Untangling the web : integrating energy and environmental policy instruments by assessing their interactions along power systems

Simões, S.

Author: Simões, Sofia
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2 A tangled web: assessing overlaps between energy and environmental policy instruments along the electricity supply chain*

* This chapter is submitted in Environmental Policy and Governance Journal for publication. Co-authors: Gjalt Huppes and Júlia Seixas

Abstract

A large number of overlapping energy and environmental policy instruments is targeting the various stakeholders in the electricity supply chain (producers, transmission and distribution companies and the diverse group of consumers). Although synergies between different policy instruments exist, e.g. reducing acidification and climate change by reducing energy consumption, there are also measures whose effects counter each other. Such counter effects arise not only within different environmental policy instruments but also with energy policy instruments. In this paper we survey the overlaps in the policy instruments that target the EU electricity system and characterise their interactions. A framework for further assessment and analysis of overlaps and co-effects between policy instruments is presented. The development of policies and their implementation using specific instruments may then be better aligned. A brief discussion on how trade-offs can be structured is made, as well as some notes on issues to be considered towards policy integration.

2.1 Introduction

The use of electricity for provision of energy services is pervasive throughout the economy. It represented 22% of the OECD countries' final energy consumption in 2009 and was the major final energy carrier in industry and buildings[4] (IEA, 2009). Thus, policies affecting the electricity system condition economies and wellbeing of populations. Presently there is a large number of energy and environmental policy instruments in place which overlap with each other in as much as they share the same targets for policy. The various stakeholders along the electricity supply chain and the end consumers are targeted by many different policy instruments, each aiming to steer their behaviour in a particular direction (Midttun & Koefod, 2003, OECD, 2005). In most cases the steering effects[5] of the policy instruments are also affected by the other instruments in place, i.e. the policy instruments have co-effects. These co-effects occur not only within the same policy field, but also between instruments of different policy fields.

For example, within the field of environmental policy, climate change policies implemented by reducing energy use, or by shifting from coal to gas, contribute to the effectiveness of acidification and air quality policies since they reduce acidifying, tropospheric ozone, chemicals and primary

[4] Electricity represented 31% of final energy consumption of industry and 42% of final energy consumption in buildings in OECD countries in 2009 (IEA, 2009).

[5] By steering effects of policy instrument(s) we mean the resulting change(s) in behaviour caused by the implementation of the instrument(s). These can be either intentional (resulting directly from the implementation of the instruments' objective, e.g. incentives to replace appliances with more efficient ones steering consumers to buy type "A" equipments) or unintentional when unexpected changes in behaviour occur. This is for example the case of rebound effects in general. In the previous example of efficient appliances, one unintentional steering effect of the instrument(s) aiming for the larger deployment of efficient appliances is the sometimes in higher energy consumption as consumers still maintain their older, inefficient appliances functioning as backup or acquire larger appliances (see Greening, et al., 2000).

particulate matter emissions (RIVM *et al.*, 2001, Bollen *et al.*, 2009). On the other hand, emission limit values to air might conflict with emission limit values to water due to relocation of pollutants from air to water (or waste) following the implementation of end-of-pipe technology in chimneys. Examples of co-effects between environmental and energy policy instruments are the CO_2 charges for emissions reduction that are counteracted by the on-budget[6] aids to subsidising oil, gas and coal infrastructures, or the subsidies to renewable electricity generation whose effect is limited by the restrictions of hydropower for water conservation purposes.

Naturally, the more policy instruments in place, the more the potential for overlaps, leading to more co-effects that might significantly reduce overall cost-effectiveness. Therefore, the fact that a large number of new policy instruments are being developed and implemented in OECD countries in order to curb CO_2 emissions (IEA, 2010; EU Commission COM(2008) 30; EU 2003) adds relevance to the assessment of overlaps and co-effects between them.

This issue has increasingly gained the attention of policy makers and researchers. On the research arena, work on interaction between policies/instruments can be found in three main literature areas: policy evaluation (e.g. Mickwitz, 2003; Mickwitz, 2009 and Jordan and Lenschow, 2010); applied policy analysis (e.g. Oikonomou, 2010; IEA, 2011; and Bohringer *et al.* 2009), and more theoretical economic policy analysis (stemming from Tinbergen, 1956 and followed up by many authors as Hoel, 2012). It is widely acknowledged that the non-coordination of energy and environment policy instruments generates costs and inefficiencies that stretch already limited government budgets and hamper the efficiency and effectiveness of all policy instruments in place (EEA, 2005; Briassoulis, 2004;

[6] "Visible in budget accounts or able to be estimated from budget accounts" (Valsecchi et al., 2009). Several authors (van de Beers and de Moor, 2001 and IEA, 2001 in OECD, 2005) estimated that in 2001 the annual subsidies to energy producers in OECD countries ranged from USD 20-80 billion per year via grants, loans and tax exemptions. Roughly a third of the amount was allocated to coal production in 2001, notably in Germany, Spain and France, although these subsidies follow a decreasing trend (IEA, 2001 in OECD, 2005).

Greening and Bernow, 2004; RIVM et al., 2001; EU Commission COM(2004) 394 final). Moreover, the excessive amount of instruments, their high complexity and variety makes the impact assessment of new proposed instruments more difficult and unreliable due to the interferences with existing ones. The same applies to verifying the compliance of the regulated entities. Accordingly, policy makers are taking efforts to integrate environment and energy policy goals. The 1998 European Council in Cardiff formulated an initiative aiming to more effectively integrate environmental aspects into sector policy making, following the articles 2 and 6 of the Amsterdam Treaty of the European Union (EU). In 2001 the Council adopted environmental integration strategies in the energy area, among other (EU Commission SEC (2001)502). In the same year a Sustainable Development Strategy for EU was adopted adding an environmental component to the Lisbon Strategy, which was reviewed in 2006 (Council of the European Union, 2006). This process finds its ultimate formulation in the Europe 2020 strategy of 2010, with policy integration as a main means to better reach sustainability goals (European Commission COM(2010) 2020 final.

This type of integration of policy goals is known as *Intrasectoral* or *Vertical* policy integration. It reflects an incrementalist attitude which mostly results in the addition of environmental goals to sector policies, with little actual integration of the instruments and procedures (Briassoulis, 2004). Therefore, it is not surprising that little has actually been achieved (Nilsson and Nilsson, 2005; EEA, 2005; EEB, 2003; Lafferty and Hovden, 2003; EU Commission SEC(2001) 502, 2001). It is necessary to move from vague statements on the integration of equally vague broad policy goals, to a concrete integration at the level of the policy instruments, where the conflicts between different objectives are more clearly visible. An approach to do so entails systematically assessing conflicts between instruments in place and changing their configuration. Such systematic approaches have been suggested mostly in the field of environmentally harmful subsidies (OECD, 2005; Valsecchi *et al.*, 2009).

This paper tries to contribute to a better integration of energy and environmental policy instruments by: 1) providing a framework to assess overlaps and co-effects between instruments in place alongside electricity systems, and 2) making suggestions for pursuing the integration of energy and environmental policy instruments. . The paper does not aim to present a thorough assessment of the overlaps and co-effects, but merely to suggest a systematic methodology that can be used to do so. The framework does not aim to supply a quantified assessment of the significance of the co-effects between instruments, but primarily contributes to a better framing of the problem. The paper starts by discussing the background for non-coordination within and between energy and environmental policy instruments. This is followed by a brief overview of the research done in this field. A characterisation of policy instruments is made to set the scene regarding the energy and environment policy instruments in place alongside electricity systems. Building on that, the framework to assess overlaps in policy instruments is then presented, and its application exemplified. Finally, a short discussion on how trade-offs can be structured is made, as well as some notes on issues to be considered towards policy integration.

