Choosing Efficient Combinations of Policy Instruments for Low-carbon development and Innovation to Achieve Europe's 2050 climate targets

Country report: Spain

WP 1 – Taking stock of the current instrument mix

Contribution to Deliverable 1.2: Review of the existing instrument mix at EU level and in selected Member States

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Table of Contents

0 Executive summary

Climate policy in Spain is mainly shaped by the European Union targets for 2020 on greenhouse gas (GHG) mitigation, renewable energy and energy efficiency. By 2020, Spain will have to reduce GHG emissions from the non-ETS sectors by 10% below 2005 levels, increase the share of energy consumption produced from renewable sources to 20% and contribute to the EU target of reducing energy demand by 20%. In order to meet these objectives the Spanish Government set a strategy (*Climate Change and Clean Energy Strategy* 2007-2012-2020) to give stability and coherence to national, regional and local policies in the medium and long term. The Strategy includes 198 measures and 11 areas of action. The aim of this report is to describe the main climate policies adopted by the Spanish Government in recent years. We distinguish the key instruments within different 'policy landscapes', identify interactions between instruments and assess the 'optimality' of the overall instrument mix.

The key instruments in the Spanish policy mix are the EU Emission Trading Scheme (ETS) and the feed-in tariff scheme for renewable energy sources (FIT-RES). The landscape on carbon pricing is mainly driven by the EU ETS, which covers around 45% of GHG emissions. The initial periods of the EU ETS were characterized by an excessive number of allowances and the financial crisis, which lead to a surplus of unused allowances and thus to low prices. Despite the start-up problems, the system ensures a certain emission reduction and the flexibility to make it relatively cost-effective. The FIT-RES has been essential in the promotion of renewable energy sources. It has contributed to increase the share of renewables in terms of primary energy consumption from 6.3% in 2004 to 11.3% in 2010. Its success in raising the share of renewables, however, and with the current electricity market design, it has also caused an increase in electricity production costs and a major fiscal burden to the central budget. The government has decided to suspend the FIT-RES scheme for new installations and raise excise taxes on energy products.

The economic downturn has also influenced the promotion of energy efficiency. Several instruments have been launched with the double objective of reducing energy consumption and encouraging economic activity. For instance, subsidies for building refurbishments or the purchase of energy-efficient cars were implemented to meet both goals. Although, in general, these instruments are highly accepted, there is little empirical evidence on their effectiveness.

Instrument interactions take place mainly around the EU ETS. Although other instruments cannot improve the environmental effectiveness of the EU ETS, they contribute to Spanish targets on GHG emission reduction, energy efficiency and the promotion of renewable energy sources. It is claimed that the other instruments alter abatement costs and thus reduce the static cost-effectiveness of the EU ETS (Sijm, 2005; del Río, 2009). However, the FIT-RES and the economic incentives to R&D may reduce the abatement costs in future, improving the dynamic effectiveness.

1 Description of policy landscapes

1.1 Classification of the instruments previously selected into policy landscapes

The objective of this report (and report series) is to perform an initial 'stock-take' of the climate policy instrument mix at the EU-Level and a representative group of Member States – the United Kingdom, Germany, France, Spain, Italy, the Netherlands, Poland and the Czech Republic. An initial list of up to 50 instruments from each country and EU-level was created, from which up to 15 key instruments for each state covering a broad selection of the economy, instrument type and objectives were selected for further analysis. Please refer to the Taxonomy of Instruments, developed under Task 1.1 of CECILIA 2050, for a full description of instrument classification. For each report, the selected instruments were categorised into policy 'landscapes', described below.

(1) **Carbon Pricing:** this includes policies that price CO_2 emissions or otherwise change the relative prices of fuel use, depending on the carbon intensities of fuels. Apart from the obvious candidates (carbon taxes and emissions trading) this would also include the reform or removal of fossil fuel subsidies;

(2) **Energy Efficiency and Energy Consumption:** this includes measures targeted at either increasing the efficiency of the energy sector, including power generation / combustion processes, transmission of energy (heat, electricity) and end-use efficiency, or at reducing overall energy consumption (demand-side management, energy saving, sufficiency);

(3) **Promotion of Renewable Sources of Energy:** this includes policies aimed at increasing the share of energy from renewable sources (solar, wind, hydro, biomass, geothermal);

(4) **Non-Carbon Dioxide Greenhouse Gases:** this covers policies geared at reducing non-CO_2 greenhouse gas emissions, typically from sectors other than the energy sector. It may include emissions like methane emissions from landfills or animal husbandry, N_2O emissions from agriculture, or greenhouse gas emissions from chemical industries (SF6, NF3, HFC, etc.)

The list of instruments for Spain, along with their landscape classifications may be seen in Table 1, below. This report describes each instrument based on a set of tabulated information found in Annex 1, and an attempt at assessing their individual 'optimality', based on the concept developed for use in the CECILIA 2050 project also developed in Task 1.1, is provided. Descriptions of interactions between instruments within each landscape are also provided, based on tables found in Annex 2. The categories and methods of interaction are based on best practice in instrument interaction assessment, and are completed in pairs against a single key instrument, or when important interactions between non-key instruments are present.

The resulting optimality of each landscape based on instruments and their interaction are then assessed, followed by interactions between each landscape and, finally, an analysis of the optimality of the climate policy mix as a whole in each country and at the EU-level is provided.

Spanish climate policy mix has been developed to meet EU targets for 2020 on greenhouse gas mitigation. The EU ETS, which covers around 45% of total GHG emissions, is the main instrument in the climate policy mix. In addition to the EU ETS, carbon pricing is also driven by energy taxes. Although in Spain energy taxes do not have an environmental component and are low compared to other EU countries, they have been included in this report because of their significant indirect effects on carbon price and energy efficiency. The main instrument in the promotion of renewable sources of energy is the feed-in tariff scheme.

Table 1. Classification of the instruments into policy landscapes

	Policy Landscapes			
Policy Instrument	**Carbon Pricing**	**Energy Efficiency and Energy Consumption**	**Promotion of Renewable Sources of Energy**	**Non-Carbon Dioxide GHGs**
EU ETS	✓	✓	✓	✓
FIT-RES			✓	
Reduced subsidies for coal production	✓			
Excise tax on oil products	✓	✓		
Excise tax on electricity	✓	✓		
Excise tax on natural gas	✓	✓		
CO_2-based vehicle registration tax on new cars	✓	✓		
Technical Code of Buildings (CTE)		✓	✓	
Subsidies on building refurbishment		✓		
Energy labeling for appliances		✓		
Subsidies for replacing inefficient cars		✓		
Speed limits		✓		
Incentives to R&D on energy and climate change			✓	✓
Subsidies for investments in equipment for anaerobic digestion			✓	✓
Tax on CO_2, SO_x and NO_x emissions in Andalucia	✓	✓	✓	

1.2 Detailed description of instruments within each policy landscape

1.2.1 Carbon Pricing

European Union Emission Trading Scheme (EU ETS)

In 1997 the EU committed under the Kyoto Protocol to reduce 8% of GHG emissions by 2008-2012 compared to 1990 levels. The EU ETS was adopted, as one of the main instruments, to enable the EU to meet its Kyoto targets. The ETS was established to reduce GHG emissions from power generators and energy-intensive industrial sectors, which accounted for close to half of the total CO_2 emissions. The system works by putting a limit on emissions by emitters, which companies can buy or sell emissions as needed. This instrument provides companies the flexibility to cut their emissions in a cost-effective way. The EU ETS was structured in 4 phases. The first phase (2005-2007) began on January 1, 2005, and was considered as a learning period. In this first period, the number of allowances allocated in the market was excessive. This and the political uncertainty led the price of allowances to fall to zero. In addition to the EU Member States, the second phase (2008-2012) included Iceland, Norway and Liechtenstein. The second phase was characterized by the economic downturn, which affected negatively industrial activity. This led to an excessive number of permits, even when these had been reduced by 6.5% compared to previous period.

Currently, the EU ETS is in the third phase (2013-2020). In addition to power generators and energy-intensive industrial sectors, the commercial aviation sector has been included in the trading system. The system operates in the 27 EU Member states plus Croatia, Iceland, Liechtenstein and Norway. In total, more than 11,000 installations are covered, which account for around 45% of total emissions. Regarding greenhouse gases, not only CO_2 is included in the system, but also N_2O from the production of certain acids and PFCs from aluminium production.

From 2013 onwards, the emission cap will be reduced by 1.74% each year. However the main change of the third phase will be the progressive shift towards auctioning of allowances in place of cost-free allocation. Power generators will have to buy all their allowances, while industrial sector will receive 80% of its allowance for free. This value will decrease progressively to 30% in 2020. Although some Member States that joined the EU after 2013 will receive free allowances, in total, more than 40% of allowances will be auctioned in 2013. The Commission stipulates that half of auctioning revenues should be used to combat climate change. Member States have to inform European Commission on how revenues are used.

Regarding the penalties associated to the EU ETS, there is a fine for each excess ton of greenhouse gas emitted (€100 per ton of CO_2 or the equivalent amount of N_2O and PFCs). However, Member States can choose between criminal or administrative penalties and

provides flexibility to implement a system of penalties that best fits with their national legal systems.

The Joint Implementation (JI) and the Clean Development Mechanism (CDM) are two instruments which provide additional flexibility to the EU ETS. In the first case, Member States can invest in any country as an alternative to reducing emissions domestically. In the second case, Member States can meet their domestic emission reduction targets by buying greenhouse gas reduction units from non JI countries, mostly developing countries.

In Spain, the EU ETS affects around 1,100 installations, which account for around 45% of total GHG emissions. In contrast to the EU average commitment, in Spain the Kyoto Protocol establishes a 15% increase in GHG emissions by 2008-2012 compared to 1990 levels. The scheme is administered by the Ministry of Agriculture, Food and Environment.

Allowances will decrease annually leading to a 21% reduction of GHGs in the EU ETS sector by 2020, compared with 2005. In 2021 the fourth phase will began (2021-2028). In this phase, it is expected that all allowances will be auctioned. The EU is looking to link the EU ETS with compatible schemes in other countries.

Under a 'cap and trade' system the number of emission permits is set at EU level. Thus, the EU ETS ensures that a certain quantity of emissions will be reduced in the covered sectors. By capping overall emissions, companies sell or buy allowances according to their need and, thus, the system creates a 'carbon price'. The EU ETS can ensure a certain quantity reduction but it cannot provide any certainty about the price. Both short-run and long-run goals are set by the number of allowances allocated in the market in each period. Companies can make their decisions based on expected carbon prices. The EU ETS can lead to 'carbon leakage' if companies reallocate their production in other countries (there is no empirical evidence on this for Spain). In 2013 and 2014, 170 sectors and subsectors will benefit from free allocation of allowances to avoid 'carbon leakage'.

Creating a market price, the EU ETS provides companies the flexibility to achieve emission goals in a cost-effective way. However, the criticism has arisen in two issues: "windfall profits" and "over-allocation" (Ellerman and Joskow, 2008). The former refers to the higher prices and consequent higher corporate profits that resulted from the free allocation of allowances. Secondly, the carbon price is influenced by the number of allowances allocated in the market. An excessive number of allowances may cause the price fall to zero (as it happened in the first phase 2005-2007). Economic growth and technological innovation are also other important price determinants[1]. All these factors generate price uncertainty, which arguably reduces the cost-effectiveness of this instrument in the medium/long-run. The JI and the CDM are two instruments related to the EU ETS, which provide additional flexibility to the system.

The directive on EU ETS was adopted by the European Parliament and Council in 2003. Companies must monitor and report their emissions. Their emission reports are checked by an accredited verifier. So far the EU ETS did not face important legal or administrative

[1] At the same time, carbon prices may also influence economic activity and technological innovation.

implementation barriers. From 2013 auctioning is the main method of allocating allowances. This and the inclusion of the aviation sector may cause come resistances of this policy[2].

Reduced subsidies for coal production

Subsidies for the coal industry began in the 1960's. The main objective was to maintain the economic competitiveness of domestic coal with respect to foreign coal and other energy sources. However, environmental damage from the production and use of coal led to a decrease in coal subsidies over time. With the entry into the EU, Spain had to cut coal subsidies. Since the early 1990s there have been four National Plans for the coal industry. The main objective of the Plans has been to reduce the subsidies for uncompetitive coal production, while protecting economically affected areas.

In Spain coal production has declined in recent years. In 2011, 6,586 thousand tons were produced, 21.9% less than in 2010 (MINETUR, 2012a). This trend is consistent with that observed in recent years. Despite a rebound in 2011[3], the demand has also declined gradually in recent years. In fact, coal has reduced its weight in electricity production from 38% in 2000 to 8% in 2010. Since 2007, several coal companies have closed, and currently only 15 companies are subsidized. Employment has also declined in the coal sector, from 5,251 employees in 2009 to 3,963 employees in 2011.

In 2005 the aid for coal mining companies amounted to €503 million; €61,200 per employee. However, Spain is reducing the aid provided to coal mining. In 2011, subsidies were reduced to around €380 million.

Council Decision 2010/787/EU stipulates the phase-out of subsidies for the production of coal from uncompetitive mines by 31 December 2018. The overall amount of closure aid granted by a Member State must follow a downward trend and, thus, Member States have to reduce their subsidies 25% below their levels in 2011 by the end of 2013; 40% by the end of 2015, 60% by the end of 2016 and 75% by the end of 2017.

Subsidies for coal production have a negative impact on GHG emissions. They reduce the final price for consumers and, thus, tend to encourage the use of coal. This is especially important in the power sector, where subsidies for coal make it more competitive. Eliminating subsidies for coal production may have important positive effects on GHG emissions. From 2005 to 2011 subsidies for coal sector decreased from €503 million to around €380 million, while coal production decreased from 6,626 Ktep to 2,287 Ktep[4].

