revenues*. This policy interaction can be relatively strong in France, as the French government uses 90% of ETS auction revenues to finance energy efficiency in the residential sector through the French National Housing Agency.

- *The EU ETS allowance price can be a complementary policy instrument but is not enough for large deployment of renewable energy in France*. The French government invests in renewable energy technology deployment through subsidy scheme amounting €14 billion between 2005 and 2011 (growing to €20 billion by 2020), which has increased the share of solar and wind energy in total energy production from 1 to 5% (between 2008 and 2015). To further support renewable energy deployment, the French government has announced a carbon floor price for on electricity generation. However, the effect of the latter policy interaction remains uncertain.

5. Case study 2: Interactions between energy efficiency policies in the household sector in Austria

5.1. Introduction

In Austria, overall final energy consumption has increased again after the sharp decline in 2009, which was due to the financial crisis and corresponding economic recession. To address this trend, Austria's Energy Strategy, the National Renewable Energy Action Plan (NREAP) and the Energy Efficiency Law have set a target value for primary energy consumption of 1050 PetaJoule in 2020 (compared to 1120 PJ in 2013, see Figure 4). Nevertheless, despite a range of measures in place, without additional efforts it will be difficult to reach the target. Therefore, Austria has implemented the EED in 2015 via its Energy Efficiency Law, which will add additional financial means to the existing policy framework.

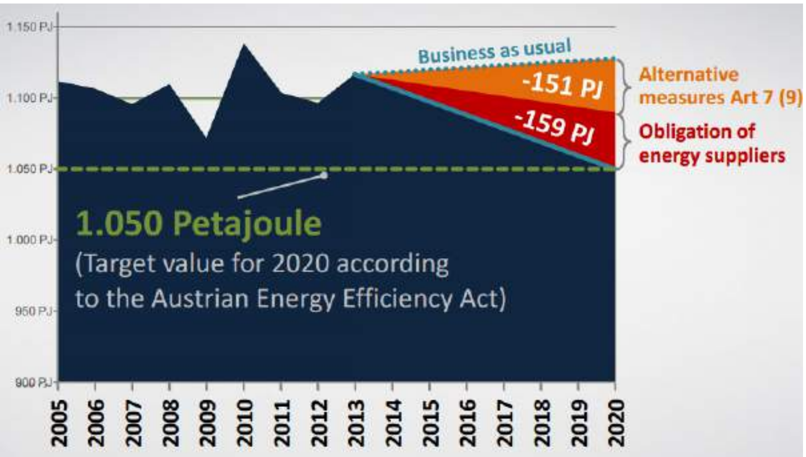

Figure 4. Final energy consumption in Austria 2005-2020 (Austrian Energy Agency, 2015)

However, these additional policy measures for reducing energy demand come on top of already existing policy measures, which increases the risk of possible overlaps with already existing policy instruments.

5.2. Background and policy context

The relevant policy framework at the EU level for the Austrian policy instruments for energy efficiency improvement consists of the EU RED, the Energy Performance of Buildings Directive (EPBD) and the EED. The transposition of the RED in Austria has taken place via the National Renewable Energy Action Plan, per which Austria must increase its share of renewable energy in gross final energy consumption to 34% by 2020. This target is not very ambitious, as the share of renewables in Austria had already reached a level of 29% in 2008. Under the EPBD, all new buildings in Austria must fulfil a near zero-energy standard by the end of 2020 (for public buildings this deadline needs to be reached already by the end of 2018). Finally, the EED require Member States to use energy more efficiently at all stages of the energy chain from its production to its final consumption.

Following the transposition of the above EU directives into domestic legislation, the following policy instruments have been formulated in Austria for energy efficiency in the household sector, which are, except for the Federal law on energy efficiency, mainly subsidy schemes:

- **Renovation check ("Sanierungscheck")**, which is a subsidy, provided at the *federal government* level, in the form of a unique and non-repayable grant, which private households obtain for the refurbishment of dwellings older than 20 years, such as through insulation of outer walls and ceilings, replacement of windows and doors and change of conventional heating systems to renewable systems.
- **The Federal Housing Subsidy Law ("Wohnbauförderungsgesetz")**, which includes general conditions for the *provincial* governments for energy efficiency improvement measures in the built environment, such as thermal insulation and space and water heating measures (MURE, 2015). Allocation of the subsidies is regulated by provincial law and each province has a scope of freedom to decide on subsidy amounts and set their own subsidy conditions and limitations, given the general federal conditions. Subsidies in the scheme are provided mainly in form of soft loans. Potential applicants are private persons, non-profit making housing associations, municipalities and other legal entities.
- **Subsidies of the Austrian Energy and Climate Fund**, which can both be focused on energy conservation and GHG emission reduction measures, such as investments in energy efficient stoves in households.
- **Federal law on energy efficiency ("Energieeffizienzgesetz")**, adopted in 2016, which obliges energy suppliers to initiate and implement energy efficiency measures corresponding to at least a 0.6% reduction of their total energy supply to energy end users in Austria in the preceding year. At least 40% of these required efficiency measures must be implemented by energy suppliers at the household level. Based on reported plans, 40% of the intended measures relate to lighting, 30% to kitchen devices and 20% to heating and warm water. As part of the energy efficiency law a monitoring institution was created to support companies in complying with the law and to evaluate proposed measures.

As can be concluded from this overview of energy efficiency enhancement plans, Austrian energy and climate policy is characterised by a dense landscape of subsidies, including investment incentives and subsidised loans for the adoption of energy-efficient technologies. The subsidies are provided both at the federal and provincial government levels.

5.3. Analysis of energy efficiency policies at different government levels

The effectiveness of the schemes is difficult to determine precisely. For example, the total electricity consumption of Austrian households has increased, but this was largely due to an increase in the number of households in Austria (E-Sieben, n.d.), which offset the decrease in average household electricity consumption (by 230 kWh per year during 2008 to 2012). Moreover, as shown in Figure 5, Austria's energy consumption in the household sector over the past ten years have been above the EU average, but in terms of energy per unit of GDP, it has been around or below the EU average. Austria has also managed to continue the trend of decreasing energy consumptions in households during the past few years, while the EU average trend has shown an increase in energy consumption since 2012. Stakeholders consulted for this case study (from government, business and research) have indicated that the overall decrease in energy demand in households cannot be clearly attributed to the existing energy efficiency policy instruments, as the influence of the mild winters in the past few years in Austria may also have been an important explanation for lower household-level energy consumption.

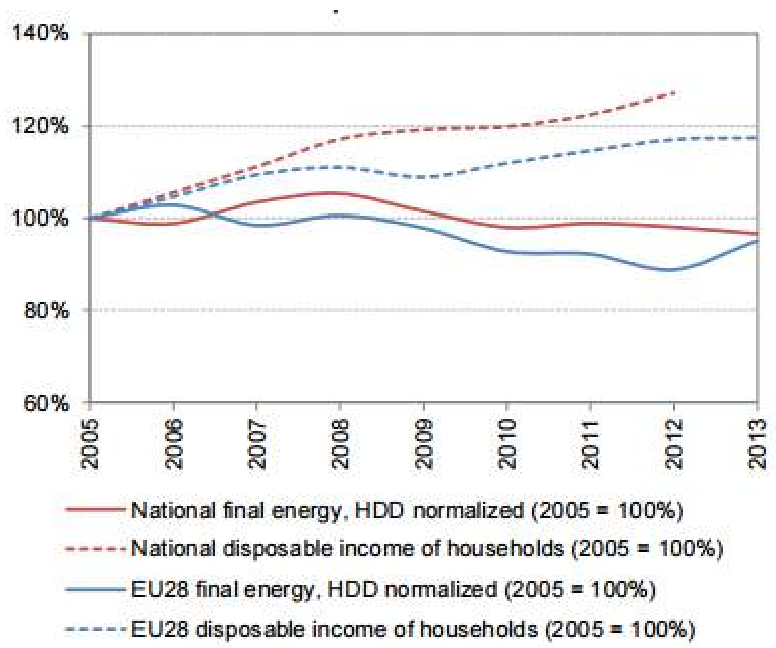

Figure 5. Energy consumption in households in Austria and the EU as well as disposable income (Austrian Energy Agency, 2015).