2.2 Background for non-coordination of energy and environmental policies and related studies

2.2.1 Why energy and environment policy instruments are not integrated

The ultimate goal of energy policies has been (and according to the International Energy Agency, will continue to be) to guarantee an adequate supply of competitively priced energy to foster economic development. At EU level the "(...) central goals for energy policy [are] (security of supply, competitiveness, and sustainability)" (EU Commission COM(2011) 112 final:2). However, in practical terms the minimisation or mitigation of caused environmental impacts is a much secondary goal of energy policy (see Nilsson and Nilsson, 2005; EEA, 2005; EEB, 2003; Lafferty and Hovden, 2003). The ultimate goal of environmental policies is to protect natural resources[7]. This **difference in policy goals,** most frequently implemented

[7] Regarding environmental policy, the objective of the EU's DG Environment is "(...) to protect, preserve and improve Europe's environment for present and future generations. It proposes policies and legislation that protect natural habitats, defend clean air and water, ensure proper waste disposal, improve knowledge of the toxicity of chemical substances, and help European businesses move towards a sustainable economy" (DG Environment, 2010:1). The protection of first three (natural habitats, clean air and water)

by different agencies and organisations, is an important cause for non-coordination between energy and environment policy instruments (although not the only one as discussed in this section).

However, **environmental and energy policy instruments are partly overlapping**, since both concern natural resources. Environmental policy instruments intrinsically condition electricity supply and demand by imposing restrictions to the use of natural resources (e.g. establishing land use restrictions or emission limit values) or by providing incentives to change the supply and demand profiles (e.g. creating a market for the emission permits of CO_2 and thus an incentive for shifting or establishing environmental taxes on electricity). Energy policies also condition the fulfilment of environmental policy's goals. The liberalisation of the electricity markets is argued to lead to the decrease of electricity prices and thus reduces incentives for energy saving (Joskow, 2008; Vine *et al.*, 2003; Fuchs & Arentsen, 2002) that allow the minimisation of the environmental impacts associated to energy supply. The loss of control over technology choice may disincentive public investment in environmentally preferably technologies.

Besides this more normative cause, other **aspects of organisational and procedural nature** contribute to lack of integration of energy and environment policy instruments (Persson, 2004; Nilsson and Nilsson, 2005). Energy and environment are autonomous policy sectors that rely on separate specialised vertical organisations (Briassoulis, 2004), with divergent political objectives and interests. The procedures of these organisations further contribute to the non-coordination since there is lack of collaboration among them - from the supra-national level (e.g. the Directorates-General of the EU Commission) to national organisations, weak administrative coordination

is irrefutably the protection of natural resources. We argue that "ensuring proper waste disposal and improving knowledge of the toxicity of chemical substances" are pursued merely to secure the first three (natural habitats, clear air and water). To "help European businesses move towards a sustainable economy" can be seen also a mean to secure the protection of natural resources in order to ensure the survival of economic activity. It is besides the point of this paper to enter into a discussion of the motives behind such concern with natural resources be it the protection of human well-being or perhaps more altruistic concerns with integrity of ecosystems.

and low degree of consultation of national authorities (Robert *et al.*, 2001 in Briassoulis, 2004).

Not only public authorities have responsibilities in lack of policy coordination. Different private lobby groups actively seek to influence political outcomes (Nilsson and Nilsson, 2005). Environmentalists and business lobbies have a prominent role in both formulation and implementation of policy instruments aiming to "*give voice to different aspects of environmental policy, making sure that all aspects are considered in the political trade off and reflected in the implemented policy*" (Aidt, 1998: 2). Therefore, lobbies intrinsically add entropy to the policy process hampering coordination of policy instruments. Lobbies also deliberately act towards the weakening/strengthening of policy instruments depending on how they perceive these to affect their interests. These deliberate actions might result in instruments that seriously counteract each other, depending on the influence of their promoters over policy-makers.

On a more empirical/practical level, other motives for the occurrence of counteracting co-effects in policy instruments are first the lack of awareness to the issue, and secondly the **lack of knowledge** on its impact on cost-effectiveness. This in turn is due to the very rapid pace of development and implementation of policies which does not include systematic policy evaluation practices. According to a study by the European Environmental Agency, there are currently more than 100 pieces of EU environmental legislation in place covering the entire spectrum of environmental problems. Of these, only 12% require Member-States (MS) to provide evaluative information on the effects of the implemented policy measures (EEA, 2001)[8], let alone that counteracting influences would be specified between them.

[8] This corresponds to 13 EU directives and regulations on: integrated pollution prevention and control, lead in petrol, monitoring forest damage, air quality framework, screening for lead, contained use of genetically modified organisms, sewage sludge, titanium dioxide and nitrates emissions to water, habitats and species conservation, cohesion fund, rural development regulation and the greenhouse gas monitoring mechanism (EEA, 2001).

Therefore, it is not surprising that although detailed analysis of individual effects of energy and environment policy instruments on certain sectors is being done[9], there is still a lack of systematic evaluation practices of individual policy instruments' effectiveness and efficiency (EEA, 2001, Vehmas, 2005). Moreover, there is yet much to be done assessing the impacts on effectiveness caused by interactions between individual policy instruments or between combinations of policy instruments (Worrell and Price, 2001; OECD, 2005; Oikonomou and Jema, 2008).

2.2.2 State of the art

Following the concerns about environmental policy integration previously mentioned, and the growing complexity of environmental policies, a new interest starts to develop in the study of the unintended effects of specific environmental and energy policy instruments. Different names are used for these: side-effects (Raadschelders *et al.*, 2003), spillovers (RIVM *et al.*, 2001), rebound effects (Muster, 1995), co-benefits or co-damages (Kleijn and van der Voet, 2002), incidental impacts (Valsecchi *et al.*, 2009) or feedback effects (Worrell and Price, 2001). Most studies in this area focus mainly on identifying the occurrence of specific unplanned effects of instruments and how much these will affect the respective environment/energy objectives, and not so much on understanding the mechanisms of interactions between the different policy instruments.

Some examples of studies of unintended effects of policy instruments are the work developed by RIVM et al. (2001) that performed repeated simulations of the DPSIR[10] chain combining cost-benefit analysis and integrated environmental assessment "for a selection of policy packages with the aim of identifying the most cost-effective set of policy responses" (ibid.:168) for all

[9] Such as the studies on policy instruments to promote industry energy efficiency by Worrell and Price (2001); on household appliances by Menanteau (2003) or Boardman (2004); on support schemes for renewable electricity by Lauber (2004), on energy taxes by Vehmas (2005) or on energy tax exemptions on aviation fuel by van Beers *et al.* (2007), to mention but a few.

[10] Driving Forces-Pressure-State-Impact-Response (DPSIR) (EEA, 1999).

environmental problems. The White and Green Project (n.d.) used a technical-economic model to study the cost-effectiveness effects that the combination of white certificates, green certificates, CO2 emissions trading and an energy tax might have. Uyterlinde & Jeeninga (1999) used a similar approach for evaluation of combinations of energy efficiency policy instruments in households. Valsecchi et al. (2009) adapted the OECD (2005) framework to identify and assess environmentally harmful subsidies (including energy ones).

Although all authors acknowledge the importance of coherently integrating different policy instruments (within environmental policies, within energy policies and between those two policy areas) and provide suggestions on how to do so within the scopes of their respective studies, their approach is partial. It considers either the environmental problems/themes and not the energy issues (RIVM *et al.* study) or a selection of a few of the policy instruments in place (the other studies). This happens not only in these studies but in the majority of the literature in this area (Oikonomou and Jema, 2008). Sorrell (2003), within the INTERACT EU Project, and Oikonomou and Jepma (2008) take a step further. The former assesses in detail the mechanism of interaction between the EU ETS and other climate policy instruments, whereas the latter propose a framework to analyse interactions between all energy and climate change policy instruments, instead of focusing on only pairs of instruments. However, both cases focus on climate policy instruments only. Energy and other environmental instruments are out of scope.

In a formal modelling sense, a converse position can be maintained: the number of instruments should equal the number of goals (see Tinbergen, 1956). In this reasoning it is assumed that goals can be specified independently and that all instruments and goals are linked in one model involving all intermediary variables. Reality is not so easily modelled, but the basic point remains: too many instruments will create unnecessary costs for reaching given goals.