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[2] In recent months there have been big pressure efforts from US/China and international aviation organisation.

[3] In 2011, the Spanish government establishes a quota on domestic coal for power generation. This led to an increase in consumption. The higher demand was mainly covered by existing stocks.

[4] Source: Institute of National Statistics (INE).

In Spain, the aid for coal production amounts to around €400 million. Eliminating subsidies implies significant savings for the budget of public administrations. At the same time, eliminating subsidies minimizes market distortions in the power sector. This instrument contributes to fix proper marginal abatement costs and thus improve the efficiency of the power sector.

It was the European Council who decided to eliminate subsidies for coal production by 2018. In Spain, the acceptance of this policy by the strong coal sector unions is very low. Coal production is focused in a small region in the north of Spain. In the absence of a proper policy to support local economy, it could lead to social unrest.

Excise tax on oil products

Spain´s entry into the EU implied a progressive adaptation to the EU directives. The Council Directive 92/12/EEC states on the general arrangements for products subject to excise duty and other indirect taxes except for VAT. Among the products covered by the directive are oil products. Thus, oil products are subject to the VAT and the excise tax. According to the Council Directive, the double taxation of oil products is justified by the social costs generated by its consumption, and not reflected in the final price. Spain levies excise taxes on oil products since 1993. However, there is not a mitigation objective behind energy taxes in Spain. Tax rates are not established according to CO_2 emissions. The main objective of this instrument is to raise tax revenues. In spite of this, energy taxes have been included within this landscape because of its significant indirect effect on carbon price.

Currently, the tax component (as a % of total price) in gasoline and diesel is 51.1% and 44.5% respectively (MINETUR, 2012b). In addition to the excise tax, oil products are also subject to 21% VAT. Thus, the excise tax represents around 30.1% of the final price in gasoline and 23.5% in diesel. Notice that the VAT is fully refunded for industry, electricity generation, and automotive diesel use for commercial purposes.

Fuel is relatively cheap in Spain compared to other European countries because of low excise taxation. In November 2012, Spain had the fourth-lowest petrol prices and the third-lowest diesel prices in the EU27 (MINETUR, 2012b).

Despite the low excise taxation on oil products, these represent the 64% of total environmental taxes in Spain. Nevertheless, it should be noted that Spain has the lowest environmental taxes (as a % of GDP) in the EU27 (CES, 2012).

In 2012, the VAT increased from 18% to 21%, and consequently the price of oil products was affected. In the draft law announced by the Spanish Government in September 2012, new energy and environmental taxes were presented; however, there was not mention to an increase in the excise tax on oil products. However, considering the “tariff deficit” problem, an increase in the excise tax on oil products cannot be discarded. Some utilities are indeed defending to increase the excise tax on oil to confer part of the “tariff deficit”.

In contrast to tradable permits, a tax on fossil fuels does not ensure a particular level of emissions. In Spain, this tax was introduced to raise revenues, regardless of the environmental impact. Although they do not levy GHG emissions directly, taxes on fossil fuels

are considered to be effective, at least on the long-run. Labandeira et al (2006) estimate that the price elasticity of car fuels is -0.11 for Spanish households in the short run.

Taxes provide the flexibility to adopt cheap abatement options and, thus, they are considered cost-effective (static efficiency). They also encourage investment in low-carbon technologies, which lower abatement costs in the future (dynamic efficiency). González-Eguino (2011) shows that a tax on oil products is not as cost-effective as a tax on GHG emissions, however it is better than a tax on electricity. He estimates that, for a 15% emission reduction, the utility loss of a tax on oil is four times lower than a tax on electricity.

In Spain, energy taxes are adapted to the European legislation, which establish minimum requirements for each energy source. Compared to GHG emissions tax, energy taxes have lower cost of monitoring. The main obstacle for energy taxes is that they have negative distributional consequences (IPCC, 2007). However, Labandeira and Labeaga (1999) state that energy taxes in Spain are less regressive than in other European countries.

Excise tax on electricity

As with the excise on oil products, in 1993, Spain included an excise tax on electricity production to adapt domestic taxation to the EU directives. According to the Council Directive 92/12/EEC, the double taxation of electricity was also justified by the social costs generated by its production, and not reflected in the final price. Currently the excise tax rate is 4.864% of the final price (excluding the VAT[5]). The electricity production under the feed-in tariff regime[6] is not subject to this tax. The tax rate is not established according to CO_2 emissions. The main objective of this instrument is to raise tax revenues.

In addition to this excise tax, the Spanish government announced in September 2012 a new tax on electricity production, which will take effect in 2013. The taxable event is the sale of electricity produced. The taxable amount is the revenue received by electricity generators from the sale of electricity. The tax rate is unique, 7% of the revenues, and paid by electricity generators. All technologies are included; there is no distinction between renewable and non-renewable energy sources.

The main objective of this new tax is to reduce the huge tariff deficit that the government owes to the utilities (the so-called “deficit tarifario”), estimated at €25 billion in May 2012. Spain has traditionally capped end-user prices of electricity to several consumer groups under a regulated tariff system. The government sets the regulated price and thus increases in the price have a political cost. With the generation costs rising faster than the tariff in the past several years, this system has created this tariff deficit.

It is not sure that this new tax can offset past deficits and, therefore, further increases in the coming years cannot be rejected.

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[5] In 2012 the VAT increased to 21% for all end users.

[6] Feed-in tariff regime covers renewable sources of electricity. For more information, this instrument is described in section 1.2.3.

The excise tax on electricity does not have an environmental goal. Therefore, its environmental effectiveness is very unlikely. Moreover, the new tax on electricity does not differentiate between energy sources. Thus, the tax rate for renewable electricity is the same as for other technologies. On the other hand, higher electricity prices may lead to improve energy efficiency in some sectors such as households. However, as pointed out by Labandeira et al (2012), price elasticity in the short run is very low in Spain. It is calculated for different consumers and they find that the price elasticity of electricity is -0.25 for households, -0.03 for companies and -0.05 for large consumers.

Taxes on GHG emissions are considered cost-effective, from both the static and the dynamic point of view (OECD, 2009). However, the effectiveness decreases when energy sources are levied instead of emissions. González-Eguino (2011) states that mitigation costs are higher for those energy sources that are more distant from the pollutant to be controlled (CO_2). He finds that a tax on electricity would increase mitigation costs considerably in Spain. He estimates that, for a 15% emission reduction, the utility loss of a tax on oil is four times lower than a tax on electricity.

The high penetration of renewables on the electricity mix has increased considerably production costs. A new tax on electricity will lead to higher prices, which are capped by the government to several consumer groups. Thus, these initiatives are very unpopular and have a high political cost. An excise tax on electricity also may affect the competitiveness of some industrial sectors. This instrument is administered by the Ministry of Industry, Energy and Tourism

Excise tax on natural gas

In addition to the new tax on electricity production, the Spanish government announced an excise tax on gas consumption, which will take effect in 2013, too. Currently gas consumption is only subject to the VAT, which represents 21% of the price for all consumer s. In the draft law, it was announced that the excise tax on gas consumption will be €1.15 GJ[7].

The excise tax on gas consumption has been announced as an environmental tax ("centimo verde"). However it is unknown whether the revenue from this new tax will be used for environmental issues or to reduce the tariff deficit in the electricity sector.

This new tax may be important given that the weight of gas consumption in the energy mix has grown in recent years. In 2010, gas consumption accounted for 23.5% of total primary energy consumed in Spain. This value is much higher than in 2001, when gas consumption accounted for 12.8% of primary energy. The importance of gas consumption has also increased in the electricity mix. In 2010, 23% of the electricity was produced using gas, while ten years ago the weight of gas on the electricity mix was insignificant (CNE, 2011). The new tax will also be applied on electricity production and, thus, the excise tax on gas consumption may have a direct impact on the electricity price.

[7] The tax will be €0.15 GJ when the natural gas is used for commercial purposes, excluding electricity generation.

The new tax on gas consumption has been included in a draft law and, therefore, more detailed information will be available in the coming months. However, no important changes are expected.

The new tax on gas consumption was announced as an environmental tax. However, similarly to the excise tax on oil products, it is unclear whether the tax rate was set according to GHG emissions. González-Eguino (2011) finds that a tax on natural gas has not environmental effects, since it is substituted by oil products and coal, which are more polluting. Labandeira et al (2006) estimate that the price elasticity of natural gas is -0.05 for Spanish households in the short run.

As mentioned above, taxes on GHG emissions are considered cost-effective. When energy products are taxed, they should be charged according to their GHG emissions. As argued by González-Eguino (2011), a unique tax on natural gas may lead to a higher consumption of oil and coal, increasing mitigation costs considerably.

Unlike electricity, natural gas price is not capped by the government to most of the consumer groups. Most of households face a market price that is not regulated by the government. Price increases are not perceived as political decisions and thus the political cost is lower. However, significant increases in prices can be very unpopular and lead to political consequences. Besides an excise tax on gas consumption can raise electricity price and it can also affect the competitiveness of some industrial sectors. This instrument is administered by the Ministry of Industry, Energy and Tourism.

CO_2-based vehicle registration tax on new cars

In 2008, the registration tax on new cars was modified. Before this date, vehicle registration tax was charged based on the size of the engine and, therefore, GHG emissions were not considered. Although, there may be some correlation between the size of the engine and GHG emissions, the tax could be improved given that the objective was to combat GHG emissions.

Thus, from 2008 onwards, registration tax on new cars is based on CO_2 emissions[8]. The tax rate is calculated according to the average CO_2 emissions per kilometre. The tax rates are shown in Table 2.

Table 2. Vehicle registration tax rates in Spain, 2008

CO_2 emissions g per km	Tax rate (%)[9]	Tax rate in Canary Islands
<120	0	0
≥120, <160	4.75	3.75

[8] Registration tax is only paid once, when the vehicle is purchased.

[9] The tax rate is applied to the final cost of new vehicles.

≥160, <200	9.75	8.75
≥200	14.75	13.75

Source: Ministry Agriculture, Food and Environment

The objective is to reduce CO_2 emissions in the transport sector and to promote energy efficient vehicles.

The tax rates shown in Table 4 are the minimum established by the central government; however each Spanish region can increase these values[10]. It is not expected any change in the tax rates in the coming years.

In contrast to previous legislation, from 2008 vehicle registration tax in Spain is based on CO_2 emissions (CO_2 g/km) rather than engine size. This tax establishes a price signal, promoting lower-emissions cars. There is not empirical evidence on its environmental effectiveness. However, given that this tax does not disincentive the use of cars, its impact should be limited.

The static efficiency of this tax may be low, given that it does not provide a proper incentive to reduce emissions. However, the new system may induce to a higher level of innovation and diffusion of low-emissions cars. Thus, the dynamic efficiency can be high. However there is no empirical evidence on this.

As mentioned above, this instrument is managed by the Ministry of Industry, Energy and Tourism, and regional authorities. This tax is subject to new vehicles and, thus, the administrative burden for compliance is low. Its implementation is not difficult.

Tax on CO_2, SO_x and NO_x emissions in Andalucia

The development of environmental taxation in Spain has been very slow. Actually, Spain has the lowest environmental taxes (as a % of GDP) in the EU27. In 2009 environmental taxes only accounted for 1.6% of GDP; In EU27 they represent on average 2.4% of GDP. Most of the initiatives to tax environmental damages have been developed in a regional level. The Spanish region of Galicia was a pioneer in this matter. Although Galicia was the first Spanish region to tax gas emissions (SO_x and NO_x), the scope of Andalucia's legislation is much wider. In 2003, the regional government of Andalucia approved a tax on CO_2, SO_x and NO_x emissions. Similarly to Galicia, the poor environmental taxation by the Spanish central government led the regional government of Andalucia to include a tax on atmospheric pollution.

The main objective of this instrument is to reduce CO_2, SO_x and NO_x emissions. Industrial installations are subject to this tax. Nevertheless those installations that participate in the EU ETS are not subject to the tax on CO_2 emissions. Waste management, agricultural installations

[10] Significant differences are not observed among regions.

and biomass combustion are also exempt of these taxes. Revenues are used for environmental purposes such as the protection of natural areas. Around €4 million were raised in 2011.

The tax rate varies progressively according to the level of emissions. Current tax rates are shown in table 3. A unit is equivalent to 200,000 ton of CO_2, 100 ton of NO_x and 150 ton of SO_x.

Each installation must report total emissions based on estimation methods adopted by the environmental department of the government of Andalucia. This department is responsible for the verification of emissions. Specific penalties are not considered in the law.

Table 3. Tax rates on CO_2, SO_x and NO_x emissions in Andalucia

Emissions	€/unit
Less than 10 units	5,000
From 10 to 20 units	8,000
From 20 to 30 units	10,000
From 30 to 50 units	12,000
More than 50 units	14,000

Most experts claim the necessity of harmonizing environmental taxation among Spanish regions. However, it is not expected any change in the coming years.

In the absence of a common taxation in Spain, the effectiveness of regional taxes is limited. Labandeira et al (2006) argue that regional tax rates are not high enough to have a significant impact on emissions. However there is no empirical evidence on this fact.

A tax on CO_2 emissions is considered cost-effective. Companies can adopt the most cost-effective measures to reduce CO_2 emissions. As mentioned above, regional taxation in Spain is not high enough to reduce significantly emissions (Labandeira et al, 2006).

Regional taxes are not easy to implement. They must be compatible with the EU and the Spanish legislation. Regional taxes would have to be abolished to avoid double taxation, if they are imposed also at a national level. Besides, they cannot overlap those sectors and emission sources covered by the EU ETS. Although there is not empirical evidence, higher tax rates may lead to 'carbon leakage' if companies reallocate their production in other regions.

1.2.2 Energy Efficiency and Energy Consumption

The EU ETS, energy taxes, CO_2-based vehicle registration tax and emission taxes in Andalucia are discussed in the carbon pricing landscape.