In terms of policy interactions, the case study has analysed whether energy efficiency improvement policies at the federal government level could lead to overlaps with policies at the level of provincial governments and what this could mean for the effectiveness and efficiency of the policies. At the federal government level, several ministries have specific energy-related responsibilities, while at the regional level, the governments of the nine federal provinces have responsibility for policy making, including setting subsidy levels, and implementing regulatory control of energy companies.

The case study analysis concludes that overlaps between federal and regional subsidies for energy efficiency are unavoidable as the scope, instruments and target groups of different subsidy scheme are too often similar. As such, this does not have to be a problem if in the design and implementation stages, a detailed fine-tuning of measures takes place. However, in actual practice fine-tuning of federal government energy efficiency policies with all nine provinces is complicated as the provinces differ from each other in terms of their regional policies and subsidies, based on different priorities, political coalitions and technological as well as socioeconomic boundaries.

An example of such fine-tuning can be found in the implementation of the Energy Efficiency Law. As the law prescribes that 40% of the required energy efficiency measures should be implemented by energy suppliers at the household level, there is a potential overlap with existing policies, especially governmental subsidies for stimulating household-level energy efficiency improvements. The Energy Efficiency Law tries to avoid such overlaps by an 'additionality check': measures under the Renovation check and Housing Subsidy Law cannot be accounted for under the new Energy Efficiency Law. For other measures that energy suppliers want to have accounted for under the law, a combination with existing subsidies is possible, and the accounted savings can be shared among the two funders (the regional or national government and the companies under the energy efficiency law). This requires an agreement between the two funders how the savings are shared before the measure can be accounted for under the new energy efficiency law. So far, there has been little experience with these provisions. Some NGOs complained that the legal basis to share the accountable savings is too vaguely defined, especially with those measures that already received federal subsidies in 2014 and 2015.

The federal government has made steps to avoid policy overlaps by limiting in some cases combinations of its subsidy system with other regional subsidies. Moreover, a possible way forward is to design a new target-oriented policy mix that is not entirely based on subsidies. For example, energy saving investments in households that require complex financing models (due to high transaction costs and long payback periods) cannot be induced by subsidies alone. For some measures, standards or a combination of standards with subsidies would be a better way forward. This would require terminating or changing some of the subsidies. The latter may not be easy though as subsidies have the largest political acceptance among policy instruments in Austria. Subsidies have been in place for long and have been agreed on in a political process with a range of different interests that needed to be satisfied. Such a 'subsidy lock-in' of a policy system is not easy to change in the short term.

A possible step forward in avoiding policy overlaps is the new monitoring institution in Austria, which:

- Systematically assesses the measures proposed by entities under the new Law on Energy Efficiency. In case overlaps are expected or known, the other funding institutions in Austria are contacted, and the share of funding and corresponding energy savings can be split.
- Increases the knowledge of the effectiveness and efficiency of energy efficiency measures in Austria. The methods for assess effectiveness and efficiency are being steadily further developed by the monitoring institution.
- Develops national energy efficiency action plans that are submitted to the European Commission. So far, the entire policy mix is not systematically considered but stakeholders expect that the integrated climate and energy plans recently proposed by the European Commission, if adopted will require EU Member States much stronger to investigate and consider policy interactions.

A better understanding of inefficiencies may serve as a suitable basis for improving and fine-tuning the policy mix at a later stage.

5.4. Findings

Based on the case study on interactions between energy efficiency policies at different policy levels in Austria, the following key findings can be formulated:

1. *Overlaps between federal and regional subsidies for energy efficiency are unavoidable*. The scope, instruments and target groups of different subsidy scheme are often similar. This could be avoided through a detailed fine-tuning in the policy design and implementation stages, but in actual practice fine-tuning of federal government energy efficiency policies with all nine provinces is complicated.
2. *Overlaps in subsidies and over-subsidisation imply the risk that governmental funds are used inefficiently*. Thus, the observed energy savings in households are achieved at relatively high public costs. Moreover, in terms of policy effectiveness, it is not entirely clear whether the observed reduction in household-level energy demand during the past few years can be fully attributed to the subsidy schemes. On the one hand, in terms of energy demand reduction Austria performs better than the EU-average, but this performance may also have been caused by the relatively mild winters in recent years.
3. *A possible way forward* is to design a new target-oriented policy mix that is not entirely based on subsidies, but, for instance, enable combination of energy or environmental standards with subsidies.

The impacts of interactions of energy support policies at different policy levels in Austria are summarised in Table 3.

Table 3. Summary of case study results Austria

Key-Variables	Impact of policy interactions on policy effectiveness	
Electricity demand/households	Increase	Caused by increase in the number of households
Energy demand /households	Decrease	Caused by EE measures and weather conditions. Energy demand reduction is however achieved in an inefficient way due to overlapping support schemes
National fossil-fuel based generation	Decrease	Decrease consequence of lower energy demand
National CO_2 emission	Decrease	Decrease consequence of lower energy demand

6. Case study 3 – Interactions between the energy efficiency obligation and the EU ETS in Greece

6.1. Introduction

Currently, the Greek government is formulating an Energy Efficiency Obligation scheme (EEO, under the EU Energy Efficiency Directive). It targets energy distributors and retail energy sales companies that are responsible for the installation, operation and maintenance of smart-meters for electricity, gas, heating, cooling and hot water for domestic consumption. Their obligation is to provide incentives to final energy consumers to either adapt their energy consumption behaviour, or purchase energy-efficient technologies.

This case study analyses potential interactions between the EEO and the EU ETS. Such interactions could work in both directions. On the one hand, energy efficiency measures may lead to lower electricity demand and thus reduce the demand of ETS power sector installation for allowances. On the other hand, the ETS market price can lead to a higher wholesale price for electricity which electricity distributors can pass on to consumers, so that they have an incentive to save energy. In order to understand potential interaction effects between the schemes Greece and whether their parallel operation contradicts their intended outcomes or causes potential unintended effects (e.g., environmental side-effects or distributional effects), this case study analyses possible interactions between an EEO scheme for retail energy sales companies in Greece and the obligations for energy-producing installations in Greece that are covered by the ETS.

6.2. Background and policy context

Most electricity production in Greece is still carried out by the Public Power Corporation (PPC), which owns transmission and distribution networks and is the major supplier for customers. The Greek electricity market, despite its deregulation, remains concentrated with PPC holding a share of 71.5% in the electricity market and only two other utilities having a share of more than 5%. Since 2013, electricity producers in Greece are required to purchase their ETS emissions allowances through auctions. Although this development was expected for years, PPC did little to upgrade its energy portfolio for lower-emissions electricity production and reduce compliance costs (Moris., 2013), as the company, given its market share, usually follows the practice of passing on emission allowance purchase costs to customers via the electricity bills. In fact, PPC has already proposed to the

Regulatory Authority of Energy (RAE) to increase charges for all customer categories (low, medium and high voltage).[7]

In other words, higher wholesale prices are translated into higher retail prices for consumers also for the Greek energy market. The economic recession and the consequent reduction for electricity demand (PPC emissions in 2011 recorded a decrease of 10% from 2008) eventually softened this effect of passing on additional costs to retail prices.