In this paper a broader policy scope is suggested than climate policy while using specifically electricity systems as a focal point. Because, in all probability, the significance of overlaps in policy instruments increases with the number of instruments, overlaps should be firstly screened at a general policy level for the electricity system, without targeting one specific policy area. This initial overall screening allows for getting a more complete picture of all overlaps from which the more problematic ones can be singled out. To do so, however, it is necessary to evaluate and rank overlaps according to their impact on overall cost-effectiveness for the electricity system.

This paper considers a larger number of policy instruments from the two different policy fields and includes the different groups and activities that constitute electricity systems. Moreover, a framework is developed to systematically assess overlaps and co-effects between instruments. This can be the starting point of a methodology for the quantification of impacts of co-effects of policy instruments.

2.3 Tangled web – energy and environment policy instruments in place in electricity systems

This section presents an overview and characterisation of policy instruments both currently in place and that will be implemented within years, in order to set the scene for the assessment of their overlaps and co-effects. Generic types of policy instruments in place across the EU were considered instead of specific policy instruments implemented in one particular country. This allows for a more complete overview of potential overlaps between different policy instruments without being restricted to the range of instruments implemented by specific governments. For the purpose of this overview electricity based transport was not considered particularly relevant, as electricity in transport represents only 1% of final energy consumption in 2009 in OECD countries (IEA, 2009), and thus is not included. This situation will most probably change as increasing policy focus is given to electric vehicles, but nonetheless we did not cover specific policy instruments for these at this point.

For the characterisation of the instruments, as presented in Figure 2.1 and in Appendix A, the following aspects are considered relevant since they give information on different levels of interaction between the instruments:

1. **Objective of the instrument**, which refers to the explicit objective of the instrument as stated in the documents that formulate it. This is usually more specific than the broader policy goal that led to the development of the instrument.

2. **Mechanism of instrument** used to steer behaviour (Command-and-control (CAC); economic/market-based and moral suasion and voluntary initiatives[11]).

3. **Target stakeholder(s)**, i.e. those whose behaviour the policy instruments primarily aims to steer, such as primary energy suppliers; electricity generators; transmitters; distributors & retail suppliers; appliances manufacturers and distributors; several types of consumers (household, services, industry), among other. Although policy instruments can affect the behaviour of other stakeholders than the ones intentionally targeted we have not included these, for the sake of simplification.

4. **Action according to the DPSIR framework**, as developed by the European Environmental Agency from the OECD Pressure-State-Response model. According to the adaptation made by RIVM et al. (2001), policy instruments can be part of macro-economic policy or sector specific when designed to reduce or eliminate the underlying causes of the problems, such as market failures[12] (acting at the level of the Driving forces); or be source-oriented (act at the level of the Pressures), effect-oriented (act at the level of the State of the environment) or curative (acting at the level of the Impacts).

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[11] This category includes a very broad range of instruments, from negotiated environmental agreements, self-auditing and voluntary disclosure, voluntary programmes and other education/information measures to enhance awareness, see Huppes and Simonis (2010).

[12] Other underlying causes besides market failure are missing markets, information gaps, policy inconsistency and implementation failure (RIVM, *et al.*, 2001).

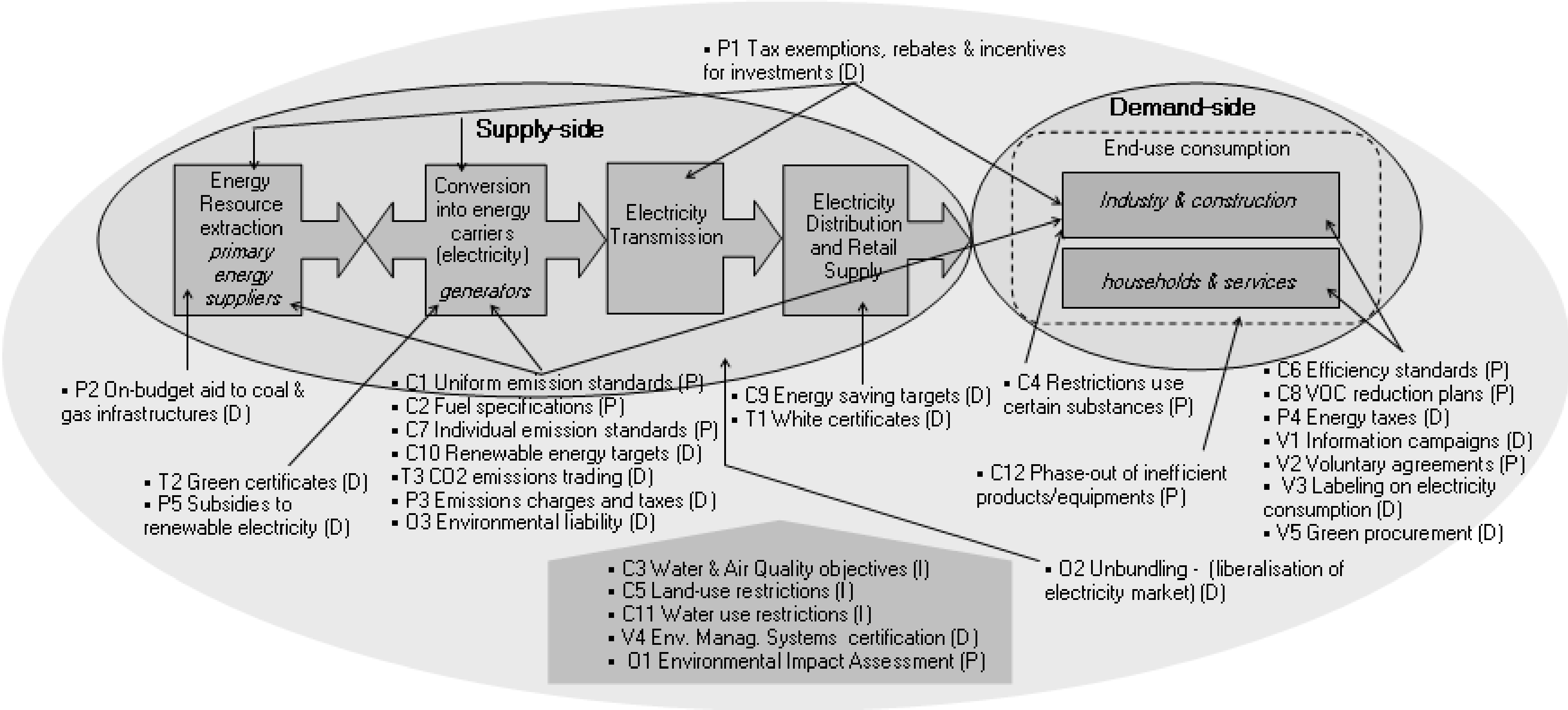

Figure 2.1 – electricity system and some energy and environmental policy instruments: a tangled web. Each instrument is identified with a letter and a number identical to the one used in Appendix A where a characterisation of instrument is presented. C – Command-and-Control; T – Tradable permits; P – price; V – moral suasion & voluntary and O – Other. The letter in between brackets indicates the type of action according to the DPSIR framework.

The characterisation of instruments also considers the instrument's **place of intervention in the electricity system**, closely related to the targeted stakeholders (extraction of primary energy sources; electricity generation; electricity transmission; electricity distribution and end-use consumption, or at a more broad scale, supply or demand of electricity). Aspects related to the institutional dimension[13] are not explored here, although they are particularly relevant since one of the barriers to the integration of policy instruments is that the benefits might not be felt at sector level in the short-term and only at the broader societal level (Persson, 2004).

Figure 2. 1 presents the electricity system as considered for the purpose of this paper. The supply and demand sides are identified together with some of the energy and environment policy instruments. Each policy instrument is shown linked to the stakeholder(s) that it directly targets. Therefore, indirect effects of one instrument over other stakeholders are not represented as this would make the picture even more complex. In the figure is also indicated the mechanism of the instrument and the type of action according to the DPSIR framework. A more complete characterisation of the policy instruments is presented in Appendix A.