Technical Code of Buildings (CTE)

In 2006, the Technical Code of Buildings (CTE) replaced the old building normative approved in 1979. The CTE adapts Spanish regulatory framework in buildings to the EU legislation, specifically to that related to construction materials (Directive 89/106/CEE) and energy efficiency (Directive 2002/91/CE). The CTE establishes the minimum energy requirements for new buildings. The objective of the code was to address the problem of GHG emissions in buildings, which account for around 40% of GHG emissions in Spain[11].

Energy requirements vary according to the 12 climate zones in the country. CTE includes requirements for energy efficiency and the use of renewable energy (minimum efficiency performance, standards for thermal installations and lighting; minimum natural lighting contribution; as well as a minimum level of solar contribution to power and domestic hot water supply).

Once the building is completed, a certificate must be submitted to the competent public authority. The law does not establish penalties for non-compliance. This instrument is mandatory and the penalty for non-compliance is the non-issuance of the building permit.

If this regulation had been in place during the housing bubble in 2001-2008 huge amount of emissions would have been avoided in the future. In the coming years the CTE will be adapted to the EU directives and more specifically to the Directive 2010/31/UE, related to energy efficiency in buildings.

In Spain, the environmental effectiveness of this instrument is expected to be very low in the coming years. The Technical Code of Buildings is in place since 2006, when the housing bubble was ending. Since then, very few new buildings have been constructed and old buildings are not subject to the new Code.

The CTE establishes technological standards, and therefore, does not provide the flexibility to adopt cheap abatement options. Command and Control instruments do not achieve marginal abatement cost equalization (OECD, 2009); their static efficiency is low. At the same time, fixing some technological standards, the incentives to develop new and more effective technologies are small (dynamic efficiency). However, considering the landlord–tenant dilemma present in the investment decision in the building sector, a technology standard could be a good “second best” instrument.

The Spanish CTE is adapted to the EU legislation on buildings. Its acceptance is high, given that the costs are not visible to households. The compliance of this instrument requires technical staff. The Ministry of Public Works is responsible for compliance.

Subsidies on building refurbishment

Subsidies for domestic building refurbishment were included within the National Plan of Housing and Refurbishment 2009-2012. This Plan was adopted in 2008, when house prices

[11] Indirect emissions are included.

were at their highest level and at the beginning of the financial crisis. Thus, the main objective of the Plan was to facilitate access to housing to all citizens. In this context, the subsidies on building refurbishment were established as an instrument to reduce energy poverty.

However the main objective of these subsidies has changed over time. In the final version, two different goals are addressed. First, after the housing market crash, very few buildings have been constructed and, therefore, the effectiveness of the Technical Code of Buildings has been very small. Thus, refurbishment of old buildings was the only way to improve energy efficiency in this sector. And second, refurbishment was meant to improve economic activity and reduce unemployment in this sector.

The subsidies were in place between 2009 and 2012. During this time, the requirements and the total amount subsidized have changed. In the last version, 20% of the expenses for improving energy efficiency in buildings were subsidized[12]. The total amount granted could not exceed €6,750 annually per household. The Plan ended on December 31, 2012, and it is not expected to be launched again.

There are no studies about the attainments of the National Plan of Housing and Refurbishment 2009-2012. Subsidies were subject to energy efficiency improvements and, consequently, it is expected that some emission reductions were achieved. However, energy efficiency was not the only goal of the Plan and, therefore, its effects could be limited. Besides, energy efficiency improvements may imply some rebound effects.

The Plan did not establish a quantitative objective on emission reductions. Most of the requirements were technology standards. In the absence of a clear objective and the flexibility to achieve that objective, the cost-effectiveness is uncertain. This instrument may stimulate the diffusion of energy-efficient technologies, therefore implying some dynamic efficiency.

Subsidies, in general, are popular and have positive distributional effects. On the other hand, they imply high administrative burden for compliance. This instrument is administered by Ministry of Public Works.

Energy labelling for appliances

In early 1990s the European Union set the Directive 92/75/ECC to harmonise national measures regarding the information on energy consumption of household appliances. Since then, Spanish legislation has been adapted to European legislation. From the beginning the main objective of energy labelling for appliances was to provide consumers with information on energy efficiency. This instrument, which is mandatory, is meant to address information barriers. Differentiating appliances for their energy efficiency helps households choosing products which save energy and thus money. The higher cost of energy efficient appliances can be offset by lower energy consumption in the future. Energy labels also provide incentives to the industry to develop and invest in new technology.

[12] The requirements are very wide and thus subsidies can be obtained from the installation of thermal envelopes to the installation of solar panels.

Energy labels contain accurate information regarding energy consumption and other essential resources during use. Thus, appliances[13] are classified into categories according to their energy efficiency; both letters and colours are used for the classification. At the beginning appliances were classified from A (green) to G (red), where class A (green) is for the most energy-efficient appliances. Since then, new advances in energy efficiency have required three new grades for some appliances[14]; A+ and A++ in 2004, and A+++ in 2010.

The last European directive on energy labelling for appliances was launched in 2010 (Directive 2010/30/EU). This directive requires that energy labels use pictograms rather than words. In the coming years, no further changes are expected.

Galarraga et al (2011, 2012) find that the price premium paid for energy efficient appliances (dishwashers, fridges and washing machines) in Spain can be between 8 and 20% of the final price. This result can provide a hint about the effectiveness of energy labelling in appliances. Well informed consumers make better choices and they are willing to pay extra-cost for energy efficient appliances. However, the overall effectiveness of this instrument is difficult to assess. The purchase of energy efficient appliances may reduce the energy demand but it can also lead to rebound effects.

Both the costs and the effectiveness of this instrument are difficult to calculate. There is no empirical evidence on this instrument for Spain. Thus, it is difficult to provide a cost-effective assessment. On the other hand, it can be considered dynamically efficient as encourages innovation and cost reduction in more efficient products.

This instrument is regulated by European directives and administered by the Ministry of Industry, Energy and Tourism in Spain. Information instruments are well accepted by the public. The administration burden is small. However, there can be resistance by industry, which are force to improve technological standards.

Subsidies for replacing inefficient cars

In February 2013, the Spanish government launched a plan for replacing inefficient cars, which is called Plan PIVE 2. The new Plan is a continuation of Plan PIVE, which was in place for six months in 2012. The characteristics of both Plans are very similar. The new Plan will be in place for one year, until February 2014.

The objective of the Plan is to replace old cars with new more energy efficient cars. The old car must be more than 10 years old for private cars and 7 years old for commercial cars. The new car has to meet certain energy efficiency characteristics[15]. The replacement of the old car will be granted with €1,000.

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[13] Fridges and freezers, washing machines, dishwashers, tumble driers, washing machines, driers, household lighting, electric ovens and air-conditioning.

[14] Fridges and freezers, washing machines, dishwashers.

[15] In general, the new car must have an energy category A or B.

The budget of the Plan is €150 million. The aim of the Plan is to substitute 150,000 cars. According to the Ministry of Industry, Energy and Tourism, this should imply a saving of 78 million litters of fuel every year or, similarly, 500.000 oil barrels.

The Plan has been addressed to reduce energy consumption in the transport sector and, thus, reduce CO_2 emissions. At the same time, it seeks to boost production in the automotive industry, a key sector for Spanish economy.

The Plan is administered by the Ministry of Industry, Energy and Tourism and the Institute for Energy Diversification and Saving. It is unknown whether it will be replaced with a new plan when concluded.

In some cases, market-based instruments are not enough to promote energy efficient technologies. This is because of market failures, such as financial barriers. The subsidies to purchase energy efficient technology are meant to solve this problem. The Plan PIVE 2 aims to replace 150,000 energy inefficient cars. The Ministry of Industry, Energy and Tourism calculates that this measure will save around 500,000 oil barrels and avoid 262,000 tons of CO_2 per year.

There is no empirical evidence of the cost-effectiveness of this instrument in Spain. The budget of the Plan is €150 million and, according to the Spanish government, is supposed to reduce 262,000 tons of CO_2 per year. For an overall assessment, it would necessary to know how long this measure will affect total emissions. This instrument can contribute to the innovation and diffusion of low-emissions cars, reducing abatement costs in future. Thus, the dynamic efficiency can be high.

Subsidies are, in general, well accepted by the general public. In this case, automotive industry is particularly benefited, because it encourages car sales. There could have been pressures from this sector to launch the Plan. This instrument is administered by the Ministry of Industry, Energy and Tourism.

Speed limits

In March 2011, the Spanish government lowered the speed limit from 120 km/h to 110 km/h. The main objective of the measure was to reduce energy consumption. Two factors led the Spanish government to adopt this measure; the economic crisis and high oil prices. Thus, there was not a direct environmental goal. The government considered that the measure could generate benefits to the Spanish economy. This measure was in place only for four months, but created a long debate about the effectiveness of this instrument.

Although the measure adopted by the Spanish government was not meant to address environmental problems, some policy makers have considered this measure as an instrument to reduce pollution. This measure has been adopted occasionally and temporally in some big cities such as Barcelona to reduce pollution.

It is not expected that this measure will be adopted again. Instead, in December 2012, the Spanish government announced the possibility of increasing the speed limit from 120 km/h to

130 km/h or 140 km/h. If the speed limit is increased, there could be important consequences on GHG emissions.

After the first month, the Spanish government announced that seasonally adjusted fuel consumption decreased 8.4% compared with the previous year (MYTIC, 2011). EEA (2011) states that, reducing speed limits from 120 km/h to 110 km/h, fuel consumption could be reduced 12-18% in an optimistic scenario and 2-3% in a more realistic scenario. IEA (2009) state that the most efficient speed for most cars is between 60 km/h and 90 km/h; above 120 km/h fuel efficiency is reduced significantly.

The main cost caused by this measure is the longer time spent in the road. On the other hand, it reduces traffic accidents and fuel consumption. IPCC (2007) considers speed limits below 120 km/h as a potential cost-effective measure.

This instrument does not imply a high legal and administrative burden. The main problem was the low acceptance by all motorists. This instrument was implemented by Ministry of Industry, Energy and Tourism.

1.2.3 Promotion of Renewable Sources of Energy

The EU ETS and emission taxes in Andalucia are discussed in the carbon pricing landscape. The Technical Code of Buildings is discussed in the energy efficiency landscape.

Feed-in Tariff for Renewable Energy Sources (FIT-RES)

A feed-in tariff (FIT) regime (called the “special regime”) has been in place for renewable sources of electricity (RES) since 1997. The owners of the distribution networks are obliged to purchase all the electricity supplied by generators in the special regime. Special-regime companies can also decide to take part in the wholesale market, where they receive a premium over the market price[16]. Either way, the goal is to reward energy produced from renewable sources at a price that guarantees the generating facilities are run profitably. Those installations with a capacity higher than 50 MW are not eligible for price premiums. The premium is payable over the complete useful life of the asset used in generation, in contrast to other countries where eligibility is set at a fixed number of years. The tariffs are recouped through a supplement on consumers’ electricity bills that is proportional to their overall electricity consumption.

The main objective of this instrument is to increase electricity production from renewable sources, and thus, to meet the target set by the EU, which states that Member States should reach a 20% share of energy consumption from renewable sources by 2020.

[16] In February 2013, the Spanish Government abolishes this alternative. Now RES generators can only sell to the distributor and a fixed tariff is received.

While Spanish FIT-RES has been successful in increasing the supply of renewable energy (Spain is one of the world leaders regarding installed capacities), the cost-effectiveness of the measures depends on the technology analysed. In terms of primary energy consumption the share of renewables increased from 6.3% in 2004 to 11.6% in 2011. This value is close to the intermediate target of 12% established by the Spanish government for 2010 (IDAE, 2011).

Table 4 shows the premiums paid by different technologies in 2008 (IEA 2009)[17].

Table 4. Feed-in Tariffs for RES in Spain, 2008

	Fixed price	**Market price**		
(cent€/kWh)	Average tariff	Average premium	Average market price	Total average remuneration
Solar PV	32			
Solar Thermoelectric	27.84	26.45	6.83	33.28
Wind	6.88	2.41	6.16	8.57
Hydroelectric	8	2.2	6.42	8.62
Biomass	10.52	4.84	6.53	11.37

Source: IEA (2009)

Spain has traditionally capped end-user prices of electricity to several consumer groups under a regulated tariff system[18]. With the generation costs rising faster than the tariff in the past several years, this system has created a huge "tariff deficit" that the government owes to the utilities, estimated at €25 billion in May 2012. This has led the government to gradually reduce the eligibility for the tariff.

This instrument has been administered by the Ministry of Industry, Energy and Tourism. In January 2012, by the Royal Decree-Law 1-2012, the Spanish government suspended the premiums for those installations that come into operation after 31st December 2012. It is not expected that premiums will be restored in the coming years. The Royal Decree-law 2/2013, launched in February 2013, impedes RES generators sell to the electricity market and receive the market price plus a premium. From now on, generators can only sell to the distributor and receive a fixed tariff. Besides, annual tariff updating will not be tied to the CPI but to the core CPI.

Spanish FIT-RES has been successful in increasing the supply of renewable energy, particularly wind electricity (del Río, 2008). Currently, renewable electricity plants produce more than 20% of the total electricity demand. In 2004, renewables represented 6.3% of primary energy consumption, while in 2010 the share was 11.3%. The price premium has been high enough to incentive the production of renewable electricity. IDAE (2012) calculates

[17] More detailed and updated values can be found in Annex III.

[18] Those consumers with an installed capacity lower than 10 kW can benefit from the regulated tariff.

that renewable energy sources avoided 34.3 Mt CO_2 emissions in power generation in 2010[19]. Although the fixed tariff is payable over the complete useful life of the asset used in generation, the recent changes introduced by the Spanish Government have increased the uncertainty about the scheme. This can undermine the effectiveness of this instrument.