The use of energy from *renewable energy sources* was promoted both in electricity production and heat supply and transportation. In 2014, a Feed-in Tariff (FiT) scheme was introduced to support that (under the so-called "New Deal") (MStR Law Firm, 2014). Moreover, the use of renewable energy technologies in heating and cooling has been supported by the provision of subsidies granted by the government. Finally, in the transport sector obligations have been introduced for use of fuel types, as well as taxes for different kinds of polluting vehicles.

In many cases these implemented measures overlap, since a strict categorisation of measures is not always possible. For instance, some measures mainly refer to renewable-based electricity generation projects, but also cover renewable-based heat generation projects (e.g., via the FiT), such as renewable energy-based co-generation installations and other thermal energy generation projects.

The EU EED was only recently transposed in Greek law (in 2015). In view of the requirements of the EED, the energy savings target for the period 2014-2020 amounts to 3.33 Mtoe, which is almost equal to 19.3% of the total final consumption in 2012. By 2020, annual energy saving is targeted at 902.1 ktoe. Energy conservation measures in the building sector are scheduled to contribute almost 58% of the national energy efficiency target. The EEO scheme will be implemented from 1 January 2017 for contributing to the national energy savings target (in the context of Article 7 of the EED). The policy instrument for operating the EEO scheme in Greece is currently in its early formation phase. Based on conversations held with Greek stakeholders (for this case study), it seems likely that emphasis under the EEO will be placed on energy savings in the built environment (residential dwellings and public buildings). Importantly, Greece has opted (in line with the provisions of Article 7 of the EED) for excluding industrial sectors from the calculation of the final energy savings target.

[7] Announcement from RAE 11/12/2012: http://www.rae.gr/site/categories_new/about_rae/factsheets/general/11122012_2.csp

Table 4 summarizes the key features of the two schemes for which the interaction analysis is undertaken. Please note that for the EEO scheme, the description provided is a proposal of its design, which is yet to be decided.

Table 4. Summary of the key features of the policy instruments (Source: Authors' own elaboration)

	Policy instrument 1: EU - ETS	**Policy instrument 2: EEO scheme (proposed)**
Level of governance	European	National
Timeframe	2013-2020 (3rd phase of implementation)	2017-2020 (1st phase of implementation)
Type of intervention	Command and Control/ quota, market-based	Command & control/ market-based subsidies
Policy target/outcome	To reduce **emissions of CO_2** by pricing these. To achieve **national emissions reduction target**	No targets so far. Achieve **final energy savings** targets in frame of EED
Policy scope /sector covered	Energy-intensive installations (i.e. industry) and energy production utilities	All end-use sectors with a focus on buildings.
Targeted stakeholders	<u>Obligated parties:</u> Energy-intensive industry, aviation, energy-producing installations	<u>Obligated parties:</u> retail energy sales companies in gas & electricity, <u>Eligible parties:</u> third parties (e.g. ESCOs, companies). <u>Beneficiaries:</u> households, public buildings, vehicle drivers
Allocation of costs	Increase of the wholesale electricity price, which is passed on to the retail electricity price.	Full cost-recovery is envisaged to be allowed (additional costs to be passed on to electricity consumers through the retail electricity price)
Types of measures	Trading of emission allowances	Not described so far. Financial assistance and advice/audits to consumers is foreseen to be provided.
Related market (price & quantity) variables	i) Wholesale electricity price ii) Retail electricity price iii) Electricity demand iv) CO_2 Emissions allowances v) Price of emissions allowances	i) Retail electricity price ii) Electricity demand iii) CO_2 Emissions allowances iv) Price of emissions allowances

6.3. Analysis of policy interactions EEO, EU ETS and RED

When introducing an EEO scheme in an electricity market that is covered by the ETS, the expectation is that demand for electricity will be reduced. In Figure 6 this is illustrated by a shift from the electricity curve to the left, leading to a new equilibrium with a lower wholesale price for and a lower quantity of wholesale electricity in the market. In terms of quantity of electricity supplied to the market, the EEO enhances the impact of the ETS. As shown in Figure 6, the ETS already leads to a quantity reduction (from $Q_{No\text{-}ETS}$ to Q_{ETS}, following a move along the demand curve) and due to the impact of the EEO, traded electricity is further reduced to $Q_{ETS,\ EEO}$ (following a shift from the demand curve). In terms of price development, the EEO is expected to reverse the wholesale electricity price increase caused by the ETS (from Pw_{no_ETS} to Pw_{ETS} following the move along the demand curve) by stimulating a price reduction (from Pw_{ETS} to $Pw_{ETS,EEO}$ due to the shift from the demand curve). This implies that the more expensive producing units stay out of the market and do not generate electricity for the specified period.

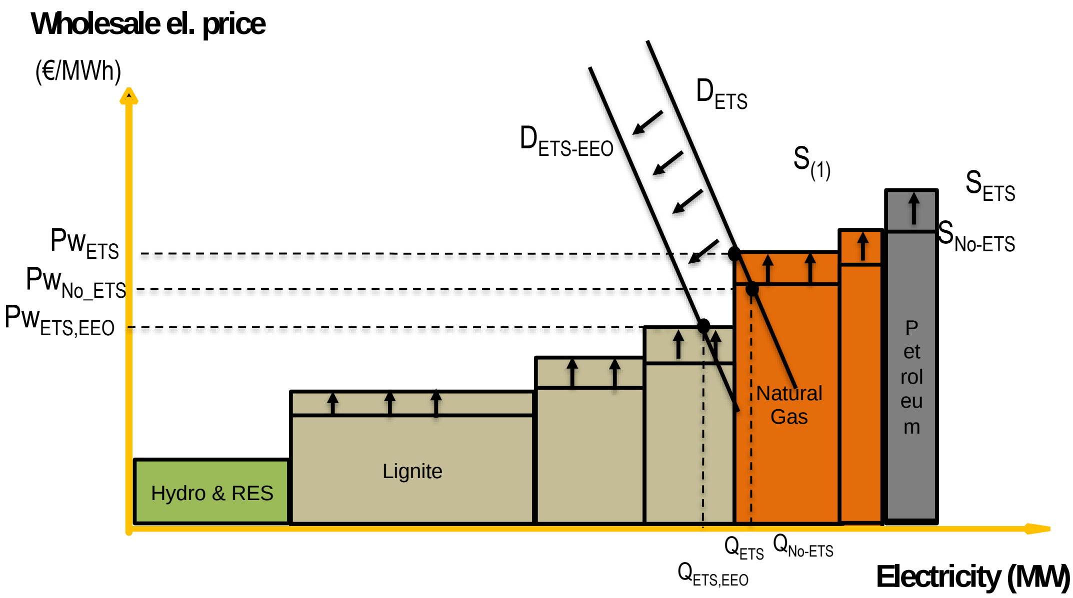

Figure 6. The impact of an EEO scheme on the Greek wholesale electricity market regulated by the EU-ETS

The reduction of CO_2 emissions caused by electricity savings depends on the type of power plant that reduces its output, which may also vary depending on the time of day. In Greece, the main fuels used for electricity production are lignite, natural gas and petroleum products, and the impact of saving a KWhel in terms of CO_2 emission reduction depends on the power plant and time of the day. For the Greek fuel mix it can range from 550 gCO_2/kWhel if natural gas is saved to almost 1,200 gCO_2/kWhel if a lignite fired power plant reduces its output. In general, though, it seems safe to conclude that the EEO scheme will assist Greece in complying with its current and future climate policy commitments as it reduces GHG emissions in both ETS and non-ETS sectors.