A total of 27 different generic types of instruments are or will be in place along electricity systems, creating quite a complex picture. Even so, the instruments here depicted do not result from an exhaustive review and other specific policy instruments for waste management, transport, noise and accidents are not represented here. These 27 instruments are quite varied regarding mechanisms used and targeted stakeholders. Whereas most policy instruments target a specific stakeholder or groups of stakeholders, there are three environmental instruments (quality objectives, land and water use restrictions) that do not directly target any of the represented stakeholders and three instruments that are of a more transversal nature and directly affect all players (environmental impact assessment, environmental

[13] These refer to the co-ordination between the institution(s) responsible for design, implementation, monitoring and enforcement of the instruments, which can operate at different administrative levels, be it different sectors (e.g. energy, finance, transport, environment) or different hierarchic levels (i.e. EU, national, regional or local).

management systems and unbundling within the liberalisation of electricity market).

Both energy and environmental policy instruments are predominantly command-and-control (11 of the 26), but there are also quite a few (8) economic instruments (essentially subsidies). All stakeholders are targeted by a similar number of policy instruments, with the exception of electricity distributors & retail suppliers and transmission system operators. Whereas instruments targeting household and services are essentially moral suasion and voluntary, other players have their behaviour steered mostly by command-and-control and economic mechanisms.

2.4 Assessing overlaps and co-effects between policy instruments

2.4.1 Concept of overlaps and of co-effects of policy instruments

The concepts of side-effects, spillovers, rebound effects, co-benefits or co-damages, feedback effects or incidental impacts used in literature are closely interrelated and all refer to the unintended effects that the implementation of one or more policy instruments might bring upon other environmental or energy objectives. It is not the goal of this paper to look into the different unintended effects approached by each concept. Instead the paper focuses on the overall systemic effects between policy instruments. The current concepts do not clearly link the affected environmental or energy objectives with the specific policy instruments designed to achieve them. This subtlety is important because to optimise overlaps in policy instruments already in place it is necessary to consider not only how environmental or energy policy objectives are affected, but also the formulation of the overlapping policy instruments.

Therefore, it is considered useful to clarify the concepts of overlaps and co-effects of policy instruments. For the purpose of this paper, the relevance in overlaps of two or more policy instruments increases to the extent that 1) they share the same target stakeholder and 2) that their steering effects occur within related policy goals. Two policy instruments that steer the behaviour of totally different stakeholders and whose steering effects are not at all related (e.g. induce consumers to reduce alcohol intake, as part of health policy, and drive industry to implement energy efficiency measures, within energy policy) are of course not overlapping. However, if the stakeholders are different and the steering effects are closely related (e.g. induce households to reduce electricity consumption and drive industry to implement energy efficiency measures) there is a relevant overlap.

This overlap is even more relevant if different instruments steer the behaviour of the same target stakeholder. Those steering effects are likely to affect each other. For the purpose of this paper it can then be said that the policy instruments have co-effects, i.e. effects on each other felt at the level of its intended steering effects. The co-effects of policy instruments can be complementary (the steering effects of the instruments supply mutual needs or offset mutual lacks) or counteracting (the steering effect of one or more instrument counteracts the action of the other(s). This rationale of overlaps and co-effects in policy instruments is depicted in Figure 2.2.

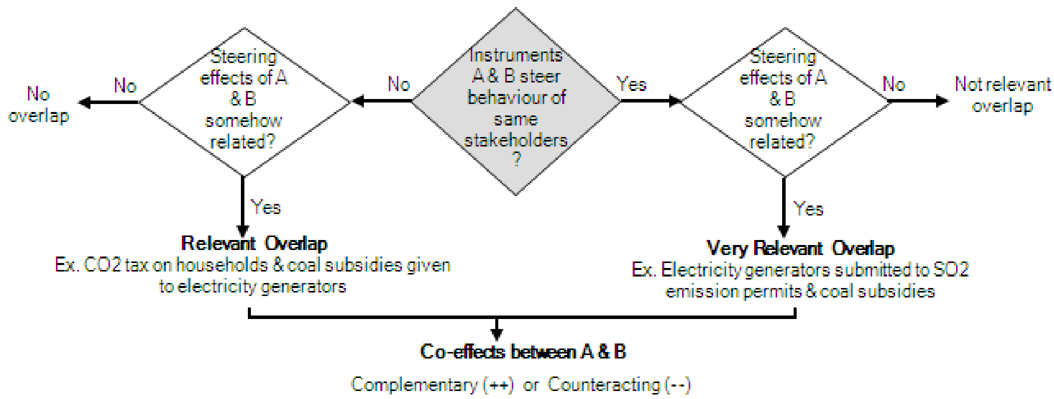

Figure 2.2 – Policy overlaps and co-effects in the context of this paper.

All policy instruments in Figure 2.1 (and Table 2.1 in next section) have relevant or very relevant overlaps since they either target the same stakeholders or have steering effects within related policy goals.

2.4.2 Framework to assess overlaps and co-effects

The question to be answered when assessing co-effects of two or more policy instruments is to what extent they overlap and how their steering effects affect each other. To understand this, the objectives of the instruments, its mechanisms and the targeted stakeholders have to be looked upon, as follows:

1. A **screening** of the objectives of the different policy instruments is made to assess as to what point they are **overlapping** (i.e. to what extent they either target the same stakeholder and/or they steer related behaviour of stakeholders, represented with +) or not (-). Note that, as mentioned before, it was already established that all policy instruments covered here are overlapping.

2. Their respective **mechanisms** are analysed to understand how well the instruments are coordinated. At this stage this can be done at two levels: a) no-coordination (0) - the instruments do not acknowledge the existence of other or b) some coordination (+) in the instruments (expressed as derogations or alterations in scope, among other).

3. The **steering effects** of the different instruments are analysed to identify if they are complementary (+; the objectives of the instruments steer the behaviour of the target stakeholders supplying mutual needs or offsetting mutual lacks), or counteracting (-; the objectives of at least one of the instruments steers the behaviour of the same stakeholders in a way that hampers the steering effect aimed by the other instruments).

This framework does not consider the actual effectiveness of the implemented policy instruments, in the sense that it do not assess, neither qualitative nor quantitatively, if the instrument was successfully implemented or if it failed to achieve its objectives, and how those successes or failures are affected by overlaps and co-effects between instruments. This would be extremely difficult due to the lack of policy evaluation assessments and the large number of instruments in place. The framework instead focuses on looking into the policy instruments' design translated into their written formulation Therefore, it cannot be used to assess the relevance in terms of quantified cost-effectiveness of the co-effects between policy instruments, but only to assist in a better understanding of how are instruments related to each other and in identifying priority areas for further analysis.

Because this framework focuses on the policy instruments and actors or stakeholders, it also does not address the other components of the policy process (objects, goals and the structures and procedures). Including these components would be relevant to understand the motives behind each overlap and co-effect but that is not the purpose of the framework. It merely aims at providing a systematic approach to identify and assess them.

Starting from the policy instruments depicted in Figure 2.1, targeting specific stakeholders, we have screened (in Table 2.1) their objectives as explicitly stated in the legislative texts (to the possible degree). By doing so, we avoid entering into a subjective allocation of "implicit" policy objectives which could be highly debatable. As it is, this identification of objectives can already be criticised. For example, P3 (emission charges and taxes) have the explicit objectives of internalising environmental costs, raising revenues and cover costs of policy instruments, but not to reduce emissions. Nonetheless, the identification of explicit objectives allows for better assessing their overlaps and co-effects. If all instruments are placed within the broader goal of "protect natural resources" or promote "secure, competitive and sustainable energy" there is no progress made towards the current *status quo*.