The large development of wind and particularly solar energy has come at a non-negligible monetary cost. While wind energy has been produced in large amounts, solar energy has received high price supports (Gelabert et al, 2011). This has meant that renewables represent a large portion of electricity production and, thus, the final cost has increased considerably in the last years. The cost-effectiveness varies depending on the technology analysed. While this instrument has not been statically efficient, it is dynamically efficient as it encourages dissemination of technologies to abatement costs in the future. Table 5 summarize the CO_2 emissions avoided and the extra cost generated by the key technologies in 2010.

Table 5. Emissions avoided and the extra cost of renewables in 2010

	Mt CO_2 avoided[20]	Extra cost (€ millions)[21]
Solar PV	2.5	2,652
Wind	17.1	1,965
Hydroelectric	12.7	0,296

Source: IDAE (2012)

FIT-RES has several political feasibility problems. It is a costly instrument, and can affect competitiveness. In Spain, electricity prices are capped for several consumer groups and, thus, the higher production costs have not been reflected in the final price, generating the huge tariff deficit. Now, there exists the need to increase prices for final consumers and to pay the debt to utilities. Thus the acceptance of this instrument by consumers and utilities has declined. This instrument is administered by the Ministry of Industry, Energy and Tourism.

Economic incentives to R&D on energy and climate change

Most of the economic incentives to R&D on energy and climate change are included within the National Plan for Scientific Research, Development and Technological Innovation. The first plan was launched in 1988, and they are usually in place for four years. The last Plan was scheduled for the period 2008-2011; however it was prolonged to 2012. The general objective of this Plan is to promote R&D in strategic sectors of the economy.

In the last plan, energy and climate change were included as one of the strategic activities. Within this research area, the following objectives were established: Promote innovation in

[19] Avoided emissions versus combined-cycle power generation plants using natural gas.

[20] Avoided emissions versus combined-cycle power generation plants using natural gas.

[21] Total payments minus the power generated multiplied by the average market price.

those technologies that use local and renewable resources, promote innovation in energy efficient technologies, encourage private sector investments and improve knowledge dissemination. Buildings and transport are identified as key sectors in which energy efficiency is essential.

Public funding covers the energy R&D path from basic and applied research to pilot and demonstration projects and to facilitating market entry. Public funding comes in two forms: loans and subsidies. The loans are interest-free, with a maximum payback period of 15 years. Subsidy levels are limited by the EU state aid rules and they vary according to the size of the enterprise in charge of the project. Subsidies on applied research projects are capped at 50% of eligible cost for large enterprises, 60% for medium-sized ones and 70% for small ones. Subsidies on demonstration projects are capped at 25% of eligible cost for large enterprises, 30% for medium-sized ones and 40% for small ones. In specific cases, higher subsidy levels can be applied.

In 2011, €76.2 million were budgeted for the R&D on energy and climate change. 60% of the budget was used to finance projects in large firms, while the rest was used to finance projects in small and medium firms. Most of the funding was in the form of loans (85%) while subsidies accounted for around 15% of the budget. Most of the loans and subsidies were managed and decided by the Ministry of Economy and Competitiveness, although regional authorities are also involved.

According to the IEA database, R&D government spending on energy technology have decreased considerably in recent years. In 2008, R&D subsidies accounted for €87.1 million, while in 2011 they fell to €64 million. In terms of GDP, R&D spending has decreased from 0.008% in 2008 to 0.006% in 2011. Most of the spending is used to support nuclear and renewable energy sources. These technologies represent 47% and 41% of total spending, respectively. Among renewable sources, solar energy and biofuels receive most of the support.

In early February the Spanish government launched the new National Plan for Scientific Research, Development and Technological Innovation for the period 2013-2016. The new Plan does not include energy and climate change as strategic activities, and thus, the total resources budgeted in this area is unknown.

R&D is playing an important role in the evolution of energy sector. The rate at which low emission technologies improve will be determinant for climate change (IPCC, 2007). Despite its importance, the effectiveness of public R&D spending is uncertain. The literature on public incentives to R&D offers different views. However, IPPC (2007) concludes that national programs relating to R&D are essential to stimulate technology advances and thus to reduce GHG emissions.

Like environmental effectiveness, there is not a general agreement about the cost-effectiveness of this instrument. Some authors claim that, in absence of higher energy prices, research subsidies are the most expensive instrument to reduce emissions (Fisher and Newel, 2004). It can promote innovation and low-carbon technologies in order to lower abatement costs in the future (dynamic efficiency), but definitely it does not encourage static efficiency.

This instrument does not present major legal and administrative problems for implementation. Besides, it is generally accepted by the public.

1.2.4 Non-Carbon Dioxide GHGs

The EU ETS is discussed in the carbon pricing landscape. The incentives to R&D on energy and climate change are discussed in the promotion of renewables landscape.

Subsidies for investments in equipment for anaerobic digestion

This instrument is part of the Slurry Biodigestion Plan, which was adopted in 2008. The Plan was established to reduce GHG emissions in the agricultural sector, which represents around 10% of the emissions in Spain. In 2010, the agricultural sector accounted for 53% and 78% of total CH_4 and N_2O emissions, respectively.

The objective of the Slurry Biodigestion Plan is to reduce GHG emissions by slurry treatments based on the anaerobic digestion process, which allows the capture and quantification of biogas, and the subsequent energy recovery. The final objective is to avoid 1.78 Mt CO_2-e per year. Subsidies, which are voluntary, are allocated to purchase equipment for anaerobic digestion. Both small farms and centralize installations can obtain the subsidies. The subsidy per installation depends on the capacity of the installation (around €100/m3).

This plan has been in place during the period 2008-2012. The Plan was launched and managed by both the Ministry of Agriculture, Food and Environment and regional authorities. It is not expected to be launched again.

The Plan was launched to reduce 1.78 Mt CO_2-e per year or 8.9 Mt CO_2-e in the period 2008-2012. This implies 5% of total GHG emissions in the Spanish agricultural sector, which are mainly CH_4 and N_2O emissions. There is not an ex-post assessment of the Plan. It is difficult to assess the cost-effectiveness of this instrument, since there is no empirical evidence. The initial budget for this Plan was €40 million.

This instrument does not present implementation problems. Besides, subsidies are usually popular. It covers rural areas and, thus, contributes to its development.

1.3 Identification of interactions of instruments within each policy landscape

1.3.1 Carbon Pricing

Objectives

The EU ETS, the CO_2-based vehicle registration tax and the tax on CO_2, SO_x and NO_x emissions in Andalucia are the only instruments that have as their primary objective the

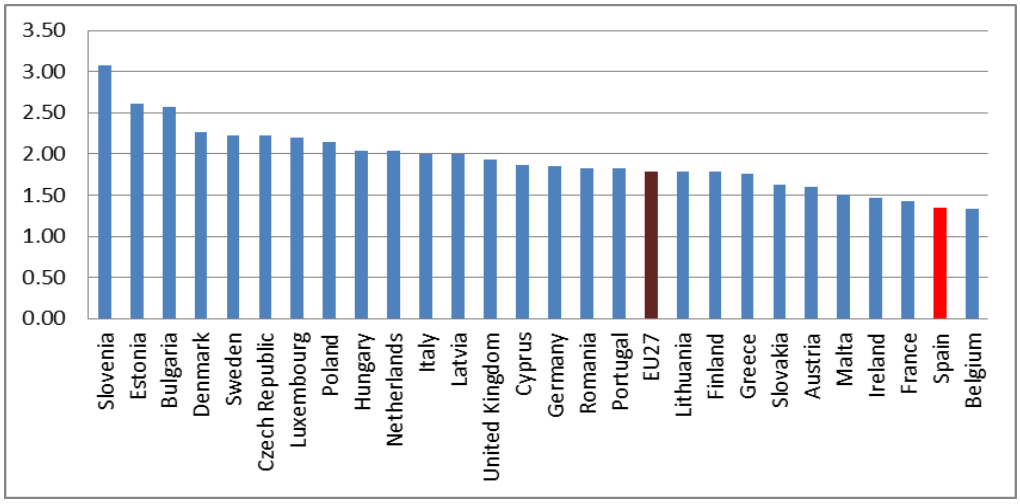
reduction of GHG emissions. They also share other secondary objectives such as the promotion of energy efficiency and the innovation in new technologies.

In Spain, energy taxes such as the excise tax on oil products, electricity and natural gas, do not have an environmental component. Consequently, energy taxes in Spain are very low compared to other countries in EU27 (Figure 1). Energy taxes were not designed to reduce GHG emissions, but to increase tax revenues. Indeed, the primary objective of the new taxes on electricity and natural gas, which were implemented at the beginning of this year, is to reduce the tariff deficit in the electricity sector.

However, they also affect energy prices and set, indirectly, a carbon price. Energy taxes discourage energy consumption and thus lead to a reduction in GHG emissions. They also promote energy efficiency and more efficient technologies.

The main objective of the subsidies for coal production is to maintain the economic competitiveness of domestic coal, but they also affect market prices. Indirectly, subsidies distort the price on carbon emissions, particularly in the electricity sector.

Figure 1: Energy tax revenues in 2010 (as percentage of the GDP)



Source: Eurostat

Scope and Coverage

The instruments within this landscape have different scope and coverage. Nevertheless they overlap in some sectors.

The most important interactions take place in the electricity sector. Electricity generators are covered by the EU ETS and total emissions are, therefore, capped. In addition to this instrument, in 2013 the Spanish government implemented a new tax on electricity production. The taxable event is the sale of electricity and has to be paid by electricity generators. The subsidies on domestic coal production also affect the electricity sector, given that coal is mainly used for electricity generation. Natural gas is another important source for electricity

generation in Spain. The new tax on the natural gas consumption may affect the share of the natural gas in the electricity mix and increase the final price of electricity.

Several industrial sectors covered by the EU ETS are also affected by energy taxes. Electricity, oil products and natural gas are, in some cases, important inputs in the production process. On the other hand, regional taxes such as the tax on CO_2 emissions in Andalucia cannot overlap with the EU ETS by law.

There is also an interaction between the excise tax on oil products and the CO_2-based vehicle registration tax in the transport sector. The registration tax incentives the purchase of energy efficient cars, while the excise tax on oil products discourages the use of vehicles.

Functioning and influencing mechanism of the instruments

It is unclear whether the instruments within this landscape have a mutually supportive relationship.

In the EU ETS, the trade of allowances creates a carbon price. This price should provide the incentives to reduce emissions in a cost-effective way. In those sectors covered by the EU ETS, other instruments such as energy taxes may distort carbon prices. This can make that the EU ETS function less effectively. Böhringer et al (2008) use a partial equilibrium framework to show how carbon taxes increase abatement costs for those sectors covered by the EU ETS. They conclude that emission taxes within the EU ETS are environmentally ineffective and all firms that are subject to emissions trading should be exempted from emission taxes. However, their analysis focuses on the static efficiency. Energy taxes may support the EU ETS to obtain secondary objectives such as innovation and the promotion of renewables. Higher energy prices may encourage energy efficiency and the innovation in new efficient technology. As mention above, in Spain energy taxes do not have an environmental component and therefore it is unclear whether they support the functioning of the EU ETS.

The subsidies for coal production clearly impede the functioning of other instruments, particularly in the electricity sector. The new tax on natural gas could have a very important and negative interaction with the coal subsidies. If the tax on gas is too high and the coal subsidies are not phase out at the necessary path, the merit of order of these technologies in the electricity market could be reversed. In Spanish electricity market gas-fired power plants are normally the marginal units, i.e. those that fix the price. If the gas becomes more expensive this order could be switched and the production displaced by coal-fired power plants. That would have a negative effect on GHG emissions, especially if these plants use domestic coal.

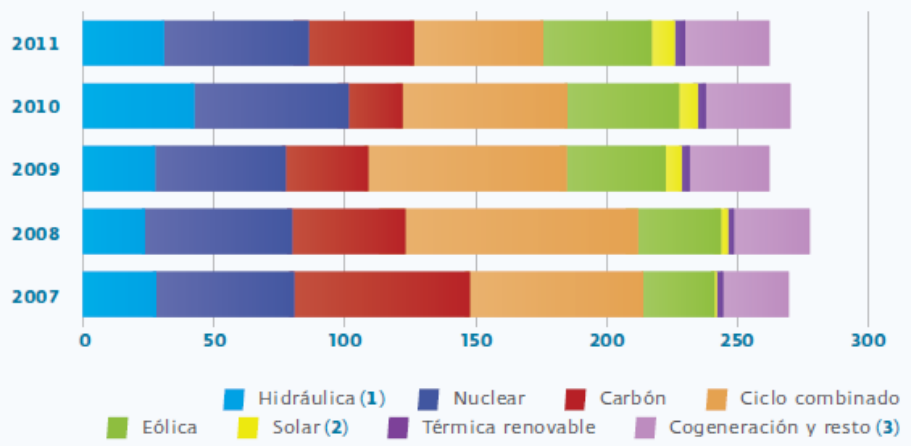
Indeed, this negative interaction has already started in 2011 just with the introduction of quotas on domestic coal. Table 6 shows a big increase in the consumption of coal for electricity production and also a big decrease in gas consumption. Figure 2 shows how the decrease in proportion of coal used in the electricity production peak in 2010 and start increasing in 2010.

Table 6. Primary Energy Consumption for electricity production by energy source (Ktep)

	2010	2011	%
Hydroelectric	3.046	2.172	–28,7%
Nuclear	16.155	15.024	-7,0%
Anthracite	93	1.936	1973,5%
Lignite	282	927	229,0%
Coal	4.548	6.808	49,7%
Gas Industrial	195	229	17,7%
Natural Gas	10.108	8.623	–14,7%
Oil	1.806	373	–79,4%

Source: MINETUR (2012b)

Figure 2. Primary Energy Consumption for electricity production by energy source (Ktep)



Source: REE (2012)

The future of this interaction will depend heavily on the phase-out of quotas and subsides on domestic coal (and also on the international price gas). However, it is clear that a tax on gas can induce a substitution by other fossil fuels that are more CO_2 intensive.