With respect to impact on diffusion of low emission technologies in Greece, the EEO scheme is expected to act as a strong driver for energy efficiency as it helps to provide a stable source of funding and stimulates the development of the ESCO (energy services company) market (European Commission, 2014). In that sense, the EEO is expected to drive additional investments in energy efficiency measures, which will lead to additional energy savings, compared to situation with only the EU ETS, thus reflecting a positive interaction between the two policy instruments.

At the same time, the EEO scheme is not aimed at accounting for switching from fossil fuel-based to renewables-based energy consumption if the total energy consumption remains the same. After all, in that case, one cannot speak of energy saving. Instead, there are no limitations on the type of end-use energy saving measures that can be counted such as the replacement of inefficient fossil fuels by more efficient fossil fuels (e.g., oil and gas boilers), which risks locking into technologies that are not compatible with the long-term decarbonisation objective (and that not significantly improve security of supply). In that respect, the EEO could have a negative impact on investments in a low-emission climate future.

On the other hand, improving energy efficiency in the energy market could be hampered by policies aimed at diffusion of renewable energy technologies, based on state support. With this support, renewable energy may become cheaper so that investments in these technologies can be preferred over and therefore crowd out energy efficiency technology investments. This risk seems quite substantial, as currently a wide mix of policy measures for the promotion of renewable energy systems for heating and cooling in buildings as well as in the transport sector exist.

Last but not least, electricity consumers are expected be directly influenced in a number of ways by the combination of the EEO and ETS impacts on energy-intensive industries. On the one hand, electricity retail prices may increase as power producers pass on the costs of purchasing ETS allowances to consumers. Consumers may also be confronted with an add-on to electricity prices in order cover deficits in the *Special RES Account* in Greece.[8] On the other hand, further reduction in energy demand (due to both the carbon and EEO charges on electricity bills, as well as due to energy efficient investments) may lower the wholesale and subsequently the retail electricity price. Increase in energy costs can also be offset for beneficiaries of the EEO scheme who receive financial aid for energy efficiency investments. Overall the reduction in the retail electricity price (due to reduction in

[8] The Market Operator (LAGIE) is authorized to operate the support and funding mechanism for the remuneration of the generated energy from RES power plants, through a dedicated account (Special Account for RES). Although the revenues of this account come from different sources, there are two primary revenue sources: 1. A charge calculated upon the consumed energy that all consumers pay through their electricity bills; 2. the amount resulting from the day-ahead electricity market dispatch (Anagnostopoulos, 2016).

demand) is most likely to be offset by the expected increases in both GHG emissions chargers and cost-recovery charges[9].

Finally, the use of revenues from auctioning emissions allowances in the power sector can be used to support energy savings at the end use level. Hence the impact of the EU ETS on the EEO scheme and energy efficiency stimulation could become more positive. However, until the end of 2015, the total revenues from auctions of CO_2 allowances in Greece were channelled to the Special RES Account. As of 1 January 2016, this was stopped and an upcoming Ministerial Decision will determine the new allocation of the revenues. The EU ETS Directive, as incorporated into national law, requires at least 50% of these revenues to be directed to "green actions", which may as well include the strengthening of RES support. The Ministry of Energy has reportedly decided to allocate a 70% share of these revenues on supporting renewable energy technology diffusion by contributing to the Special RES account. This offers an opportunity to dedicate these funds to renewable energy technologies, which could go at the expense of investments in energy savings technologies and may risk the successful implementation of the EEO scheme, especially during the first critical years of its operation.

6.4. Findings

This case study discusses potential implications of introducing and EEO scheme in the EU ETS regulated energy market in Greece, in terms of changes in the distribution of costs and benefits for relevant market players. These effects are likely to occur due to interactions (overlaps) between the two policy instruments and are exacerbated by the operation of the Greek energy market, its nature (i.e. relatively concentrated) and several market failures. Below, the implications of policy co-existence, likely be observed due to the expected Greek EEO design, are summarised, which may act as a trigger for recommendations to Greek policy makers.

- The increasing compliance costs of the combined EEO and ETS scheme for energy producers are most likely to be passed on to Greek electricity consumers, lowering their consumer surplus significantly especially in the short-term. Alternative financing approaches to counterbalance the increase in compliance costs are highlighted as a priority action for Greek policy makers. For that, the Greek Government envisages the creation of a National Energy Efficiency Fund to support the obligation scheme with revenues coming from alternative sources although its scope remains relative ambiguous.
- The Greek EEO scheme and its short-term targets may jeopardise the attainment of long-term GHG emission targets due to a lower price for allowances, which may implicitly put off R&D efforts in more efficient low emission technologies. Lower

[9] Experience from European EEO schemes has shown that allowing for full cost-recovery of costs result in annual consumer charges ranging from 0.02 to 0.06 €/KWhel for consumers in the household sector (ENSPOL, 2015).

emission prices due to less scarcity of allowances in the market can be mitigated by temporarily withholding emission allowances to tackle the current and future oversupply in the ETS.

- Investments in RES technology in end-use sectors (e.g., buildings or transport) are discouraged within the implementation of the obligation scheme. To avoid lock-in phenomena in fossil-fuel technologies at the demand-side, it is advisable to Greek policy makers to consider putting in place energy efficiency measures under Article 7 (of the Energy Efficiency Directive). This would lead to changes in terms of final energy savings, but also in terms of energy sources and therefore CO_2 emissions.
- The use of revenues from auctioning emission allowances in the power sector can be used to support energy savings at the end use level. Hence the impact of the EU ETS on the EEO scheme and EE improvements could become more positive.

The possible impacts of interactions of ETS, EEO and renewable energy support policies are summarised in Table 5.

Table 5. Summary of case study results for ETS and EEO scheme interaction impacts

Key Variables	EU ETS & Greek EEO scheme	
Electricity demand	Decrease	Reduction in demand due to energy efficiency investments and higher retail electricity prices
Wholesale electricity price	Decrease	The shift in the demand curve to the left results in lowering the wholesale price, since less electricity is needed to cover lower demand levels than with the ETS stand-alone.
Retail electricity price	Ambiguous/ Increase	Reduction in the retail electricity price (due to reduction in demand and subsequent reduction in the wholesale price) is likely to be offset by the expected increases in both GHG emissions chargers and cost-recovery charges.
National fossil-fuel based electricity generation and CO_2 emissions	Decrease	Decrease due to lower demand than with the ETS alone; lower emissions from the power sector due to reduction in demand in non-ETS sectors (e.g., buildings).
Non-RES Producers' surplus	Ambiguous	Lower surplus than with the ETS alone due to decrease in demand may be offset by the benefits from the ETS (reduction in emission due to reduction in energy demand leading to lower compliance costs).
Consumers Surplus	Decrease	Surplus is likely to be lower than with EU ETS alone especially for non-EEO beneficiaries of energy efficient investments.
EE technology investments	Increase	Investments in EE technologies will be increased more than with the ETS alone
RES technology investments	Decrease	Investments in RES technology are likely to be reduced in the long term than with the ETS alone due to lower emission prices and non-eligibility of measures resulting in primary energy savings.

7. Case Study 4: Interaction between the EU ETS and the Renewable Energy Directive at the EU-level

7.1. Introduction

When the original ETS Directive was drafted and later revised (European Union, 2003; 2009), the effects of the RED on the EU ETS were considered, but it is unlikely that the effects of ETS Phase I (2005-07) and its transition to Phase II (2008-12) have been anticipated. The latest ETS reform proposal (European Commission, 2015) for Phase IV (2021-2030) provides an opportunity to review in a systematic way the impacts of the co-existence of the ETS and policies based on RED. A priori, this co-existence could be justified for several reasons: to correct for market and policy failures and to meet multiple targets and objectives (Rey, L., et al., 2013; Löschel & Schenker, 2015; Lehmann & Gawel, 2011; OECD, 2011), but could also lead to lower policy effectiveness and efficiency.