Table 2.1. Policy instruments objectives and grouping into clusters of objectives to assess co-effects (the codes for policy instruments correspond to the characterisation presented in Appendix A)

#	Objective of reviewed policy instruments	Policy instruments	Cluster of policy instruments objectives			
			Environment	End-use efficiency	Competitive supply	Secure supply
1	Reduce emissions	C1, C2, C4, C7, C8, T3	✓			
2	Minimise risk of environmental damage	C3, C11, O3, O1	✓			
3	Minimise environmental impacts	C5, V5	✓			
4	Improve overall (environmental) performance	V4	✓			
5	Increase end-use energy efficiency	C6, C9, T1, V2, V3, C12		✓		
6	Increase awareness for end-use energy efficiency	V1		✓		
7	Internalise environmental costs	P3, P4	✓			
8	Cover cost of policy instruments	P3, P4	✓		✓	
9	Raise revenues	P3, P4	✓		✓	
10	Increase energy/electricity from renewable sources	C10, T2, P5				✓
11	Promote security of energy supply	P1, P2				✓
12	Improve efficiency of electricity supply, price gains & quality of service	O2			✓	
13	Provide affordable energy	P1, P2			✓	

Most of the objectives of the reviewed instruments contribute both to broad energy and environmental policy goals. It is not straightforward to separate energy and environmental policy instruments, but groups or clusters of overlapping, but yet complementary, policy instruments objectives can be made to better assess co-effects between them. The screening of objectives allows stating that there are relevant overlaps within each cluster and between clusters since most of the instruments in Table 2.1 steer the behaviour of the same stakeholders and/or their steering effects occur within related policy objectives (we have established in section 2.2.1 that broad environment and energy policy goals are closely related, and in this section the linkages of objectives in Table 2.1 within each cluster). We have grouped the instruments in clusters according to how complementary their co-effects are within each cluster:

- *Environmental Cluster* - includes instruments with objectives that fall within the policy areas implemented by the EU's DG Environment. Policy instruments with objectives 1 to 4 (reduce emissions, minimise risk, impacts and improve overall performance) and 7 (internalise environmental costs) overlap each other because they mostly[14] target the same stakeholders (industry, electricity generators and primary energy suppliers), each steering their behaviour to reduce/control damage to the environment;
- *End-use efficiency cluster* – includes instruments in the policy areas of energy efficiency of the EU's DG Energy, i.e. that explicitly mention in their formulation end-use energy efficiency. Policy instruments with objectives 5 and 6 are complementary (Increase end-use energy efficiency and awareness end-use energy efficiency) because they both steer the behaviour of the same stakeholders (retail suppliers and/or industry & buildings) to supply the same need of promoting end-use energy efficiency;
- *Competitive supply cluster* – includes policy instruments in the policy areas of the EU's DG Energy and aiming for more affordable electricity,

[14] The exception are the instruments C5 (Land use restrictions), C11 (Water use restrictions) and V4 (Certification of environmental management systems) that do not target explicitly any stakeholder (or target all).

i.e. with objectives 12 and 13 (Improve efficiency of electricity supply, price gains & quality of service and provide affordable electricity) which steer the behaviour of mostly overlapping energy suppliers (electricity generators, primary energy suppliers, distribution & retail supply) to provide more competitive, affordable energy (and electricity);

- *Secure and diverse supply cluster* – includes instruments in the policy areas of the EU's DG Energy promoting security of energy supply and renewable energy (which contributes to security of supply through the diversification of energy sources, many of which are endogenous to the EU). These include objective 11 (promote security of supply) which overlaps with objective 10 (increase use of energy/electricity from renewable sources), since these are mostly the same stakeholders (primary energy suppliers and electricity generators) whose behaviour is being steered to generate more energy/electricity. Although it could be argued that the promotion of end-use energy efficiency also contributes to the security of supply, the targeted stakeholders are different (demand *versus* supply stakeholders) which is why we have separated the instruments in two clusters.

Prior to exemplifying how to implement the framework to assess overlaps and co-effects at the level of policy instruments (Table 2.2) we do it at the more general level of the different clusters of instruments. At this point we have already established that there are significant overlaps for these instruments. At the cluster level there is no point in looking into the coordination aspect since this is dependant of each instrument's formulation, which can only be assessed at the level of the instruments themselves. The advantage of firstly implementing the framework at cluster level is to allow for gradually increasing the level of complexity and that only to the necessary extent. Basically, if we can to some extent infer on the types of co-effects at the cluster level, it might not be necessary to detail further the assessment for each policy instrument. Therefore, regarding the co-effects between different clusters:

i) There is the potential for complementary effects (+) between the Environmental and End-use efficiency clusters, since when steering behaviour of (albeit different) stakeholders to reduce end-use energy consumption is also achieved a reduction of environmental impacts associated to energy supply;

ii) It is not straightforward to assess the types of co-effects between the Environmental and Competitive supply clusters and this has to be done at the policy instruments level. Both clusters target the same stakeholders (mostly supply-side and industry). However, although P3 (Emission charges and taxes) and P4 (Energy taxes) are in both clusters and thus there is also here potential for complementary co-effects (+), the same cannot be said for other instruments in the Environmental cluster and the Competitive supply instruments P1 (Tax exemptions…), P2 (On-budget aids to coal and gas) and O2 (Unbundling) which have potential for counteracting co-effects (-). We discuss this in the policy instrument level assessment in Table 2.2;

iii) Likewise, is not straightforward to assess the co-effects between the Environmental and Secure supply clusters. Both clusters target the same stakeholders (mostly supply-side electricity and industry). In one hand increasing electricity generation from renewable resources (C10 RES targets, T2 Green certificates and P5 Subsidies to RES electricity) might (or not depending on the energy sources and types of environmental impacts considered) contribute to the objectives in the environmental cluster (+ co-effects). On the other hand, the instruments in the secure cluster P1 (Tax exemptions…), P2 (On-budget aids to coal and gas) might have counteracting co-effects (-) with the instruments of the environmental clusters (see Table 2.2);

iv) The clusters End-use efficiency and Competitive supply target different stakeholders mentioned and their steering effects can potentially be counteracting (-) as P1 (Tax exemptions…) and P2 (On-budget aids to coal and gas) can potentially lead to cheaper final energy prices thus reducing the incentive for end-use energy efficiency.

v) Between the End-use efficiency and Secure supply clusters, although targeting different stakeholders (again demand versus supply stakeholders), there is a potential for complementary co-effects (+) as when steering behaviour of stakeholders to reduce end-use energy consumption, the overall needs for energy are reduced decreasing for example dependency from external imports;

vi) Finally, Competitive and Secure supply clusters target the same stakeholders (suppliers) and there are potentially counteracting co-effects (-) as typically renewable electricity technologies (C10, T2, P5) are costlier than fossil ones (at the present and assuming externalities are not considered), and since P1 (Tax exemptions…) and P2 (On-budget aids to coal and gas) add cost to electricity generation to ensure security of supply (see van de Beers and de Moor, 2001 and IEA, 2001 in OECD, 2005).

Table 2.2 exemplifies the application of the above mentioned framework to a few of the characterised instruments. To do so for the whole of environmental and energy policy instruments is outside the scope of this paper. We do not go into detail into assessing the overlaps between instrumented (denoted with +), as was already discussed. Therefore we focus on the coordination of mechanism (+ or 0) and assessing complementary (+) or counteracting (-) steering effects caused on their target stakeholders.

Both emission standards within C7 IPPC and the T3 CO_2 emissions trading have emission reduction as an objective and both steer stakeholders towards emission reduction. Hence they are classified as having complementary co-effects (+). IPPC permits should not consider CO_2 emissions of the plants within the scope of the CO_2 emission trading Directive, showing some coordination of the two instruments (+). Similarly C7 IPPC, T3 CO2 emission trading and P5 Feed-in tariffs have complementary co-effects (+) as the promotion of renewable electricity contribute to pollution prevention and control and abate CO2 emissions. However, there is no specific coordination in their texts (0) regarding feed-in tariffs and vice-versa.