In the transport sector, it can be considered that there is a mutually supportive relationship between the excise tax on oil products and the CO_2-based registration tax. The registration tax incentives the purchase of energy efficient cars. While the excise tax on oil products discourages the use of vehicles.

Implementation Network/administrative Infrastructure

The EU ETS is a European instrument administered by the Ministry of Agriculture, Food and Environment in Spain. The EU also establishes a common tax structure and minimum levels on several energy products subject to excise duty and other indirect taxes. However, Member

States have freedom to set their own taxes. In Spain, the Ministry of Industry, Energy and Tourism fixes energy tax rates. In some cases, such as the CO_2-based vehicle registration tax, regional authorities can increase the tax rate.

1.3.2 Energy Efficiency and Energy Consumption

Objectives

As mentioned above, in Spain energy taxes were not designed to reduce energy consumption, their main goal is to raise fiscal revenues. Although energy taxes in Spain are not as high as in other European countries, they increase final energy prices and, therefore, incentivise energy efficiency and reduce energy consumption. The EU ETS provides the flexibility to meet emissions target in the most cost-effective way and thus it encourages energy efficient measures.

The subsidies both on building refurbishment and for replacing inefficient cars have two main objectives. First, improve energy efficiency in buildings and the transport sector, respectively, and secondly incentivise economic activity. In buildings, the Technical Code of Buildings was mainly implemented to increase energy efficiency in this sector and thus reduce emissions. Similarly, energy labeling for appliances is meant to promote energy efficient technology and reduce households' energy consumption.

The speed limit was temporally lowered because of economic reasons. The economic crisis and the high oil prices lead the Spanish government to reduce speed limits from 120 km/h to 110 km/h and thus decrease oil consumption and improve energy efficiency in driving.

Scope and Coverage

Most of the instruments specifically implemented to reduce energy consumption and increase energy efficiency are in those sectors not covered by the EU ETS. The target sectors of the Technical Code of Buildings, the subsidies on building refurbishment and energy labelling for appliances are buildings and households. Additionally, these sectors are also affected by the excise on electricity and natural gas consumption.

In the transport sector, different instruments also overlap. There are taxes such as the excise tax on oil products and the CO_2-based vehicle registration tax. Other instruments such as speed limits and the subsidies for replacing inefficient cars were implemented to reduce energy consumption in the transport sector.

The new taxes on electricity and on natural gas also affect electricity generation, which is covered by the EU ETS.

Functioning and influencing mechanism of the instruments

Even with high enough energy taxes, price signals often do not encourage energy saving and efficiency measures. This is often caused by market failures. Non-market based instruments are usually implemented to overcome these failures.

In buildings, the Spanish taxes on electricity and natural gas are not high enough to incentivise energy efficiency. The Technical Code of Buildings was implemented to improve energy efficiency in new buildings. However, after the housing bubble, few new buildings have been constructed and thus its effects have been limited. The subsidies for building refurbishment support the objective of the Technical Code of Buildings, although their scope is old buildings. The subsidies are used to overcome financial barriers that impede the functioning of price signals. Energy labeling for appliances is also used to overcome market barriers, in this case, information barriers. Thus, these measures support the functioning of energy taxes.

However, on the other hand, in order for energy efficiency measures to function properly energy taxes has to be high enough. Otherwise, there can be rebound effects. In Spain, energy taxes are not very high and impede the functioning of energy efficiency measures.

A similar analysis can be done in the transport sector. The subsidies for replacing inefficient cars can overcome financial barriers and thus promote energy efficient technology. However, in the absence of high enough gasoline and diesel prices, there can be rebound effects. In order to make this instrument function effectively, the excise tax on oil products should be higher.

Implementation Network/administrative Infrastructure

In Spain energy taxes are set by the Ministry of Industry, Energy and Tourism. Both the EU ETS and the energy labeling for appliances are European instruments; however the former it is administered in Spain by the Ministry of Agriculture, Food and Environment and the latter by the Ministry of Industry, Energy and Tourism.

The Ministry of Industry, Energy and Tourism is also in charge of the subsidies for replacing inefficient cars. The Technical Code of Buildings and the Subsidies on building refurbishment are managed by the Ministry of Public Works.

1.3.3 Promotion of Renewable Sources of Energy

Objectives

The promotion of renewable sources, particularly for electricity production, is the main objective of the FIT-RES. The use of renewable sources for energy production is a measure that the companies covered by the EU ETS can adopt to meet emissions target. Thus, these two instruments share common objectives. The economic incentives to R&D on energy and climate change were established to stimulate technological advances and thus promote renewable energy sources too.

Other instruments within this landscape, such as the Technical Code of Buildings and the subsidies for investment in equipment for anaerobic digestion, were implemented to promote the use of renewable energy sources.

Scope and Coverage

The FIT-RES system is mainly focused on the electricity generation, which is also covered by the EU ETS. The economic incentives to R&D on energy and climate change also promote renewable technologies in the electricity sector. However, as its target group is wider, any sector can benefit from the economic incentives to R&D on energy and climate change

The subsidies for investment in equipment for anaerobic digestion are meant to reduce emissions in the agricultural sector. Most of the emissions in this sector are CH_4 and N_2O emissions.

Functioning and influencing mechanism of the instruments

The EU ETS provides the flexibility to achieve emission goals in a cost-effective way. However, as mentioned above, the first two periods of the EU ETS have been characterized by an over-allocation of allowances and thus very low carbon prices. This can impede the achievement of other secondary objectives, such as the promotion of renewables. The FIT-RES may support the EU ETS to obtain this secondary objective. On the other hand, the FIT-RES contribute to reduce emissions in the electricity sector. This should decrease the demand and thus the price of ETS allowances. But since prices are determined at an EU level the effect will be very small.

The economic incentives to R&D in renewable technology can contribute to the functioning of the FIT-RES. Innovation can reduce the costs of renewable technology and make the system less costly. Similarly R&D can reduce abatement costs in those industries covered by the EU ETS.

Implementation Network/administrative Infrastructure

The EU ETS, the FIT-RES and the incentives to R&D in energy and climate change are the main instruments within this landscape, and they administered by different departments. The EU ETS is a European instrument managed by the Ministry of Agriculture, Food and Environment, while the FIT-RES and the incentives to R&D are managed by the Ministry of Industry, Energy and Tourism and the Ministry of Economy and Competitiveness, respectively.

1.3.4 Non-Carbon Dioxide Greenhouse Gases

There are not significant interactions of instruments within this policy landscape. This landscape is composed by two instruments: the EU ETS and the subsidies for investments in equipment for anaerobic digestion. While the EU ETS covers power generation and energy-intensive industry sectors, the subsidies for investments in equipment for anaerobic digestion in the agricultural sectors.

1.4 Description and evaluation of policy landscapes in the light of the concept of optimality developed in task 1.1

1.4.1 Carbon Pricing

The Spanish policy landscape is composed of market-based instruments. In addition to the EU ETS, most of the instruments are taxes on energy products. However, energy taxes were not designed to reduce GHG emissions as their primary objective. Thus, the EU ETS is the key instrument in this policy landscape. In Spain, it covers 1,100 installations, which account for around 45% of GHG emissions. Several Spanish regions, such as Andalucia, have established their own emission taxes to complement the EU ETS. It is important to note, however, that by law, regional emission taxes cannot overlap the target groups and the emission sources of the EU ETS.

Within this policy landscape, most of the interactions are between the EU ETS and the other instruments. We have identified the interaction of the EU ETS with taxes on energy sources (oil products, natural gas and electricity). These taxes affect the use of energy sources in those sectors covered by the EU ETS, and thus, influence the energy mix and the total energy consumption. The subsidies on coal production also interact with the EU ETS, mainly through price signals in the electricity sector. Finally, in the transport sector, which is not covered by the EU ETS, the excise tax on oil products interacts with the CO_2-based registration tax on cars.

Although, in Spain, taxes on energy sources were not designed for environmental purposes, they interact with the EU ETS and affect carbon prices. In a perfect economy with no market failures, taxes affecting the fossil fuel use of those sectors covered by the EU ETS reduce the cost-effectiveness of the EU ETS (Sijm, 2005). However, the coexistence of the EU ETS and other instruments can be justified by the need to improve the EU ETS, to correct market failures and to meet other objectives. Sijm (2005) states that these three reasons may improve the cost-effectiveness of the EU ETS, but they cannot improve its environmental effectiveness, since the amount of CO_2 reductions are capped. On the other hand, energy taxes can rise carbon prices and, thus, promote innovation, which may reduce abatement costs in the future (dynamic efficiency).

In Spain, the excise tax on oil products, natural gas and electricity coexist with the EU ETS. Gallastegui et al (2012) use an applied general equilibrium model for the Spanish economy to analyse the interaction between the EU ETS and different taxes on CO_2 emissions and energy sources (oil and electricity). They compute the cost-effectiveness of instruments interaction for the whole economy, and not only for those sectors covered by the EU ETS. Given that they construct an economy with no market failures, they find that the best scenario combines a trading system for ETS sectors and a CO_2 emission tax for non-ETS sectors.

Gallastegui et al (2012) have argued that the CO_2 emission tax is the best instrument to reduce emissions on non-ETS sectors. This tax is not usually used due to information and political difficulties and, thus, they analyse the cost-effectiveness of taxes on electricity and oil.

They find that a tax on oil is more cost-effective than a tax on electricity. They state that the tax rate on energy sources should be proportional to its carbon content.

Currently, in Spain, the tax rate on oil products is the highest among all energy sources. This is consistent with the results on the literature regarding cost-effectiveness. However, it seems that the tax rate on oil products is not high enough. Notice that Spain has the fourth-lowest petrol prices and the third-lowest diesel prices in the EU27. This is because of low excise taxes on oil products.

The excise tax on oil products also interact with the CO_2-based registration tax on cars. Although the registration tax may incentive the purchase of energy efficient cars, it does not discourage its use. It seems that these taxes are not setting a proper carbon price on the transport sector and, thus, their environmental effectiveness is limited.

The subsidies for coal production have a negative impact on both the environmental effectiveness and cost-effectiveness of this policy landscape. This effect can indeed be very negative if they are combined with quotas for domestic coal in the electricity production sectors because gas could be switched by coal. The reduction of gas imports will have a positive impact on Spanish´s current account balance but the emissions will increase. The phase-out of subsidies for coal production by 2018 makes more likely that the EU ETS will function effectively, especially in the case of the power sector.

From the feasibility perspective, although taxes on energy sources are not popular and usually have negative distributional consequences, their administrative burden is not a big constraint. Their main advantage is that they provide considerable fiscal revenues. In Spain, this is an important aspect, especially in the electricity sector. In Spain, electricity prices are capped for several consumers. This has led to a difference between the price and the cost of electricity, generating a huge deficit, which the government has to repay to utilities.

The excise tax on oil products is one of the most important sources of revenue for the central and regional governments. The auctioning of the EU ETS allowances will also increase the revenues of EU Member States.

On the other hand, high energy taxes and allowance prices, can affect the competitiveness of some energy-intensive industrial sectors. This can lead to ‘carbon leakage’ if companies reallocate their production in other countries (there is no empirical evidence on this). In 2013 and 2014, 170 sectors and subsectors will be benefited from free allocation of allowances to avoid ‘carbon leakage’.

Different departments are involved in the administration of the instruments within this landscape. The EU ETS is a European instrument administered by the Ministry of Agriculture, Food and Environment in Spain. Although the EU sets minimum level on several energy products subject to excise taxes, energy taxes are fix by national authorities; the Ministry of Industry, Energy and Tourism in Spain.

1.4.2 Energy Efficiency and Energy Consumption

In addition to market-based instruments, this policy landscape is composed of command and control regulations and information programs. Apart from the subsidies for building refurbishment, which are voluntary, the rest of instruments are mandatory. The instrument mix within this landscape covers most of the sectors in the economy. Most of instrument interactions take place in the building sector. The Technical Code of Buildings, the subsidies on building refurbishment and the energy labelling for appliances interact with the excise tax on energy sources such as electricity and natural gas. In the transport sector, the excise tax on oil products interacted with the temporary speed limits that were in place in 2011. Those sectors covered by the EU ETS are affected by both the excise tax on energy sources and the trading system.

Energy efficiency measures are often considered as both environmentally effective and cost-effective. Moreover, in some technologies, they derive economic benefits, given that investment costs are lower than the savings obtained from the reduction in energy consumption[22]. Despite their effectiveness, relatively few energy efficiency measures are implemented. This is known as the energy efficiency paradox.

Linares and Labandeira (2010) summarize the main reasons that explain the energy efficiency paradox; some are market failures and others not. In case of a market failure public intervention is justified, as long as it passes a cost-benefit test.

For instance, a market failure occurs when energy prices do not reflect the real cost because they do not include external costs such as environmental costs. In this case, taxes are usually considered a good instrument to overcome the market failure and thus to promote energy efficiency. Taxes are market-based instruments that provide flexibility to reduce energy consumption in a cost-effective way. However, as pointed out by Gago et al (2007), the excise taxes on oil products, electricity and natural gas are not high enough in Spain compared to other EU countries (Figure 1). This implies that they may not provide enough incentives for energy efficiency.

Even when taxes reflect the real cost of energy sources, they may not be able to overcome other market failures. This is especially true for households, who face high transaction costs, capital market imperfections and information failures (Sijm, 2005). The subsidies for building refurbishment can overcome capital market imperfections and promote energy efficient technologies. They are very popular, although can also promote free-riding. Technological standards such as the Technical Code of Buildings have also a high political acceptance, promote new technology and are environmentally effective. However, they are rigid and its cost-effectiveness is in doubt. Galarraga et al (2011) show the effectiveness of energy labelling for appliances to overcome information failures in Spain. They find that the knowledge about energy consumption of appliances leads to a higher willingness to pay for high efficient appliances by households.