This case study examines primarily the effects of the EU RED on the implementation of EU ETS, with a focus on two main sources of literature: one from the research community (both scientific and policy research) and the other based on consultation of market participants (the power and trading sectors). At the same time, this analysis not only looks at policies and policy instruments but also at policy targets (i.e. renewable energy targets, GHG emission reductions).

7.2. Background and policy context

The adoption in 2008 of the EU's Climate and Energy Package for 2020 (European Parliament and the Council, 2009) was a strategic policy choice to support the UNFCCC climate negotiations in Copenhagen (2009). As such, the package was mainly a climate package with EU energy policies, especially those relying on renewable energy and energy efficiency contribute to the EU's climate policy and the EU's position in international climate negotiations. This policy landscape has significantly changed since the start in 2015 of the European Energy Union, which has a stronger focus on the supply side of the energy market, including security of energy supply and the internal energy market. Thus, EU climate policy nowadays is also aimed at contributing to the Energy Union. Nevertheless, the role of the ETS as the main European instrument to meet its 2030 climate target in the most cost-effective manner was not only confirmed in the European Council Conclusions in October 2014 (Council of the European Union, 2014) but also reaffirmed in the EU's post-Paris strategy published in March 2016 (European Commission, 2016).

A majority of European stakeholders perceive the ETS as the main policy instrument for inducing GHG emission reductions (e.g., Nordeng et al. (2014) (2015), Fujiwara (2015)). On the other hand, there are interesting changes in stakeholders' perceptions as well as Member States' preferences. First, there is an increasing view that in contrast to the conventional wisdom (Sartor & Mathieu, 2015), the ETS will remain the best but not the only instrument for EU climate policy, and can be combined with other policy instruments such as subsidies for renewable energy (for variance in preference across member states, see Nordeng et al. (2015)). Second, there is a shift in preference for choice of policy instruments, such as a shift from Feed-in-Tariffs (FiTs) to Feed-in-Premiums (FiPs) for supporting renewable energy technology development (e.g., Ragwitz (2015). In a survey, to which about 75 ETS-covered installations responded, 19% answered that the EU ETS had induced their companies to reduce emissions in the early phase but has little impact now. By comparison, 32% suggested that the ETS had and would continue to cause reductions, while 29% were of the view that it had not and would not likely cause any reductions (Nordeng, A. et al., 2015).

A survey commissioned by the European Commission found that carbon abatement and prices for emission allowances were not the primary drivers for most companies and sectors to invest in carbon-efficient solutions. Nevertheless, the survey concluded on a positive note that the ETS played a supportive role in many decisions, especially in the early years of the second ETS phase when the price was higher (around 2008-2009). This has induced installations to minimise energy costs, improve financial viability and profitability, raise awareness for climate issues at the management level and among employees, and build capacity for more accurate monitoring and reporting of emissions (European Commission, 2015). A ZEW survey among German installations revealed that in ETS Phase I and Phase II the main drivers for these installations were the need for them to reduce energy and raw material costs and improvements in the general efficiency of the production process (European Commission (DG Climate Action), 2015).

7.3. Analysis of policy interactions RED and ETS at EU-level

The European Commission's impact assessment for the 2020 Climate and Energy Package (European Commission, 2008) assessed impacts of various design choices to implement both renewable energy and GHG emission reduction targets. Nevertheless, actual effects of the RED were realised by market participants such as power companies and traders, then later verified by researchers when data for the ETS Phase I became available for ex-post evaluation. By 2010, emission reductions triggered by the RED were estimated at around 50 MtCO_2 across the EU ETS sectors (IETA, 2015). Another assessment found that over the last six years, renewable energy capacity has led to a reduction of GHG emissions in the ETS-covered power sector of around 15 Mt every year (Energy Aspects, 2015). Similar conclusions were found in an ex-post assessment based on the data from 12 Member States in Western and Southern Europe between 2007 and 2010: deployment of renewable electricity technologies displaced CO_2 emissions within the ETS sectors, thereby reducing demand for ETS allowances resulting in a lower allowance prices (Van den Bergh, Delarue, & D'haeseleer, 2012).

A case study of Germany showed that approximately 10 to 16% of the reduction in CO_2 emissions from the electricity sector between 2005 and 2011 could be attributed to the increase in the share of renewable energy technologies the energy mix (Weigt, Delarue, & Ellerman, 2012). More recently, Berhmans et al. (2014) conducted an ex-post assessment for CO_2 emissions from the electricity sector in the EU during Phases I and II (2005-12) and concluded that supporting policies for renewable energy generation enhanced reductions of CO_2 emissions in the power sector. Most of the new renewable energy generation capacity was set in place by Member States in the form of FiTs or green certificates without a link to EU allowance (EUA) prices. Berghmans et al. (2014) conclude that CO_2 emission reductions within the ETS-covered sectors have been mainly induced by stimulation measures for renewable energy technologies. This has also been due to the low ETS market prices because of the economic crisis, as with low allowance prices fewer incentives exist for ETS installations to invest in low emission technologies. Koch et al. (2014), using a data set which includes a full period of ETS Phase II (2008-12) and the first year of Phase III (2013), also concluded that growth in renewable energy deployment, especially that of wind and solar, contributed to (further) lowering EUA prices, although they found that the effects of renewable energy growth on EU allowance prices are smaller than what ex-ante simulation-based assessments predicted.

With a view to the future, IETA (2015) expects that interacting EU policies, including the energy efficiency, renewable energy and Ecodesign Directives, will reduce demand for EUA by 1.1 billion tonnes by 2020. Other reports similarly assume continuation of renewable energy uptake but on a smaller scale due to a fall in the levels of subsidies[10] with annual emission reductions due to renewable energy policies in the range of approximately 10-15 Mt (Energy Aspects, 2016). A possible consequence of supporting renewable energy deployment with corresponding price reductions on the EU ETS market is that it becomes economically attractive to use high-emission technologies. After all, with high EUA prices, these technologies become relatively expensive so that in the merit order they will be scaled down, while low-emission technologies become more favourable (Löschel & Schenker, 2015).

Because of perceived low EUA prices over the long term, most ETS-compliant companies in the power sector have stalled investing in newer and low-emission gas-fired plants while having kept running existing coal and lignite-fired plants which have lower operating costs (e.g., installation CEZ, see European Commission (2015)). An energy market research group, AB Energiebilanzen, estimated that energy-related CO_2 emissions in Germany increased by 0.9% in 2015 due to increased demand and more burning of lignite and natural gas. The figure would have been higher without a 10.5% increase in renewables-based power (Carbon Pulse, 2016). While the overall balance of interactions between the ETS and renewable energy support in terms of CO_2 reduction may therefore still be positive, a possible consequence of the interactions is that investments in low-emission technologies needed for future climate commitments have been slowed down and that continuation of

[10] For the case of Germany, see Nordeng, et al. (2015).

coal and lignite-fired plants may cause lock-in effects, leading to continuation of these technologies for a longer period.