Table 2.2. Assessment of co-effects of selected energy and environment policy instruments. (Env) - Environmental cluster, (End)- End-use efficiency cluster, (Comp) – Competitive supply cluster, (Sec) – security of supply cluster

Policy instrument	C7 IPPC	T3 CO2 trade	P5 Feed-in Tariffs	C6 Eff. Targets	C12 Phase-out ineff. prod./eq.	P1 Tax exemptions	P2 On-budget aid
C7 Individual emission standards IPPC (Env)		+overlap + mechanism + effect	+ overlap o mechanism + effect	+ overlap + mechanism + effect	+ overlap o mechanism + effect	- overlap o mechanism - effect	- overlap o mechanism - effect
T3 CO2 emission trading (Env)			+ overlap o mechanism + effect	+ overlap o mechanism + effect	+ overlap o mechanism - effect	- overlap o mechanisms - effect	- overlap o mechanism - effect
P5 Subsidies to renewable electricity Feed-in tariffs (Sec)				+ overlap o mechanism - effect	+ overlap o mechanism - effect	+ overlap o mechanism - effect	- overlap o mechanism - effect
C6 Efficiency Targets (End)					+ overlap + mechanism + effect	+ overlap o mechanism - effect	+ overlap o mechanism o effect
C12 Phase-out inefficient. products/equip. (End)						+ overlap o mechanism - effect	+ overlap o mechanism - effect
P1 Tax exemptions on fossil fuels (Eff and Sec)							+ overlap + mechanism + effect
P2 On-budget aid to coal & gas industry (Eff and Sec)							

C6 end-use energy efficiency targets, T3 CO_2 emissions trading and C7 IPPC applicable to industry and have complementary co-effects (+) since while pursing the former, overall energy consumption is decreased and with it associated pollution (C7 IPPC and CO_2 emissions from T3). However, the CO_2 emissions trading Directive does not establish an explicit link with existing C6 energy efficiency legislation (0). Coordination of the mechanisms of the two instruments might or might not occur depending on what to extent energy consumption benchmarking is effectively used in the allocation criteria. On the contrary, while implementing IPPC permits the regulator is encouraged to use energy efficient benchmarks defined in the Best Available Techniques Reference Documents (+ some coordination).

The P5 Feed-in tariffs and C6 end-use energy efficiency targets are found to have counteracting co-effects (-) because the former steer electricity generators to generate more electricity (from RES0, whereas the latter aims to reduce final energy consumption (Pehnt et al., 2009). There is no explicit coordination of the instruments mechanisms (0).

The C12 Phase-out of inefficient products/equipments has complementary co-effects (+) with C6 end-use energy efficiency targets as both steer consumers to reduce end-use energy consumption and with C7 IPPC as between C& and C6. The mechanisms of the instruments C6 and C12 are coordinated (+) as the phase-out regulation stems from the eco-design directive included in C6. However, we find that there are counteracting co-effects between this instrument and T3 CO2 emissions trading and P5 feed-in tariffs to RES. On the latter the counter effect is similar to what happens between P5 and C6. For the case of T3 it has been argued that this phase-out brings down the demand for electricity and associated CO2 emissions thus brings down the price for CO2 permits (Frondel and Lohmann, 2011).

The steering effects of P1 tax exemptions on fossil fuels and P2 On-budget aids to coal and gas industry are likely to have counteracting co-effects with all the other presented instruments in Table 2.2 since they steer stakeholders to adopt technologies and energy carriers that increase emissions (C7, T3), counteract the overall penetration RES electricity (P5) and the incentives to C6 save energy (see Vehmas, 2005 and Matschoss, 2002). Thus, on a very simplistic way, merely by looking into Table 2.2 the seemingly most relevant conflicts found in the tangled web stem from these two instruments.

By performing such a generic assessment to the characterised policy instruments in place it is possible to systematically identify the types of co-effects between them. This can be an essential first step in the development of a methodology to quantify its impact in terms of the overall cost-effectiveness of the instruments in place.

2.5 Towards integration of energy and environment policy instruments

Due to human limitations in understanding all the dimensions of complex problems (as to achieve sustainable electricity systems) it is not realistic to expect that policies can develop perfectly coordinated instruments capable of successfully addressing all social, economic and environmental problems. The step-by-step policy making approach, handling one issue at a time is in many cases the best possible solution. In fact, one cannot talk about the relevance of policy integration if there are not several elements to integrate. It is only because we have now achieved a more mature state in environmental and energy policy making that integration can become a concern.

Looking back to the times of implementation of the reviewed policy instruments, one can realise that they were implemented over a long time-frame (approximately 30 years) and the more recent ones seem better coordinated, mostly due to the great umbrella of climate change policy (see the energy climate policy package, EU Commission COM(2008) 30 and the roadmap for moving to a competitive low carbon economy, EU Commission COM(2011) 112 final). Climate change policies seem to be the ideal meeting point between energy and other environmental policies, or at least for demand-side energy and environmental policies. Nonetheless, there is still large room for improvement in achieving commitments between these two areas, as there are still many different policy objectives, as was shown in Table 2.1. Moreover, climate change is but one of the environmental problems to be dealt with. For other environmental problems this intrinsic drive for integration might not apply, such as conservation of biodiversity; toxicity policies; nutrient and acidification policies; and climate policies are relevant together.

2.5.1 Structuring trade-offs

In such cases where there are quite different policy goals, the optimisation of co-effects of the policy instruments and development of a unitary integrated policy is not possible or even desirable. Likewise, in some cases policy objectives besides being different might directly or indirectly contradict each other. For example, supplying energy at the lowest costs might imply reliance on few energy sources/suppliers whereas ensuring security of supply requires a more diverse portfolio that includes more expensive resources/suppliers. Horizontal integration[15], or the integration of policy instruments of different sectors inevitably brings out the issue of trade-offs (Lafferty and Hovden, 2003). The different components to integrate usually do not have the same weights and there is the risk that the output of integration will only be a dilution (Liberatore (1997), in Persson (2004:14); Nilsson and Nilsson, 2005).

Not only is it necessary to assess the trade-offs between two different policy instruments (A), but also between having them separate versus their integration (B) (Figure 2.3). For simplification it is necessary to reduce the analysis to two things to be traded any one time. But even if it is possible to isolate just two policy goals and two costs of these policies involved, with two simple policy instruments; there is not one *numeraire* available to express different non-market effects. Reflecting this, the approaches to structure trade-offs in policy integration are mostly quite vague and generic. For instance, Collier (1994), in Persson (2004:13) suggests that the ideal approach for structuring such trade-offs would be to use Pareto optimality[16]

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[15] *Intersectoral* or *horizontal* policy integration refers "*to the establishments of relationships among policies with respect to a given issue (e.g. environmental protection) or to several interlinked issues* (…)"(Briassoulis, 2004) and typically entails a central authority that develops a comprehensive cross-sectoral strategy for environmental policy integration. This approach is acknowledged as being more effective than intrasectoral policy integration but is more difficult to implement since it requires "*substantive coordination and a willingness to prioritise among sectors*" (Lafferty and Hovden, 2003).

[16] In a Pareto optimal solution it is not possible make one person better without making another person worse off. In multi-criteria situations, as is the case, this can be translated

as criterion to do so, but he also acknowledges that due to lack of knowledge this is not feasible in practice and thus a set of probably less optimal criteria could be used. The literature for policy integration essentially focuses on criteria to assess if policies are integrated and not on how to actually integrate policy instruments already in place (Persson, 2004).

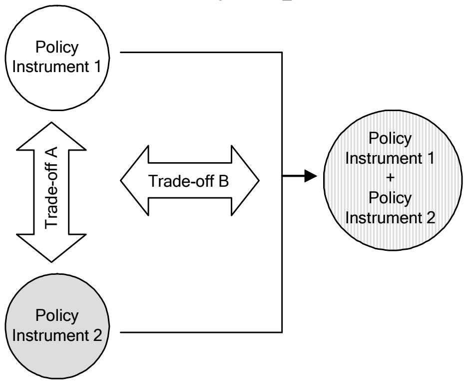

Figure 2.3 – Trade-offs to be structured

A starting point for a set of criteria to integrate energy and environment policy instruments could be to consider an approach similar to the one of the Water Framework Directive. Different water uses have to be combined, some of which are partly conflicting amongst each other such as ecological protection and drinking water supply. For uses that "*adversely affect the status of water but which are considered essential*" derogations from the requirement to achieve good status are provided "*so long as all appropriate mitigation measures are taken*" (Environment DG, 2010). In cases where the water quality damaging activity is open to alternative approaches (similar to the case of power generation where other means of power generation can be used), derogations are provided, but subject to three conditions: "*i) that the alternatives are technically impossible, ii) that they are prohibitively expensive, or iii) that they produce a worse overall environmental result*" (*ibid.*). The question, of course, is how to deal with the somewhat subjective nature of these conditions.

as to make an improvement in one of the considered criteria without damaging at least one other criteria. In other words, a solution can be considered Pareto optimal if "there is no other solution that performs at least as well on every criteria and strictly better on at least one criteria".