[22] McKinsey abatement cost curves identify those technologies that have negative marginal costs.

The interaction of market-based instruments (such as taxes) and both technological standards and information instruments can result in an improvement in the environmental effectiveness and cost effectiveness over instruments in individual operation. However, when prices are not high enough there can be rebound effects. Energy efficiency can lead to lower demand and thus to lower energy prices, resulting in price and income effects. This implies an increase in energy demand again.

From the feasibility perspective, taxes on energy consumption are not popular and have normally negative distributional consequences. However they provide revenues, which can be used in implementing other instruments. Subsidies, for instance, are very popular and can compensate from distributional problems. For that reason, subsidies are the main instrument used in Spain to promote energy efficiency.

Similar conclusions can be drawn from the transport sector. The excise tax on oil products interacts with other instruments such as speed limits, CO_2-based registration tax on new cars and subsidies for replacing inefficient cars. The excise tax on oil products is a market-based instrument, which provides flexibility to reduce energy consumption and encourages energy efficiency. However, it presents some shortcomings. First, Spanish excise tax on oil products is one of lowest in EU27. It does not reflect the real cost of oil products, and does not yield enough incentives for energy efficiency. Second, many households respond poorly to price incentives and thus some other market barriers, such as information and financial barriers, may hamper energy efficiency in the transport sector.

In Spain, speed limits were implemented as a temporary instrument in 2011. They were adopted to reduce oil consumption. However, in contrast to market-based instruments, this measure is not flexible to meet reduction targets in the most cost-effective way. IPCC (2007) considers speed limits as a potential cost-effective measure. Although they are not very popular, in Spain, they also worked as an information measure.

Other instruments such as CO_2-based registration tax[23] and subsidies for replacing inefficient cars can incentive the purchase of efficient car, and overcome market barriers. Therefore, they can interact well with the excise tax on oil products. However, in the absence of high enough prices, there can be rebound effects.

In this landscape, the administrative burden mainly rests on the Ministry of Industry, Energy and Tourism and the Ministry of Public Works. The former is in charge of the energy taxes and the former manages the Technical Code of Buildings and the Subsidies on building refurbishment.

1.4.3 Promotion of renewable sources of energy

Spain has been very successful in the promotion of renewable sources of energy in recent years. The key instrument in this landscape has been the feed-in tariff scheme for renewable

[23] Registration tax is only paid once, when the vehicle is purchased.

energy sources (FIT-RES). In addition to the FIT-RES system, renewable sources of energy have been promoted through the EU ETS, the Technical Code of Buildings, incentives to R&D and subsidies for technology investment in the agricultural sector. Thus, within this landscape the total amount of non-market based instruments is higher than market based instruments. And the policy landscape includes mandatory and voluntary instruments.

Within this policy landscape the main instrument interaction is between the FIT-RES and the EU ETS. The FIT-RES provides price premiums to renewable energy producers to guarantee its profitability, while the EU ETS covers, among others, the power sector. Sijm (2005) states that the FIT-RES cannot increase the effectiveness of the EU ETS. The total amount of GHG emission reduction is established by the EU ETS and, therefore, further reductions are not possible. However, local emissions are not capped and the FIT-RES can lead to emission reductions in Spain, in addition to the EU ETS targets. This can be important, if Spain wants to meet its Kyoto target emissions and the EU targets of 20% reduction in GHG emissions and a share of 20% of renewable energy sources in energy consumption by 2020 (del Río, 2009). Thus, although the FIT-RES cannot improve the environmental effectiveness of the EU ETS, it helps to meet other policy outcomes if carbon price is low. Indeed, the FIT-RES has been very successful in increasing the share of renewables in the electricity mix in Spain.

As argued by del Río (2009), the interaction between the FIT-RES and the EU ETS does not lead to a cost-effective result from the static point of view. The FIT-RES changes the relative market price of each technology and, thus, prevents the adoption of cheaper abatement technologies. However, the FIT-RES may be necessary to promote renewable energy sources. The carbon price under the EU ETS is not high enough to make renewables competitive compared to conventional technologies (Linares et al, 2008). Therefore, the interaction between these instruments leads to a higher dynamic efficiency.

The level of governance is different for the FIT-RES and the EU ETS. While the former is a national instrument, the latter is a European instrument. National priorities may differ from those in Europe, and this may lead to possible conflicts between instruments.

In Spain, the interaction between the FIT-RES and the EU ETS has had a limited impact on electricity prices (del Río 2009)[24]. This is partly because the electricity price is capped to several consumers, particularly households. However, with the generating costs rising faster than the final price, the system has created a huge deficit that will have to be paid in the future. The lack of transparency of the real cost for the consumers has affected positively on the acceptance of the FIT-RES by the public. However, it can change as prices increase to reflect real costs. The new energy taxes implemented in 2013, particularly on electricity, are addressed to reduce the gap between real cost and final price.

On the other hand, the FIT-RES has contributed to the development of a highly dynamic sector, job creation, improvement in local air quality and other benefits. The association of renewable energy producers estimates that the sector generated more than 100,000 jobs in

[24] Other authors such as Gelabert et al (2011) argue that a marginal increase of electricity using renewables is associated with a reduction of electricity prices.

2011. Renewables also contributed to reduce energy dependency and, thus, reduce trade deficit (APPA, 2011).

Other instruments such as the incentives to R&D have also been implemented to promote renewable energy sources. There is not a general agreement about the effectiveness of public incentives to R&D. While some researches indicate that public R&D spending is not correlated with emission reductions, others consider an essential instrument to stimulate technological advances. The benefits of R&D may not realized for many years, but public incentives can contribute to efficient levels of innovation and lower abatement costs in the future (dynamic efficiency).

The subsidies for investment in equipment for anaerobic digestion try to cover the agricultural sector, which represents 10% of GHG emissions in Spain. There is not empirical evidence on the environmental effectiveness and the cost-effectiveness of this instrument. Like other subsidies, this instrument is popular. Besides it contributes to the development of rural areas and, thus, has positive distributional effects.

Although it was not covered in the description of instruments, in Spain the promotion of renewables in the transport sector is based on fiscal incentives and supply obligations. Biofuels are exempted from excise taxes and there is a quota of biofuels to be blended to conventional fuels. In 2013, the Spanish government reduced the quota of biofuels from 6.5% to 4.1%. This can hamper the 10% renewable energy target for the transport sector by 2020. The share of renewable energy in fuel consumption of transport increased from 0.7% in 2006 to 4.7% in 2010.

1.4.4 Non-Carbon Dioxide Greenhouse Gases

Non-carbon dioxide greenhouse gases represent around 20% of GHG emissions in Spain. Among them, CH_4 and N_2O have the highest share, and account for around 10% and 8% of total emissions, respectively (MAGRAMA, 2012). There are two key instruments within this landscape: the EU ETS and the subsidies for investment in equipment for anaerobic digestion. The former covers N2O and PFC emissions in power generation and energy-intensive industry sectors. The latter covers CH_4 and N_2O emissions in the agricultural sectors. There is no interaction between these two instruments.

The GHG emissions in the agricultural sector are focused on CH_4 and N_2O emissions. However they account for around 10% of total GHG emissions in Spain. In 2010, 53% of total CH_4 emissions were in the agricultural sector. The share of the N_2O emissions of the agricultural sector is even higher; it represents 78% of total emissions. In 2008, the Slurry Biodigestion Plan was adopted to reduce GHG emissions in the agricultural sector; the subsidies for investment in equipment for anaerobic digestion were the key instrument.

The Plan was in place between 2008 and 2012, and it is not expected to be launched again. There are no studies that analyse the environmental effectiveness or the cost-effectiveness of this Plan. In 2008, the objective was to reduce 1.78 Mt CO_2-e per year or 8.9 Mt CO_2-e in the

period 2008-2012. These values imply around 5% GHG emission reduction in the agricultural sector. The initial budget for this plan was €40 million.

The public acceptance for subsidies is usually high. This Plan covers mainly rural areas and, thus, contributes to its development.

The EU ETS is the other key instrument implemented to reduce non-CO_2 GHG in Spain. As explained above, the EU ETS ensures that a certain quantity of emissions will be reduced. It is also a flexible mechanism that allows reducing emissions in a cost-effective way.

2 Description and initial evaluation of the overall instrument mix

2.1 Identification and description of the main interactions between policy landscapes

Objectives

The objective of the policy landscape on carbon pricing is to establish a carbon price that gives companies and households the incentives to cut their emissions in the most cost-effective way. Energy efficiency and the promotion of renewable sources of energy are among the measures that companies and households can implement to adapt to higher carbon prices. Thus, although energy efficiency and the promotion of renewables are not the primary objective of the policy landscape on carbon pricing, they can be considered a secondary objective. Therefore, the primary objectives of both the landscape on energy efficiency and the landscape on the promotion of renewables are part of the multiple sub-objectives of carbon pricing.

The primary of objective of the landscape on non-carbon dioxide greenhouse gases is to reduce non-CO_2 gases. In addition to CO_2 emissions, the third phase of the EU ETS, running from 2013 to 2020, has included the N_2O and PFCs emissions. Thus, the EU ETS is also present in the landscapes of non-carbon dioxide GHGs. Depending on their abatement costs, companies may find more cost-effective to reduce CO_2 emissions or the equivalent amount of N_2O or PFCs.

Scope and Coverage

The landscape on carbon pricing is mainly driven by the EU ETS. Other instruments such as taxes on energy sources were not planned for environmental purposes. They may indirectly affect carbon pricing but their contribution is limited. Thus, carbon pricing affects mainly those sectors covered by the EU ETS, that is, power and heat generation, energy-intensive industry sectors and commercial aviation. The sectorial scope of the landscape on energy efficiency is wider. In addition to the sectors covered by the EU ETS, it also includes buildings, households and the transport sector.

Carbon pricing and the promotion of renewables mainly overlap on the power sector, which receives most of the benefits of the FIT-RES and is covered by the EU ETS. On the other hand, most of non-CO_2 emissions take place in the agricultural sector, which is scarcely covered by the rest of landscapes.

Functioning and influencing mechanism of the instruments

The landscapes on energy efficiency and the promotion of renewables may have a negative impact on the landscape of carbon pricing. In those sectors covered by the EU ETS, the instruments that promote energy efficiency and renewable energy sources may reduce the demand for EU ETS allowances. This should reduce the price of allowances, but since these are determined at an EU level the effect will be very small.

On the other hand, the existence of a carbon price makes more likely that energy efficiency will function effectively. Carbon prices encourage the adoption of energy efficient technologies. Moreover, in the absence of high enough carbon prices, the instruments of the policy landscape on energy efficiency may not function effectively. As argued by Linares and Labandeira (2010), improvements in energy efficiency may not imply a proportional energy demand reduction, due to rebound effects. Carbon pricing increases energy prices and thus moderates rebound effects. Therefore, energy efficiency measures need to be accompanied by carbon pricing of some kind to avoid the rebound effect. Similarly, carbon pricing benefits the promotion of renewable energy sources. However, Linares et al (2008) state that the EU ETS has not been enough to promote renewable energy sources in Spain. Carbon pricing supports the functioning of renewables promotion, but higher carbon prices are needed to be effective.

Implementation Network/administrative Infrastructure

As mentioned above, the key instrument in carbon pricing is the EU ETS, an EU-wide instrument. Several of the instruments in the landscape on energy efficiency are based on EU directives; however they are administered by national authorities. Different Ministries are involved in the administration of these instruments. Energy taxes are established by the Ministry of Industry, Energy and Tourism. This Ministry is also in charge of the instruments to improve energy efficiency in the transport sector, such as the subsidies for replacing inefficient car and speed limits. The instruments that cover the buildings sector are administered by the Ministry of Public Works.

The FIT-RES, the main instrument in the landscape on the promotion of renewable energy sources, is a national instrument, administered by the Ministry of Industry, Energy and Tourism.

2.2 Summary discussion of the combination of policy landscapes (the overall instrument mix) against each one of the elements of the concept of optimality

Spanish climate policy has mainly developed around the EU legislation. In Spain, as in many other EU countries, the EU ETS is the key instrument to combat climate change. Since it was

launched, in 2005, new sectors and GHGs have been incorporated into the system. Currently Spain has around 1,100 installations covered by the EU ETS which account for around 45% of total GHG emissions. Spain's entry into the EU also implied a progressive adaptation to the European taxation on energy products. The EU establishes a common tax structure and minimum levels on several energy products subject to excise duty and other indirect taxes. However, these taxes are used to raise fiscal revenues and do not include environmental purposes. The initiatives for taxing GHG emissions have come from the regional level. In 1995, Galicia was the first region to approve a tax on atmospheric pollution. More recently, other regions such as Andalucia and Castilla-La Mancha have created similar taxes.

National efforts to reduce GHG emissions have focused on promoting energy efficiency and renewable energy sources. The latter has been based on a FIT scheme. Since 1997, the FIT-RES have contributed to increase the supply of renewable energy. Last year, the government suspended the premiums for those installations that come into operation after 2013. Domestic measures on energy efficiency are part of the Energy Saving and Efficiency Strategy Action Plan 2008-2012 and, more recently, Energy Saving and Efficiency Plan 2011-2020. Several instruments included in these Plans, such as the Technical Building Code (CTE), adapt and harmonize the national regulation with the EU dispositions.