Several stakeholders in the energy sector are concerned about the overlap of multiple instruments and multiple objectives. For example, RWE suggests the use of the ETS for climate policy and to move away from FiTs and towards FiPs and tendering schemes for renewable energy support.[11] In addition to the ETS, Repsol views that multiple targets for renewable energy, fuel quality, and energy efficiency create a complex regulatory framework with additional risks for competitiveness and uncertainties (European Commission (DG Climate Action), 2015). CEZ even sees "a threat that the increased deployment of renewables, based on a non-market approach and relying on national support schemes, conflicts with the EU ETS as it creates emission buffers in the ETS with absolute targets" (CEZ in European Commission (DG Climate Action) (2015)). Such adverse effects have been also acknowledged by the research community (e.g., (Sartor & Mathieu, 2015; Berghmans, Cheze, Alberola, & Chevallier, 2014; Van den Bergh, Delarue, & D'haeseleer, 2012).

On the other hand, based on the concerns about the potential of the ETS to drive low-emission technologies and innovation, most studies reviewed for this case study recommend the continuation of combining different approaches, which they view as complementary, instead of relying on the ETS as the only instrument of EU climate policy. Based on the literature review and stakeholder consultation, there are three main suggestions to avoid and/or mitigate possible detrimental effects of RE support on the ETS:

1. *The ex-ante assessment of the ETS cap at the start of each Phase, i.e. no ex-post adjustment to the cap during the Phase*

Possible policy interaction effects need to be fully accounted before setting the ETS cap for each phase through the review of the Linear Reduction Factor. At the start of a phase there is a possibility for adjustments, depending on the need for making progress towards the 2050 goal (80-95% GHG emission reductions from 1990 levels) and in international negotiations (IETA, 2015). Aligning complementary policies with the ETS means that the ETS cap should be reduced by an equivalent amount of abatement expected from complementary investment support policies in the context of National Energy and Climate Plans (NECP) (Sartor & Mathieu, 2015) (for NECP see European Commission (2015).

[11] RWE, presentation at the 3rd POLIMP stakeholder workshop, Brussels, 11 February 2015.

2. Transparency in information

Greater transparency in information is needed to assess the adequacy of the ETS cap and to monitor impacts of abatement delivered through complementary policies such as renewable energy support. Essential data include GHG emission reductions and sub-sectoral allocation at an installation level, as well as costs and impacts of complementary policies (IETA, 2015). For example, this requires differentiation of technology types, as the evidence for effects of renewable energy support measures on the ETS was robust in wind and solar, but not necessarily in hydro (Koch, Fuss, Grosjean, & Edenhofer, 2014). In addition, energy traders argue that Member States and the European Commission do not provide detailed fundamental assumptions at a local or aggregated level, particularly on economic growth (GDP growth) and carbon intensity (emission per unit GDP) and that Member States fail to inform about the impacts that National Energy and Climate Plans would have on the ETS (European Federation of Energy Traders, 2016).

3. The Market Stability Reserve

It was the *over-achievement* of the RE target which caused high uncertainty about the level of demand for EUAs (Jalard, Dahan, Alberola, Cail, & Keramidas, The EU ETS emissions reduction target and interactions with energy and climate policies, 2015a).[12] While the Market Stability Reserve (MSR) primarily aims to restore the balance between supply and demand and enhance the ETS resilience against external shocks, it can be regarded as the only and most effective instrument in place to mitigate the impacts of complementary policies, which were unpredictable or/and unavoidable, during the phase. It may not avoid the problem at its origin but could repair the negative effect of those policies by withdrawing allowances from auctioning (IETA, 2015; Jalard, Dahan, Alberola, Cail, & Cassisa, 2015b). The amount of withdrawal may be determined based on assessment of different scenarios assuming different rates of increase in abatement resulting from complementary policies such as on renewable energy (Sartor & Mathieu, 2015).

These three suggestions are not mutually exclusive but related to each other. Long-term scarcity should be ensured by the ex-ante assessment of the ETS cap, which requires comprehensive data collection and periodic and systematic monitoring of impacts of

[12] Unlike energy efficiency or offsets, the RE target itself was accounted for in the ETS cap-setting at the start of Phase 3. What was unaccounted for was the overachievement of the target. Renewable energy policies accounted for a large share of CO_2 emission reductions but their contribution to allowance surpluses did not contribute significantly to the increasing surplus in contrast to the impacts of energy efficiency policies and offsets (Jalard, Dahan, Alberola, Cail, & Keramidas, The EU ETS emissions reduction target and interactions with energy and climate policies, 2015a).

abatement from complementary policies. Unavoidable effects of the latter could be mitigated to some extent using the MSR.

The EU-level impacts of renewable energy support schemes on the ETS are summarised in Table 6.

Table 6. Summary of case study results on interaction renewable energy schemes and ETS (at EU level)

Key variables	Impact of ETS and RED interaction	
CO_2 emissions in ETS power sector	Decreased	Renewable energy (through RED) has led to additional emission reductions in ETS sectors (e.g., 15 Mt per year during 2010-2015). However, due to lower EUA prices, ETS-compliant companies kept coal and lignite-fired plans operational, which counter-weighted the RE-induced emission reduction
EUA price	Decreased	Renewable energy development support has reduced demand for EUAs in ETS sectors, resulting in EUA price reduction.
Renewable electricity technology deployment	Increased	Instruments such as FIT and FIP have resulted in stronger deployment of renewable energy technologies, which had not yet reached the stage of commercial application.
Low emission energy investments in ETS power sector	Decreased	Most ETS-compliant companies in the power sector have stalled investing in newer and low-carbon gas-fired plants due to lower EUA prices

7.4. Findings

From this EU level case study on interactions between renewable energy support policies and the EU ETS, the following key findings can be presented:

1. The combination of policy instrument for energy efficiency improvement, renewable energy support and the EU ETS can be justified because each of them has its own target under the EU Climate and Energy Package.
2. Nevertheless, detrimental effects of renewable energy support measures on the EU ETS have been among the major concerns of EU stakeholders in the power and

energy trading sectors. The overachievement of the RE target meant that in the power production sector demand for ETS allowances decreased, resulting in a lower ETS market price. In terms of efficiency, this resulted in a loss as emission reductions delivered by RE support measures such as FiTs have higher abatement costs than those through cap-and-trade systems such as the EU ETS.

3. While interactions between the policy instruments were foreseen, the overachievement of the RE target was not anticipated. This success has been driven by policy objectives other than GHG emission reductions, e.g., energy security and air pollution reductions. The current EU policy framework in this field, the Energy Union, aims at an increase in RE share for multiple reasons.
4. It is important to understand how RED affects the ETS, and to identify the conditions under which this effect will become detrimental to undermining the purpose of the latter, and how this can be prevented. For that the case study analysis concludes on three key measures:

    a. The effects of policies such as renewable energy support need to be fully accounted for when the ETS cap is set at the start of each ETS Phase through the review of the Linear Reduction Factor,
    b. Greater transparency in information is needed to assess the adequacy of the ETS cap and to monitor impacts of abatement delivered through complementary policies such as RE,
    c. The Market Stability Reserve is the only and most effective instrument in place to mitigate the impacts of complementary policies, which were unpredictable or/and unavoidable, during the phase.

8. Key findings from the case study analysis

In this report, interactions between EU climate and energy policies have been analysed based on four case studies. The case studies, while acknowledging that they cannot cover the full landscape of potential energy and climate interactions, nor cover the full policy landscape of all EU Member States, illustrate how simultaneous implementation of policies can lead to interactions. Policies covered by the case studies are in the areas of energy efficiency improvement, renewable energy support and the EU ETS. In three of the case study the analysis has focused on national policies which are the result of transposing the EU Directives for Renewable Energy, Energy Efficiency and the ETS into national law.

Findings from the four individual case studies were formulated in the preceding sections. This section contains a few key findings which have been generated from the case study analysis and which are assumed to have a wider applicability to cases of other energy and climate policy interactions.