Finally, for further structuring of trade-offs it is necessary to increase the objectivity of the criteria to use, which can only be done if there is more information on the functioning of co-effects of policy instruments and on their quantitative impacts on overall effectiveness and efficiency.

2.5.2 Improving the current policy making

The fact that currently there is lack of coordination between policy instruments does not mean that policy approaches should follow one single line. Authors seem to agree that a package of diversified policy instruments integrated into coherent policy packages can be more effective. However, if these several policy instruments are not seen as part of one unified policy and its co-effects are not dealt with, its effectiveness and efficiency will surely be reduced (White & Green, n.d.; Uyterlinde and Jeeninga, 1999; Worrell and Price, 2001; Boardman, 2004).

The difficulty is that the policy making process is too complex to ensure that this is always done, especially since there is lack of supporting methodologies and tools. In the policy integration literature much can be found on the necessary steps for policy integration (normative, organisational and procedural). However, these suggestions are more directed towards the integration of policies than of policy instruments. As a starting point to gain insights into concrete suggestion for the integration of policy instruments it seems to be more useful to look into the many analyses of individual instruments made, despite the fact that these intrinsically result from a non-integrated approach and thus provide limited input towards the development of a generic policy instrumentation framework.

On a different level, and because the role of public policy has been recurrently discussed in relation to the liberalisation of electricity markets, it is relevant to state here that to minimise conflicts in policy instruments, governments should have a strong role in policy development and implementation sending out clear signals to stakeholders (this view is shared by many authors, such as Boardman, 2004; Wuppertal, et al., 2000; Uyterlinde and Jeeninga, 1999). Not only that, but also governments should pay more attention to the signals sent by the stakeholders to 1) minimise distortion of policy goals due to lobbying (at policy development level), and 2) ensure stability at policy implementation level.

2.6 Conclusions

Currently there is a multiplicity of energy and environmental policy instruments in place that target the various stakeholders in the electricity system. More than thirty years of environmental and energy policy making have created a tangled web. This has led to significant overlaps between policy instruments. Some of these overlaps are synergistic but quite a few steer the behaviour of stakeholders in opposite directions, compromising the overall policy effectiveness. Although several studies have looked into such interactions of policy instruments they are limited to specific pairs or groups of instruments from the field of energy policy and/or climate policy. In this paper we presented a framework in which to consider both the energy policy instruments as well as those from the broad field of environmental policy (climate policy is seen as a segment of the wider field of environmental policy).

In order to do so, the paper established the concept of overlaps of policy instruments that measures the extent to which: 1) target stakeholders are shared, and 2) their steering effects occur within related policy goals. If there are relevant overlaps in policy instruments co-effects between them will occur, i.e. effects on each other felt at the level of its intended steering effects. These can be complementary, synergetic or counteracting.

The proposed framework systematically assesses overlaps and co-effects of policy instruments looking into their objectives, mechanisms and targeted stakeholders. The first step of the framework is the screening of the objectives of the different policy instruments to assess to what extent they steer related behaviour of the same stakeholders, followed by the identification of the type of overlap (complementary or counteracting). The coordination of the policy instruments' mechanisms is then analysed and classified in two straightforward levels: a) no-coordination - the instruments do not acknowledge the existence of other or b) some coordination in the instruments (expressed as derogations or alterations in scope, among other). Finally, divergences in the target stakeholder's steering effect are assessed.

The seemingly most relevant conflicts found in the tangled web are between hidden subsidies provided to energy supply infrastructures and environmental command-and-control regulation. Although there are policy instruments acting both on the supply and the demand side, these do not necessarily lead to integration of supply and demand-side policy instruments.

Due to lack of information on analysis of policy instruments it is not possible at this stage to assess the relevance of the identified co-effects regarding overall efficiency, effectiveness and equity. More work is needed on methodologies for the qualitative and quantitative assessment of co-effects of policy instruments. Furthermore, the approach to assess co-effect presented in this paper concerns the interactions between policy instruments and therefore is limited to only two of the components of the policy process (the policy instruments and actors or stakeholders). The other components - objects, goals and the structures and procedures – are not approached here. It has to be noted that to achieve policy integration it is not enough to simply secure the integration of its instruments, because the effects of the policy instruments are dependent of the context and thus of all the other components of the policy process. Nonetheless, integration at level of the policy instruments is a good starting point towards the next challenge, the integration of the policy processes in all its components.

Achieving sustainable electricity systems is a very complex problem, which our limited human minds can only grasp partially. Thus, it simply might be unrealistic to aim for fully coordinated policy instruments. Likewise, policy instruments do not necessarily have to follow one single line. Coherent policy packages can be more effective, as long as its co-effects are assessed and dealt with. While governments develop and implement such packages it is fundamental to make sure that clear signals are sent out to stakeholders. While doing so governments should pay more attention to minimise distortion of policy goals due to lobbying (at policy development level), and ensuring stability at policy implementation level.

Finally, we have focused on electricity systems but the proposed framework could be adapted beyond electricity, to the whole energy system, for example to include production and use of refined oil products and renewable heat, among other. Other developments would be to go in more depth into the environmental policy instruments that here, because they do not target specific stakeholders in the electricity system, we have only identified without further analysis. This is the case of water and air quality objectives, land use restrictions, and water use restrictions, among others. Another step further with the proposed framework would be to try to quantify some of these overlaps and co-effects, estimating the variations in overall cost-effectiveness for the electricity/energy system, for example by using an energy-economy-environment energy system model. All these developments would naturally increase the complexity of the tangled web but nonetheless we believe the framework implementation is still manageable and worthwhile.

2.7 Appendix A

Table 2.3. Overview of some energy and environment policy instruments in place along electricity systems

#	Policy Instrument/Mechanism	Objective of the instrument [a]	Target stakeholder [b]	DPSIR	Responsible for implementation & implementation date [c]	Supply / demand	Example
Command and Control							
C1	Uniform emission standards (air, water & soil)	Reduce emissions by setting uniform emission limit values per sector/activity	Industry & services (primary energy suppliers & generators are covered by IPPC)	Pressure	Environmental agency 1970 (air) & 1975 (water)	Supply & Demand	NO_x, SO_2, VOC, particles, metals, P, NO_3, organic pollutants among other – several Directives
C2	Fuel[d] specifications	Reduce emissions to air	Industry, electricity generators, primary energy suppliers	Pressure	Energy agency 1975	Supply & Demand	S content in heavy fuel oil - Directive 99/32
C3	Water & air quality objectives	Minimise risk of environmental damage	–	Impact	Environment agency 1975 (water) & 1980 (air)	Supply & Demand	NO_x, SO_2, O_3, Pb, particles, benzene, CO, metals, pesticides, microorganisms, among other-Directives 04/107, 08/50, 08/105, 06/7, 98/83
C4	Restrictions of use of certain substances / products	Reduce emissions by decreasing use of substances	Industry (manufacturers of products using such substances), although other stakeholders that use products have to adapt	Pressure	Economy/ industry agency 1976	Supply & Demand	O_3 depleting substances - Regulation 2037/00; F-gases – Regulation 842/06; biocidal products-Regulation 1451/07; VOC in paint & varnish-Directive 04/42