Thus, the Spanish instrument mix is mainly based on the EU ETS, taxation on energy products, the FIT-RES and different measures on energy efficiency. The landscape on carbon pricing is driven by the EU ETS. Taxes play a minor role, since they do not include an environmental component. Both the EU ETS and taxes also promote energy efficiency and thus are part of the landscape on energy efficiency. Besides, this landscape includes instruments to promote energy efficiency in buildings (CTE and subsidies on building refurbishment) and the transport sector (CO_2-based vehicle registration tax and speed limits). The landscape on promoting renewable sources of energy is mainly based on the FIT-RES. Finally, the EU ETS and the subsidies for investment in equipment for anaerobic digestion are the key instruments to reduce non-CO_2 GHGs.

The Spanish instrument mix is characterized by the interaction between the EU ETS and the FIT-RES, the two key instruments in the landscape of carbon pricing and promotion of renewable energy sources, respectively. Besides, the EU ETS interacts with the excise taxes on energy products and other instruments on the landscape of energy efficiency. Thus, important interactions also occur between the landscape of carbon pricing and energy efficiency.

Environmental effectiveness

Given that the EU ETS is the key instrument, the environmental effectiveness of the Spanish policy mix depends on the performance of this instrument. As mentioned above, it covers the power and heat generation sector, energy-intensive industry sectors and commercial aviation, which together account for around 45% of GHG emissions in Spain. The EU ETS ensures that a certain quantity of emissions will be reduced in these sectors. The FIT-RES and other instruments cannot improve the environmental effectiveness of the EU ETS, since emission reductions are capped by the system. Although total emissions cannot be reduced, local emissions can vary. Therefore, other instruments can be used to reduce local emissions and

thus meet international targets. In Spain, the FIT-RES has been the main instrument to reduce local emissions and increase the share of renewables in the electricity sector. The FIT-RES has been successful in raising the share of renewables, particularly wind electricity. The share of renewables in terms of primary energy consumption has increased from 6.3% in 2004 to 11.3% in 2010.

The environmental effectiveness of other instruments, which do not cover EU ETS sectors, is limited. Transport[25], the largest non-ETS emitter, is mainly affected by the excise tax on oil products. As mentioned above, this instrument does not include an environmental component, and thus, Spanish diesel and gasoline tax is one of the lowest in the EU27. Biofuels are exempted from excise taxes and there is a quota of biofuels to be blended to conventional fuels. In buildings, the effectiveness of the CTE has been very low, since it was implemented after the housing boom. The scope of other instruments, such as the subsidies on building refurbishment and energy labeling for appliances, has been much narrower.

Cost-effectiveness

In general, market-based instruments are considered cost-effective. The EU ETS, for instance, is a system that gives companies the flexibility to meet their targets. Taxes on energy products are also a flexible mechanism that facilitates the adoption of the most cost-effective measures. However, the criticism has arisen in two issues: "windfall profits" and "over-allocation" (Ellerman and Joskow, 2008). The former refers to the higher prices and consequently higher corporate profits that resulted from the free allocation of allowances. The latter refers to the excise number of allowances allocated in the market, which led to low prices. This affects dynamic efficiency given that low prices or high volatility disincentive innovation in more efficient technology. Some authors defend that the interaction of the EU ETS with other instruments reduces its cost-effectiveness. For instances, del Río (2009) argues that the interaction between the FIT-RES and the EU ETS is not cost-effective from the static point of view. In Spain, the FIT-RES has been successful in increasing the share of renewables, but the electricity cost has risen considerably. Although the static effectiveness of the EU ETS does not increase in interactions with other instruments, the FIT-RES and the economic incentives to R&D may reduce the abatement costs in future, improving the dynamic effectiveness (Linares et al, 2008).

Feasibility

The main problem of the Spanish instrument mix has arisen from the FIT-RES, given that the system has raised considerably the production costs of electricity[26]. For several consumer groups, electricity prices are capped and thus they did not notice the cost rise. Hence, the acceptance of the instrument by general public is high. However, the government has

[25] In this sector, emissions increased around 90% between 1990 and 2009.

[26] Other authors (Fabra and Fabra, 2013) suggest that one of the main reasons for the increase of the price of electricity is a wrong design of the spot market in Spain that overcompensates to some technologies where there is no real competition such as hydropower or nuclear.

generated a huge tariff deficit that is owed to the utilities. To solve the problem the government has suspended the FIT-RES scheme for new installations. Besides, they have increased the excise tax on electricity and natural gas. These measures may affect negatively both the environmental effectiveness and the cost-effectiveness of the instrument mix. Some experts considered that an increase on the excise tax on oil products would be more effective (IEA, 2008).

Most of the Spanish climate change policy is based on European instruments or measures based on EU legislation, and thus, do not present legal problems. The instruments are administered by different Ministries. Three Ministries are in charge of most of the instruments: the Ministry of Agriculture, Food and Environment, the Ministry of Industry, Energy and Tourism and, the Ministry of Public Works.

3 Conclusions

The key instruments in the Spanish policy mix are the EU Emission Trading Scheme (ETS) and the feed-in tariff scheme for renewable energy sources (FIT-RES). The landscape on carbon pricing is mainly driven by the EU ETS, which covers around 45% of GHG emissions. The first periods of the EU ETS were characterized by an excessive number of allowances and the financial crisis, which lead to a surplus of unused allowances and thus to low prices. Despite the initial problems, the system ensures a certain emission reduction and the flexibility to make it relatively cost-effective. The FIT-RES has been essential in the promotion of renewable energy sources. It has contributed to increase the share of renewables in terms of primary energy consumption from 6.3% in 2004 to 11.3% in 2010. Its success in raising the share of renewables has also caused an increase in electricity production costs. This has led the government to suspend the FIT-RES scheme for new installations and raise excise taxes on energy products.

The economic downturn has influenced in the promotion of energy efficiency. Several instruments have been launched with the double objective of reducing energy consumption and encouraging economic activity. For instance, the subsidies for building refurbishments or the purchase of energy-efficient cars were implemented to meet both goals. Although, in general, these instruments are highly accepted, there is little empirical evidence on their effectiveness.

Instrument interactions take place mainly around the EU ETS. Although other instruments cannot improve the environmental effectiveness of the EU ETS, they contribute to Spanish targets on GHG emission reduction, energy efficiency and the promotion of renewable energy sources. It is claimed that the other instruments alter abatement costs and thus reduce the static cost-effectiveness of the EU ETS (Sijm, 2005; del Río, 2009). However, the FIT-RES and the economic incentives to R&D may reduce the abatement costs in future, improving the dynamic effectiveness. Besides, the environmental effectiveness of energy efficiency measures have probably suffered from rebound effects to the extent that the price of fossil based energy has not gone up at the same time.

It is critical therefore for the future for carbon-based energy to become more expensive (whether it is through EU ETS or other measures) for the transition to a low carbon economy to start in earnest.

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Annex I: table for the description of instruments

Table 1: Description of instruments **Areas of Policy interaction in design parameters**	**Emission Trading Scheme (ETS)**	**Feed-in tariffs for Renewable Energy Sources (FIT/RES)**	**Subsidies for coal production**	**Excise Tax on oil products**	**Excise tax on electricity**
Instrument category	ETS	Technology support	Perverse incentives	Taxes	Taxes
Instrument subcategory	Cap-and-trade	Feed-in tariffs	Removing negative taxes	Taxes on inputs or output of a production process	Taxes on inputs or output of a production process
Level of governance	European Union	National level	European Union	National Level	National Level
Degree of bindingness	Legally binding	Legally binding. The owners of the distribution networks are obliged to purchase all the electricity supplied by companies in the special regime	Legally binding	Legally binding	Legally binding
Objectives					
Goal(s)	Mitigation primary, other goals secondary. 'GHG Emission reductions in a cost-effective and economically efficient manner' (Art.1). Preserving integrity of int'l market and avoiding distortions of competition (recital 7) Encouragement of energy efficient technologies (recital 20), minimize negative impacts on competitiveness of EU industry (Arts. 10a and 10b).	Mitigation primary, other goals secondary. Promote renewable energy sources in the production of electricity	Mitigation secondary goal. Avoid market distortions and the use of coal for electricity production	Mitigation secondary goal. Raise tax revenues and penalize the use of oil products	Non-mitigation goals, with impacts on mitigation. Raise tax revenues
Type of target	Cap on total emissions per installation	Increase electricity production from renewable source	The removal of perverse incentives	Tax on energy sources	Tax on energy sources
GHG Scope					
GHGs covered	CO2, N2O and PFCs	CO2	CO2	CO2	CO2
Direct/indirect emissions	Direct emissions	Indirect emissions	Indirect emissions	Indirect emissions	Indirect emissions
Primary/final energy	Primary	Final energy	Primary energy	Final energy	Final energy

Opt-in/opt-out	MS can opt-in GHGs subject to conditions (Art.24).	No	No		
Sectorial scope					
Sectors of economy	• Power and heat generation • Energy intensive industry • Commercial aviation	Power generation sector	Coal sector	• Transport • Industry	Power generation sector
Covered entities	Installations	Entities that produce electricity from renewable sources	Installations	Those entities that produce or/and import oil products.	Installations
Covered sites	Installations for the production of energy, refining of mineral oil, coke, metal ore, iron and ferrous metals, aluminium, non-ferrous metals, cement, glass, ceramic products, pulp from timber, paper, carbon black, nitric acid, adipic acid, ammonia, bulk organic chemicals, hydrogen, soda ash.	Entities that produce electricity from the following technologies: • Solar PV • Solar Thermoelectric • Wind • Hydroelectric • Biomass	Mining companies which are subsidized	Those entities that produce or/and import oil products. • Excise taxes on the use of oil fuel for electricity production, commercial aviation and navigation for fishing are excluded • Some activities can benefit from partial tax refund: road transport of goods and passengers, taxis and agriculture	• Since 1993, there is an excise tax on electricity production (4.8%). Installations under the feed-in tariff regime are excluded. • In 2013, a new tax will be set (6%). All installations are included
Capacity thresholds entities/sites	• Governments can exclude installations whose reported emissions were lower than 25,000 tons CO2 equivalent in each of the 3 years preceding the year of application. For combustion installations, an additional capacity threshold of 35MW applies • In these cases, installations must adopt other measures that will cut their emissions by an equivalent amount.	Installed capacity must be equal or less than 50MW	No	No	Entities with installed capacity less than 100 KW are excluded
Opt-in/opt-out for sectors	MS can opt-in entire sectors subject to conditions (Art.24).	No	No		
Opt-in/opt-out for entities	MS can exclude small installations (emissions below 25000 tonnes CO2eq and/or rated thermal input below 35 MW) subject to conditions (Art. 27).	No	No		

Opt-in/opt-out for sites		No	No		
Implementation network					
Competent bodies for adopting instrument	EU institutions	National authorities (Ministry of Industry, Energy and Tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)
Competent body for setting-up instrument	National Authorities	National authorities (Ministry of Industry, Energy and Tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)
Competent body to administer instrument	Commission (through comitology procedures) National authorities	National authorities (Ministry of Industry, Energy and Tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)
Competent body for registration of participating entities	National authorities, EU Commission	Regional authorities	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)
Competent body for Monitoring & verifying compliance	National authorities, following EU law, EU Commission competent to draft the regulation on M&R	Regional authorities	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)
Competent body for enforcement of compliance	National authorities, EU Commission (in relation to MS)	Regional authorities	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism)
Rules & influencing mechanisms					
Market arrangements					
Non-obligatory for eligible parties	None				
Number of participants	• More than 11,000 installations in power generation and manufacturing industry. Plus operators of flights • Around 1100 entities in Spain		Currently 15 companies are subsidized		
Market flexibility					
Trading	Not limited			No	No
Unit type and name	EU allowance				
Nature of unit	1 Ton CO2eq				
Lifetime of unit	8 years, but can be replaced by new ones				

	(Art. 13)				
Banking provisions	Allowed between years in each period and between periods				
Borrowing provisions	Allowing between years of each period				
Financing					
Cost-recovery	Possible via price increases of electricity or products	The tariffs are recouped through a supplement on consumers' electricity bills that is proportional to their overall electricity consumption.		Possible via price increases	Possible via price increases of electricity
Revenues raised	Increasingly substantial through auctioning, particularly from 2013 onwards			• In 2011, €9,200 million were raised by the excise tax on oil products. • Around 60% of the revenue goes to regional governments.	The revenues will be used to reduce the tariff deficit
Technological parameters					
Eligible technologies	Scope defined in terms of industrial activities rather than technologies	• Solar PV • Solar Thermoelectric • Wind • Hydroelectric • Biomass			All technologies are included; there is no distinction between renewable and non-renewable energy sources.
Opt-in/opt-out	None provided				
Treatment of additionality	Not relevant				
Timing					
Operational?	Yes	Yes. However, those installations registered after December 31, 2012 will not benefit from the premiums	Yes	Yes	Yes

Operational changes foreseen?	Possible Increase of ambition in cap, possible introduction of carbon price floor, possible withdrawal of allowances by Commission/MS, introducing more sectors and gases, further limits in access to international credits	No	The EU stipulates the phase-out of subsidies for the production of coal from uncompetitive mines by December 31, 2018. The overall amount of closure aid granted by a Member State must follow a downward trend and, thus, Member Estates have to reduce their subsidies 25% below their levels in 2011 by the end of 2013; 40% by the end of 2015, 60% by the end of 2016 and 75% by the end of 2017.	No	No
Compliance period(s)	Phase I (2005-2007), Phase II (2008-2012), Phase III (2013-2020) and Phase IV(2021-2028)	The premium is payable over the complete useful life of the asset used in generation	By December 31, 2018, uncompetitive mines cannot be subsidized		
Future continuation	Yes	Those installations registered after December 31, 2012 will not benefit from the premiums. It is not sure that it will be restored in the coming years.		Yes	The new tax has been established to reduce the tariff deficit. It is going to take many years to reduce this deficit. Thus, the tax will continue for a long time
Compliance					
Monetary penalties	Yes, EUR100 per ton CO2eq emitted and not covered by an allowance		If uncompetitive mines are not closed before December 31, 2018, they will have to pay back the subsidies.		
Naming and shaming	Yes (Art.16.2)				
Administrative liability	Yes (Art.16) (penalties should be effective, proportionate, and dissuasive)				
Civil liability					