1. *Consistency between policies during policy design stages*: Policy interaction can take place through policies' overarching objectives, policy instruments (to achieve policy objectives) and their design characteristics (target, scope, technologies, and target groups). Policy co-existence can be justified if the policies are aimed at different targets, such as one policy to achieve short-term environmental targets and another policy for longer-term targets. Policies can be considered consistent when individual policy instruments do not contradict each other, but instead, result in synergies within the policy mix. To avoid negative interactions, it is therefore important that ex ante impact assessments of policies consider potential interactions and ensure that they all work in the same 'direction'.
2. *Have provisions in place in case the effects of policy interactions are not anticipated or stronger than anticipated*: There can be cases in practice where a specific policy interaction is assumed to lead to synergistic effects (e.g., policies all contribute to CO_2 emission reduction), but that actual practice shows that the policy results are undesirable. For example, the EU-level and Greek case studies on interaction between ETS and renewable energy support and ETS and the energy efficiency obligation scheme, respectively, has shown that accelerated deployment of renewable energy technologies has resulted in extra CO_2 emission reductions, larger EUA surpluses and a lower EUA price. While beforehand, these effects were expected, the impacts of the economic crisis after 2008 on the ETS market were not anticipated. Consequently, market imbalances could not be repaired. Quantity management solutions, such as the ETS Market Stability Reserve (EU case study) or price floors (French case study) can serve as a solution for that.
3. *Streamline and fine tune policy making at different policy making levels within countries*: While most of the case studies focus on interactions between different policy instruments covering different policy areas (i.e. energy efficiency, renewable energy

and climate), the case study in Austria has shown an example of policy interactions taking place within one policy area but between federal and provincial levels of government, which both, quite independently from each other, operate subsidy schemes for energy efficiency improvements in households. The case study has shown that Austria's energy consumption in households decreased over the last years, which is likely to be attributable to energy efficiency measures at different government levels. However, it also raises the question of how efficient the current policy mix has been and whether there is a need to reform the current system towards a policy mix that is not entirely based on subsidies. One potential issue, which has been mentioned in the Austrian case study, is that more efficient federal and provincial mixes of energy efficiency policies may require termination or changing some of the subsidies. At the same time, subsidies have the largest political acceptance among policy instruments in the country, which may require a trade-off between policy efficiency and acceptance.

4. *Renewable energy targets formulated as percentages can 'automatically' be achieved because of energy efficiency policies*: The French case study shows how renewable energy targets were 'automatically' met because of achieving energy efficiency goals. Due to energy efficiency measures, energy consumption reduced, so that renewable energy goals, formulated as a percentage of energy consumption, were automatically met. While this is no problem for short-term policy goals, this interaction reduces the pressure to increase investments in renewable energy technologies, which may be detrimental for development of technologies needed for future energy and climate goals. To mitigate this, renewable energy targets can be set as absolute amounts of renewable energy to be produced/consumed.
5. *Impact of policy interactions partly depends on (energy) market characteristics*: The case study in Greece has shown how a monopoly situation in the electricity market can lead to a passing on to consumers of increasing compliance costs due to the combined effect of the energy efficiency obligation and ETS schemes for energy producers. The case study in France has demonstrated that interaction between national renewable energy support policies and the EU ETS is much weaker as in other Member States, especially compared to Germany, as the French power sector has a relatively small CO_2-intensity so that national policies are likely to have a negligible impact on the EU ETS (in terms of surpluses and prices).
6. *Short-term interactions between EU ETS and renewable energy policies may result in negative impact on renewable energy technology deployment in the longer term*: The case studies illustrate how short-term interactions may have negative impacts on achieving long-term energy and climate targets. Case study examples of energy efficiency and ETS, as well as renewable energy and ETS policy interactions have shown that in general CO_2 emissions decrease, but the lower prices for EU allowances may postpone investments in low-emission technologies. This may jeopardise the attainment of long-term GHG emission targets and implicitly put off R&D efforts in more efficient low emission technologies.

References

Altman, M., Michalski, J., Brenninkmeijer, A., Lanoix, J.-C., Tisserand, P., Egenhofer, C., . . . Ellison, D. (2010). *EU Energy Efficiency Policy – Achievements and Outlook.* Brussels, Brussels: European Parliament.

Anagnostopoulos, P. S.-A. (2016). *A "New-Deal" for the development of photovoltaic investments in Greece? A parametric techno-economic assessment.* Working Paper.

APRAISE. (2012). *The APRAISE 3E Method - Deliverable 2.2.* Groningen, the Netherlands; Graz, Austria: Consortium for FP7 project APRAISE.

Austrian Energy Agency. (2015). *Final energy consumption in Austria 2005-2020.*

Berghmans, N. (2012). *Energy efficiency, renewable energy and CO2 allowances in Europe: a need for Coordination .* CDC Climat Research, Climate Brief n°18.

Berghmans, N., Cheze, B., Alberola, E., & Chevallier, J. (2014). *The CO2 emissions of the European power sector: economic drivers and the climate-energy policies 'contribution.* CDC CLIMAT RESEARCH.

Carbon Pulse. (2016, February 3). *Germany's energy-related CO2 emissions up 0.9% in 2015*. Retrieved from Carbon Pulse: http://carbon-pulse.com/13587/

Chevaleyre, G., & Berghman, N. (2013). *Revenu des enchères de la Phase 3 de l'EU ETS: une nouvelle ressource publique.* CDC Climat Research, Point Climat n°36.

CITEPA. (2015). *Rapport National d'Inventaire pour la France au titre de la Convention cadre des Nations Unies sur les Changements Climatiques et du Protocole de Kyoto.* Paris, France: Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique.

Council of the European Union. (2014). *European Council conclusions, 23-24 October.*

Cour des Comptes (French Court of Audit). (2013). *La politique de développement des energies renouvelables, Rapport public thématique.*

Del Rio, P. (2014). On evaluating success in complex policy mixes: the case of renewable energy support schemes. *Policy Science*, Vol. 47: 267-287.

Duval, R. (2008). *A Taxonomy of Instruments to Reduce Greenhouse Gas Emissions and their Interactions.* Paris: OECD Economics Department Working Papers, No. 636.

Edenhofer, O. P.-M. (2014). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press.

Energy Aspects. (2015, June 30). *Greece is the word.* Retrieved from Energy Aspects: https://www.energyaspects.com/publications/view/greece-is-the-word

Energy Aspects. (2016, January 18). *European carbon*. Retrieved from Carbon Weekly: https://www.energyaspects.com/publications/view/european-carbon180116

ENSPOL. (2015). *Report on existing and planned EEOs in the EU - Part II Description of planned schemes.* http://enspol.eu/results.

E-Sieben. (n.d.). *E-Sieben project: Electricity consumption of Austrian Households*. Retrieved from http://www.e-sieben.at/en/projects/1206_austrian_electricity_diary.php

European Commission (DG Climate Action). (2015). *Study on the impacts on low carbon actions and investments of the installations falling under the EU emissions trading system (EU ETS).* final report.

European Commission. (2008). *Impact assessment, Document accompanying the Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020, Commission Staff Working Document, SEC (2008) 85/3.* Brussels, Belgium.

European Commission. (2009). *National Action plans, Greece.* Brussels, Greece.

European Commission. (2014, January 22). *Document 52014DC0015.* Retrieved from EUR-Lex Access to European Union Law: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52014DC0015

European Commission. (2014). *Energy Efficiency and its contribution to energy security and the 2030 framework for climate and energy policy.* Brussels.