#	Policy Instrument/Mechanism	Objective of the instrument [a]	Target stakeholder [b]	DPSIR	Responsible for implementation & implementation date [c]	Supply / demand	Example
C5	Land use restrictions	Minimise environmental impacts by restricting access	All	Impact	Municipalities, regional and national authorities 1979	Supply & Demand	Natura 2000 network – Directives 79/409 & 92/43; national action in all member states
C6	Efficiency Standards	Increase end-use energy efficiency in buildings, household appliances and industrial processes	Builders & industry (manufacturers of appliances & other)	Pressure	Energy Agency 1996	Demand	Directive 09/125 Eco-design framework in Energy-related products & regulations e.g. 245/09, 643/09 (household appliances), 649/09 (electric motors); Directive 10/31(buildings); national regulation e.g. Portugal & Sweden
C7	Individual emission standards – IPPC permits	Reduce emissions by setting individual emission limit values based on Best Available Techniques	Industry, electricity generators, primary energy suppliers	Pressure	Environment agency 1999	Supply & Demand	Directive 08/1
C8	Emission reduction plans	Reduce emissions by implementing individual reduction plans	Industry & services that use solvents above certain limits	Pressure	Environment agency 2001	Demand	Directive 99/13 for VOC emissions
C9	Energy saving targets	Ensure more efficient end-use of energy by imposing annual energy saving standards	Member States (ensure action by retail suppliers / distributors)	Driving Forces	Energy agency 2004-2006	Supply	Directive 06/32 on the promotion of End-use efficiency and energy services
C10	Renewable energy targets	Promote use of energy from renewable sources (RES) by setting targets for overall share of energy from RES in gross final consumption & in transport	Member States (ensure action by generators, retail suppliers & industry & construction)	Driving Forces	Energy agency 2001-2003	Supply & Demand	Directive 09/28 on the promotion of the use of energy from renewable sources & subsequent national plans

#	Policy Instrument/Mechanism	Objective of the instrument [a]	Target stakeholder [b]	DPSIR	Responsible for implementation & implementation date [c]	Supply / demand	Example
C11	Water use restrictions	Minimise risk of environmental damage	–	Impact	Environment agency 2008	Supply & Demand	Water Framework Directive 02/60
C12	Phase-out of inefficient products/equipments	Increase end-use energy efficiency	Industry (manufacturers) and households	Pressure	Energy agency 2009/2012	Demand	Regulation 244/2009 phasing out incandescent lamps
Economic/Market based							
Tradable permits/quotas							
T1	White Certificates	Increase end-use energy efficiency by issuing mandatory targets for improvements combined with tradable titles	Energy distribution companies (that implement activities in Industry, services & households)	Driving forces	Energy agency and distributors of gas and electricity 2002	Supply	UK Energy Efficiency Certificate Trading; Italy Energy Efficient Titles; France Energy Saving Certificates
T2	Green Certificates	Increase electricity generated from renewable sources by issuing mandatory targets combined with tradable titles	Electricity generators	Driving forces	Energy agency 2001	Supply	Belgium, Italy, Netherlands, Sweden, UK
T3	CO2 emission trading	Reduce emissions	Industry, electricity generators, primary energy suppliers	Driving forces	Environment agency 2005	Supply & Demand	Directive 2003/87 (amended)
Price							
P1	Tax exemptions, rebates and incentives for investments	Promote economic development; security of energy supply	Industry, electricity generators, primary energy suppliers	Driving forces	Finance ministries 1970's	Supply & Demand	DK abolished payment of royalties on gas and oil production; tax exemptions provided to less profitable NL gas fields; reduced VAT for domestic energy use in UK and PT; subsidies to insulation in low-income households

#	Policy Instrument/Mechanism	Objective of the instrument [a]	Target stakeholder [b]	DPSIR	Responsible for implementation & implementation date [c]	Supply / demand	Example
P2	On-budget aid to the coal & gas industry infrastructures	Promote regional economic development; security of supply & lower emissions (for gas)	Primary energy suppliers	Driving forces	Finance ministries & EU 1990's	Supply	Denmark, Greece, Ireland and Spain have provided state aid to the gas infrastructure, Germany supports domestic coal mining
P3	Emissions charges and taxes	Reduce emissions by internalisation of env costs; cover cost of policies & raise revenues	Industry, electricity generators, primary energy suppliers	Driving forces	Finance ministries 1992	Supply & Demand	NO_x charge in SE, FR; NO_x tax in DK, ES; SO_2 tax in SE; CO_2 tax in SE & DK
P4	Energy taxes	Reduce environmental damage by internalisation of env. costs, cover cost of policies & raise revenues	Consumers (industry but mainly services & households)	Driving forces	Finance & environment 1997 (electricity in FI) 2001 (UK levy)	Demand	Directive 03/96, UK climate change levy; electricity consumption tax in FI; combined energy & CO_2 tax in NL; FI, DK & SE
P5	Subsidies to renewable electricity or from CHP	Increase electricity generated from renewable sources or combined heat and power production	Electricity generators	Driving forces	Electricity regulator 2001	Supply	Portugal, Denmark, Germany, Spain use different approaches as feed-in tariffs; obligation to purchase & competitive tender
Moral suasion and voluntary initiatives							
V1	Information campaigns	Increase awareness (typically for increasing end-use energy efficiency)	All, most usually households & services	Driving forces	Energy agencies, municipalities & retail suppliers 1970's	Demand	Eco Top Ten in DE; Topten.pt in PT; Eco n'home in UK, IT, BE, FR, PT, DK; SE info on electricity bills and many more at national level; EU level Public Awareness Campaign for Energy Sustainable Europe

#	Policy Instrument/Mechanism	Objective of the instrument [a]	Target stakeholder [b]	DPSIR	Responsible for implementation & implementation date [c]	Supply / demand	Example
V2	Voluntary agreements	Increase end-use energy efficiency	Industry & services	Pressure	Energy agency 1990's	Demand	NL Energy Covenants; also in DK, DE, FR, SE, IR, SP; EU Green light Programme; Energy Star Programme; EU agreements on TV & DVD players, refrigerators & freezers, washing machines
V3	Labelling on electricity consumption	Increase end-use energy efficiency by providing information on electricity consumption	Industry (manufacturers of appliances) and households	Driving forces	Energy Agency 1992	Demand	Directives 10/30, 03/66, 02/40, 02/31, 99/9, 98/11, 96/60, 95/13; Regulations 1059/10, 1060/10, 1061/10, 1062/10
V4	Certification of environmental management systems	Improve overall environmental performance	All	Driving forces	Certification organisations 1993	Supply & Demand	EU Regulation 1221/2009 (EMAS); ISO 14001 standards
V5	Green procurement	Reduce environmental impacts all al levels by taking into account environmental criteria when procuring goods, services or work	All end-use consumers	Driving forces	1980's (some Member States), 2004 (EU public procurement), 2006-2012 (EU energy services)	Demand	Directives 04/17 & 04/18 for EU public procurement; Directive 06/32 on the promotion of End-use efficiency and energy services
Other							
O1	Environmental impact assessment	Minimise environmental impacts by imposing minimisation/mitigation measures	Industry, electricity generators, primary energy suppliers	Pressure	Environment agency 1985	Supply & Demand	Directives 09/31, 03/35, 97/11 and 85/337

#	Policy Instrument/Mechanism	Objective of the instrument [a]	Target stakeholder [b]	DPSIR	Responsible for implementation & implementation date [c]	Supply / demand	Example
O2	Unbundling (Liberalisation of electricity market)	Improve efficiency of electricity supply, price gains & quality of service	Electricity companies: Generators, transmission, distribution & retail supply	Driving forces	Energy agency, electricity regulator 2004	Supply & Demand	Directive 09/72
O3	Environmental liability	Prevent and remedy environmental damage by creating obligation to bear the cost of preventive and remedial action	Industry, electricity generators, primary energy suppliers	Driving forces	Environment agency 2007	Supply & Demand	Directives 06/21 and 04/35

[a] Refers to the policy instruments' explicit objective. [b] Refers to the stakeholders that are directly targeted, i.e. those whose behaviour the policy instruments primarily aims to steer and thus does not consider the indirect effects over other stakeholders. [c] Year of first implementation of such type of instrument across the EU. [d] Since transportation is not included in the scope of this paper the lead content of petrol and sulphur content of diesel are not considered in the table. Although these fuels are used by other sectors than transport, the quantities are not relevant when compared to other fuels.

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