Table 1: Description of instruments **Areas of Policy interaction in design parameters**	**Excise tax on gas consumption**	**CO2-based vehicle registration tax on new cars**	**Technical Code of Buildings (CTE)**	**Subsidies on building refurbishment**	**Energy labeling for appliances**
Instrument category	Taxes	Taxes	Command and Control regulations	Active technology support policies	Information
Instrument subcategory	Taxes on inputs or output of a production process	Taxes on inputs or output of a production process	Buildings codes and standards	Policies to remove financial barriers to acquiring green technology	Environmental labeling programs

Level of governance	National level	National level	National level	National Level	European Union
Degree of bindingness	Legally binding	Legally binding	Legally binding	Voluntary	Legally binding
Objectives					
Goal(s)	Mitigation and other equally important. Raise tax revenues and penalize the use of natural gas	Mitigation only Reduce CO2 emissions and incentive the purchase of energy efficient vehicles	Mitigation primary, other goals secondary. Promote energy efficiency and renewable energy sources	Mitigation and other goals equally important Increase energy efficiency in buildings	Mitigation primary/other goals secondary. Provide consumers with energy efficiency information to make purchase decision. Differentiate the product by energy efficiency
Type of target	Tax on energy sources	Tax on motor vehicles	Set environmental targets in the construction of buildings	Mitigation and other goals equally important	Information on energy efficiency
GHG Scope					
GHGs covered	CO2	CO2	CO2	CO2	CO2
Direct/indirect emissions	Indirect emissions	Indirect emissions	Indirect emissions	Indirect emissions	Indirect emissions
Primary/final energy	Final energy	Final energy	Final energy	Final energy	Final energy
Opt-in/opt-out					
Sectorial scope					
Sectors of economy	Gas sector	Transport	Buildings	Households	Households
Covered entities	Utilities	Entities that sell vehicles	Construction companies	Households	Appliances manufacturers
Covered sites	Natural gas utilities	Entities that sell vehicles. Those vehicles for transport of goods and passengers are excluded	Construction companies	Households	Appliances manufacturers
Capacity thresholds entities/sites				Households' income must be less than €71,000.	
Opt-in/opt-out for sectors					
Opt-in/opt-out for entities					
Opt-in/opt-out for sites				Some Spanish regions have their own instruments for building refurbishment. Regional subsidies complement (and not substitute) national subsidies	
Implementation network					

Competent bodies for adopting instrument	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism) and Regional authorities	National authorities (Ministry of Public Works)	National authorities (Ministry of Public Works)	National authorities, EU institutions
Competent body for setting-up instrument	National authorities (Ministry of industry, energy and tourism)	National authorities. Regional authorities can increase the tax rate	National authorities (Ministry of Public Works)	National authorities (Ministry of Public Works)	National authorities, EU institutions
Competent body to administer instrument	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism) and Regional authorities	National authorities (Ministry of Public Works)	National authorities (Ministry of Public Works) and regional authorities	National authorities, EU institutions
Competent body for registration of participating entities	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism) and Regional authorities	National authorities (Ministry of Public Works)	National authorities (Ministry of Public Works) and regional authorities	National authorities, EU institutions
Competent body for Monitoring & verifying compliance	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism) and Regional authorities	National authorities (Ministry of Public Works)	National authorities (Ministry of Public Works) and regional authorities	National authorities, EU institutions
Competent body for enforcement of compliance	National authorities (Ministry of industry, energy and tourism)	National authorities (Ministry of industry, energy and tourism) and Regional authorities	National authorities (Ministry of Public Works)	National authorities (Ministry of Public Works) and regional authorities	National authorities, EU institutions
Rules & influencing mechanisms					
Market arrangements					
Non-obligatory for eligible parties					
Number of participants					
Market flexibility					
Trading	No	No			
Unit type and name					
Nature of unit					
Lifetime of unit					
Banking provisions					
Borrowing provisions					

Financing					
Cost-recovery	Possible via price increases	Possible via price increases	Possible via price increases		
Revenues raised	The revenues will be used to reduce the tariff deficit	In 2011, €48 million were raised.			
Technological parameters					
Eligible technologies					• Fridges and freezers • Washing machines • Dishwashers • Tumble driers • Washing machines - driers • Household lighting • Electric ovens • Air-conditioning
Opt-in/opt-out					
Treatment of additionality					
Timing					
Operational?	Yes	Yes	Yes	No	Yes
Operational changes foreseen?	No	No	The CTE has to be adapted to EU directives.		No
Compliance period(s)					
Future continuation	Yes	Yes	Yes	The Plan ended on December 31, 2012.	Yes
Compliance					
Monetary penalties			In case that a building does not meet the requirements, there is a monetary penalty.		
Naming and shaming					
Administrative liability					
Civil liability					

Table 1: Description of instruments **Areas of Policy interaction in design parameters**	**Subsidies for replacing inefficient cars**	**Speed limits**	**Subsidies for investments in equipment for anaerobic digestion**	**Tax on CO2, SOx and NOx emissions in Andalucia**	**Economic incentives to R&D on energy and climate change**
Instrument category	Active technology support policies	Command and Control regulations	Technology support	Taxes	Technology support

Instrument subcategory	Policies to remove financial barriers to acquiring green technology	Prohibition or mandating of certain products or practices	Policies to remove financial barriers to acquiring green technology	Taxes directly applied to the pollution source	Public and private R&D funding
Level of governance	National Level	National Level	National Level	Regional Level	Regional Level
Degree of bindingness	Voluntary	Legally binding	Voluntary	Legally binding	Voluntary
Objectives					
Goal(s)	Mitigation and other goals equally important Increase energy efficiency in cars	Non-mitigation goals, with impact on mitigation. Reduce oil products consumption and, thus, external dependency Improve energy efficient driving	Mitigation and other goals equally important Reduce GHG emissions in slurry management The recovery of biogas energy	Mitigation and other goals secondary Reduce GHG emissions in a economically efficient manner Promote energy efficient technologies	Mitigation and other goals secondary Promote renewable energy and energy efficient technologies
Type of target	Mitigation and other goals equally important	Improve energy efficiency in driving	Subsidize investments in technology	Tax on emissions	Subsidies and loans for investment
GHG Scope					
GHGs covered	CO2	CO2	CH4 and N2O	CO2	All GHGs
Direct/indirect emissions	Indirect emissions	Indirect emissions	Direct and indirect emissions	Direct emissions	Indirect emissions
Primary/final energy	Final energy	Final energy	Final energy	Final energy	Final energy
Opt-in/opt-out					
Sectorial scope					
Sectors of economy	Transport	Transport	Food and Agriculture	Industry	All sectors
Covered entities	Entities that sell vehicles	Households and transport sector	Installations	Installations	R&D centres
Covered sites	Entities that sell vehicles	Households and transport sector	Industrial installations and individual farmers	All industrial installations. Those installations covered by the ETS are not subject to the tax on CO2	R&D centres
Capacity thresholds entities/sites	Cars with a price higher than €25,000 (electric vehicles are excluded)			No	No
Opt-in/opt-out for sectors					
Opt-in/opt-out for entities					
Opt-in/opt-out for sites					

Implementation network					
Competent bodies for adopting instrument	National authorities ((Ministry of industry, energy and tourism)	National authorities	National authorities (Ministry of Agriculture, Food and Environment) and Regional authorities	Regional authorities	National authorities (Ministry of Economy and Competitiveness)
Competent body for setting-up instrument	National authorities ((Ministry of industry, energy and tourism)	National authorities	National authorities (Ministry of Agriculture, Food and Environment)	Regional authorities	National authorities (Ministry of Economy and Competitiveness)
Competent body to administer instrument	National authorities ((Ministry of industry, energy and tourism)	National authorities	National authorities (Ministry of Agriculture, Food and Environment) and Regional authorities	Regional authorities	National authorities (Ministry of Economy and Competitiveness) and Regional authorities
Competent body for registration of participating entities	National authorities ((Ministry of industry, energy and tourism)	National authorities	National authorities (Ministry of Agriculture, Food and Environment) and Regional authorities	Regional authorities	National authorities (Ministry of Economy and Competitiveness) and Regional authorities
Competent body for Monitoring & verifying compliance	National authorities ((Ministry of industry, energy and tourism)	National authorities	National authorities (Ministry of Agriculture, Food and Environment) and Regional authorities	Regional authorities	National authorities (Ministry of Economy and Competitiveness) and Regional authorities
Competent body for enforcement of compliance	National authorities ((Ministry of industry, energy and tourism)	National authorities	National authorities (Ministry of Agriculture, Food and Environment) and Regional authorities	Regional authorities	National authorities (Ministry of Economy and Competitiveness) and Regional authorities
Rules & influencing mechanisms					
Market arrangements					
Non-obligatory for eligible parties					
Number of participants					
Market flexibility					
Trading				No	No
Unit type and name					
Nature of unit					
Lifetime of unit					
Banking provisions					
Borrowing provisions					

Financing					
Cost-recovery			The plan had a budget of €40 million.	Possible via price increases	
Revenues raised				In 2010, around €3.7 million were raised. They must be used in environmental issues	
Technological parameters					
Eligible technologies	• Private cars with energy category A or B • Private and commercial cars with CO2 emission <120 g/km • Electric cars		The equipment used for anaerobic digestion		
Opt-in/opt-out					
Treatment of additionality					
Timing					
Operational?	Yes	No	No	Yes	Yes
Operational changes foreseen?		Currently it is under consideration to increase the speed limit from 120 km/h to 130 km/h	No	No	In the coming months, the Spanish government should launch the new National Plan for Scientific Research, Development and Technological Innovation
Compliance period(s)		This instrument was in place for few months in 2011	2008-2012		
Future continuation	The Plan will be in place until February 2014		It is unknown whether the Plan will be launched again	Yes	Yes
Compliance					
Monetary penalties			In case that investments do not meet the requirements, the subsidies must be paid back		
Naming and shaming					
Administrative liability					
Civil liability					

Annex II: Types of interactions between instruments

		ETS-Subsidies for Coal Production	ETS-Excise tax on electricity production	ETS-Excise tax on gas consumption	Excise tax on oil products-CO2 based vehicle registration tax on new cars	Subsidies on coal production -Excise tax on electricity production	Excise tax on oil products-Speed limits	Technical Code of Buildings-Subsidies on building refurbishment
Area of policy interaction		Carbon pricing	Carbon pricing	Carbon pricing	Carbon pricing	Carbon pricing	Energy efficiency and consumption	Energy efficiency and consumption
Instrument type	Identical/different	different	different	different	identical	different	different	different
Degree of bindingness	m-m/m-v/v-v	m-m	m-m	m-m	m-m	m-m	m-m	m-v
Objectives	p-p/p-s/s-s	p-s	p-s	p-s	p-s	p-s	p-s	p-s
Scope	os-pa/p-pa/f-pa/i-i	i-i	os-pa	os-pa	os-pa	i-i	os-pa	f-pa
Implementation network	f-r/p-r/d-r	p-r	p-r	p-r	p-r	p-r	p-r	p-r
Rules and influencing mechanisms	Trading/regulatory	trading	trading	trading	trading	trading	regulatory	regulatory

		Excise tax on electricity-Energy labeling for appliances	Excise tax on electricity-Subsidies on building refurbishment	Excise tax on gas consumption-Subsidies on building refurbishment	Excise tax on electricity-EU ETS	FIT/RES-ETS	FIT/RES-Incentives to R&D on energy	EU ETS-Incentives to R&D on energy
Area of policy interaction		Energy efficiency and consumption	Energy efficiency and consumption	Energy efficiency and consumption	Energy efficiency and consumption	Promotion of renewable sources of energy	Promotion of renewable sources of energy	Promotion of renewable sources of energy
Instrument type	Identical/different	different	different	different	different	different	different	different
Degree of bindingness	m-m/m-v/v-v	m-m	m-v	m-v	m-m	m-m	m-v	m-v
Objectives	p-p/p-s/s-s	p-s	p-s	p-s	p-s	p-s	p-s	p-s
Scope	os-pa/p-pa/f-pa/i-i	os-pa	os-pa	os-pa	os-pa	os-pa	os-pa	os-pa
Implementation network	f-r/p-r/d-r	p-r	p-r	p-r	p-r	p-r	p-r	p-r
Rules and influencing mechanisms	Trading/regulatory	regulatory	trading	trading	trading	trading	regulatory	trading

Annex III

Table XX presents the fixed tariffs in the FIT-RES scheme for the main energy sources. Before February 2013, RES generators could sell to the electricity markets and receive the market price plus a premium. This alternative was eliminated by the Royal Decree-law 2/2013 and hence, it is not included. The values presented in Table XX are for 2012. Based on the Royal Decree-law 2/2013, from 2013 on, annual tariff updating will not be tied to the CPI but to the core CPI.

Table 7: Feed-in Tariffs for RES in Spain, 2012

	Capacity	Time limit	Fixed tariff (cent€/kWh)
Solar PV	C ≤ 100 kW	First 30 years	48.87
	100 kW < C ≤ 10 MW	First 30 years	46.33
	10 MW < C ≤ 50 MW	First 30 years	25.50
Solar Thermoelectric		First 25 years	29.90
		Afterward	23.92
Wind		First 20 years	8.13
		Afterward	6.79
Hydroelectric	C ≤ 10 MW	First 25 years	8.66
		Afterward	7.79
Biomass	C ≤ 2 MW	First 15 years	13.95
		Afterward	9.41
	2 MW < C	First 15 years	11.93
		Afterward	8.95

Source: Ministry of Industry, Energy and Tourism