European Commission. (2015). *Annex: Guidance to Member States on National Energy and Climate Plans as part of the Energy Union Governance' to the State of the Energy Union, Communication from the Commission to the European Parliament, The Council, the Eur.*

European Commission. (2016). *The Road from Paris: assessing the implications of the Paris Agreement and accompanying the proposal for a Council decision on the signing, on behalf of the European Union, of the Paris agreement adopted under the United Nation.*

European Federation of Energy Traders. (2016). *Tackling overlapping policies with the EU ETS.* EFET discussion paper, 18 January. http://www.efet.org/Cms_Data/Contents/EFET/Folders/Documents/EnergyMarkets/RE/~contents/AR52M5NJ6JSN87T9/EFET-on-overlapping-p.

European Parliament and the Council. (2009). *2020 Climate and Energy Package .* Brussel: European Parliament and the Council.

European Union. (2003). *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, Official Journal .*

European Union. (2009). *Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community, Official Journal of.*

European Union Transaction Log. (2016). *EUTL Data Viewer*. Retrieved from http://ec.europa.eu/environment/ets/allocationComplianceMgt.do;EUROPA_JSESSIONID=Ym4CpTdWrzoD7tm9XIm5x0NNnOFv0Y7l-Y79CnNJe8jljX9J9V-r!12068461

Fischer, C. (2015). *Overlapping Climate and Energy Policy Instruments in the EU: Ready for 2020 and Beyond? Dissertation thesis University of Oxford.* Oxford, UK.

Fischer, C., & Preonas, L. (2010). *Combining Policies for Renewable Energy: Is the Whole Less than the Sum of Its Parts?* Washington, D.C.: RFF Discussion Paper 10-19, Resources for the Future.

Fujiwara, N. C. (2015). *'European Stakeholders' Perspectives on the EU ETS.* POLIMP Policy Brief, No. 3.

Hood, C. (2011). *Summing Up the parts, Combining policy Instruments for Least-Cost Mitigation Strategies.* Information Paper, IEA/OECD, Paris .

IEA. (2011a). *Energy efficiency policy and carbon pricing - Information Paper.* Paris: International Energy Agency.

IEA. (2011b). *Summing up the parts – combining policy instruments for least-cost climate mitigation strategies - Information Paper.* Paris: International Energy Agency.

IETA. (2015). *Overlapping policies with the EU ETS.* http://www.ieta.org/resources/EU/IETA_overlapping_policies_with_the_EU_ETA.pdf.

Jalard, M., Dahan, L., Alberola, E., Cail, S., & Cassisa, C. (2015b). *The EU ETS and the Market Stability Reserve.* Chapter 2 in Exploring the EU ETS beyond 2020.

Jalard, M., Dahan, L., Alberola, E., Cail, S., & Keramidas, K. (2015a). *The EU ETS emissions reduction target and interactions with energy and climate policies.* Chapter 1 in

Exploring the EU ETS beyond 2020: First assessment of the EU Commission's proposal.

Jensen, S., & Skytte, K. (2002). Interactions between the power and green certificate markets. *Energy Policy, 30*(5), 425-435.

Jensen, S., & Skytte, K. (2003). Simultaneous attainment of energy goals by means of green certificates and emission permits. *Energy Policy, 31*, 63-71.

Koch, N., Fuss, S., Grosjean, G., & Edenhofer, O. (2014). Causes of the EU ETS price drop: Recession, CDM, renewable policies or a bit of everything? - New evidence. *Energy Policy, 73*, 676-685.

Lehmann, P., & Gawel, E. (2011). *Why should support schemes for renewable electricity complement the EU emissions trading scheme?* UFZ-Diskussionspapiere, No. 5/2011.

Löschel, A., & Schenker, O. (2015). *Report on assessment and interaction of policy instruments and policy mixes.* ENTRACTE.

Meng, S. S. (2015). *The impact of an ETS on Australian energy sector: an integrated CGE and electricity modelling approach.*

Moris., D. a. (2013). *Carbon Fatcat Companies in Greece. Policy Document.* WWF.

MStR Law Firm. (2014). *The Bill of the Ministry of Environment Energy & Climate Change (YPEKA) on New Deal with the producers from RES and Cogeneration stations.* URL: http://www.mstr-law.gr/media/documents/2014/03/10/NewDeal_EN.pdf.

Mulder, A. (2016). *CO2 emissions trading in the EU.* Groningen, the Netherlands: University of Gronignen Ph.D thesis.

MURE. (2015). Retrieved from http://www.measures-odyssee-mure.eu/public/mure_pdf/household/AU13.PDF

Nordeng, A. et al. (2014). *The carbon market survey 2014.* Thomson Reuters.

Nordeng, A. et al. (2015). *The carbon market survey 2015.* Thomson Reuters.

OECD. (2011). *Interactions Between Emission Trading Systems and Other Overlapping Policy Instruments.* General Distribution Document, Environment Directorate, Paris.

Official Journal of the European Union. (2009). *Directive 2009/28/EC of the European Parliament and of the council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives*

2001/77/EC and 2003/30/EC. Brussel, Belgium: European Parliament and the council.

Oikonomou, V., Flamos, A., & Grafakos, S. (2010). Is blending of energy and climate policy instruments always desirable? *Energy Policy, 38*, 4186-4195.

Oikonomou, V., Flamos, A., Gargiulo, M., Giannakidis, G., Kanudia, A., Spijker, E., & Grafakos, S. (2011). Linking least-cost energy system costs models with MCA: An assessment of the EU Renewable Energy targets and supporting policies. *Energy Policy, 39*(5), 2786-2799.

Philibert, C. (2011). *Interactions of Policies for Renewable Energy and Climate.* Working Paper, IEA/OECD, Paris.

Ragwitz, M. (. (2015). *Options for a sustainable EU renewable energy policy.* DIACORE Policy Brief.

Reuters. (2016, May 17). *Emissions trading: France sets carbon price floor.* Retrieved from the guardian: https://www.theguardian.com/environment/2016/may/17/france-sets-carbon-price-floor

Rey, L., et al. (2013). *Assessing interaction between instruments and the 'optimality' of the current instrument mix'. .* CECILIA2050, WP1, Deliverable 1.3. Bilbao: Basque Centre for Climate Change (BC3), London: University College London (UCL), November.

RTE. (2016). *"Signal-Prix du CO2 : Analyse de son impact sur le système électrique européen".*

Sandbag. (2016). *Carbon Floor Price Briefing.* UK: Sandbag.

Sartor, O., & Mathieu, M. (2015). *What does the European power sector need to decarbonise? The role of the EU ETS & complementary policies post 2020.* Final report, Climate Strategies.

Sorrell, S., Smith, A., Betz, R., Walz, R., Boemare, C., Quirion, R., . . . Pilinis, C. (2003). *Interaction in EU Climate Policy.* Brussels: INTERACT project (EU 5th Framework Programme).

Spyridaki, N., & Flamos, A. (2014). A paper trail of evaluation approaches to energy and climate policy interactions. *Renewable and Sustainable Energy Reviews, 40*, 1090-1107.

Trotignon. (2016). *Prix plancher sur le secteur électrique: quelles conséquences pour le marché des quotas de CO2 et sa réforme.* Chaire Climate Economics and Chaire European Electricity Markets conference, University Paris-Dauphine.

Van den Bergh, K., Delarue, E., & D'haeseleer, W. (2012). *Impact of renewables deployment on the CO2 price and the CO2 emissions in the European electricity sector.* Working Papers, RSCAS, 2012/66, Robert Schuman Centre For Advanced Studies, Climate Policy Research Unit.

Weigt, H., Delarue, E., & Ellerman, D. (2012). *CO2 Abatement from Renewable Energy Injections in the German Electricity Sector: Does a CO2 Price Help? .* CEEPR WP 2012-003.