ENERGY SYSTEM TRANSITION THROUGH STAKEHOLDER ACTIVATION, EDUCATION AND SKILLS DEVELOPMENT

ENTRUST

Report on policy & regulation landscape

Deliverable D4.1

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About the ENTRUST Project

ENTRUST is mapping Europe's energy system (key actors and their intersections, technologies, markets, policies, innovations) and aims to achieve an in-depth understanding of how human behaviour around energy is shaped by both technological systems and socio-demographic factors (especially gender, age and socio-economic status). New understandings of energy-related practices and an intersectional approach to the socio-demographic factors in energy use will be deployed to enhance stakeholder engagement in Europe's energy transition.

The role of gender will be illuminated by intersectional analyses of energy-related behaviour and attitudes towards energy technologies, which will assess how multiple identities and social positions combine to shape practices. These analyses will be integrated within a transitions management framework, which takes account of the complex meshing of human values and identities with technological systems. The third key paradigm informing the research is the concept of energy citizenship, with a key goal of ENTRUST being to enable individuals overcome barriers of gender, age and socio-economic status to become active participants in their own energy transitions.

Central to the project will be an in-depth engagement with five very different communities across Europe that will be invited to be co-designers of their own energy transition. The consortium brings a diverse array of expertise to bear in assisting and reflexively monitoring these communities as they work to transform their energy behaviours, generating innovative transition pathways and business models capable of being replicated elsewhere in Europe.

For more information, see **http://www.entrust-h2020.eu**

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Acronyms

ACER	Agency for the Cooperation of Energy Regulators
ADEME	French Environment and Energy Management Agency
BCM	Billion Cubic Meters
CCA	Climate Change Agreement
CEE	Certificat d'Economie d'Energie
CER	Commission for Energy Regulation
CEU	Council of the European Union
CHP	Cogeneration Heat and Power
CLH	Hydrocarbons Logistic Company
CME	Coordinated Market Economy
CNE	Energy National Commission (Spain)
CNMC	Comisión Nacional Mercado y Competencia
COP	Conference of the Parties
CPI	Climate Policy Integration
CTE	Spanish Technical Building Code
CSP	Concentrated Solar Power
CSS	Competitive, Sustainable and Secure
CT	Carbon Tax
DCENR	Department of Communications, Energy and Natural Resources (IE)
DECC	Department for Energy and Climate Change (UK)
DECLG	Department of Environment, Community and Local Government (IE)
DEFRA	Department for Environment, Food & Rural Affairs (UK)
DG	Directorate General
DOA	Description of Action
DSO	Distribution System Operator
EBPD	Energy Performance Buildings Directive
EC	European Commission
ECA	Enhanced Capital Allowances
ECF	European Climate Foundation
ECU	European Currency Unit
EEA	European Environment Agency
EEG	Renewable Energy Sources Act
EIA	Energy Information Administration
ENEA	Italian National Energy Agency (IT)
ENTSO	European Networks for Transmission System Operators – Gas and Electricity
EP	European Parliament
EPG	Energy Policy Group
EPI	Environmental Policy Integration
EPR	European Pressurised Reactor
ERGEG	European Regulators Group for Electricity and Gas
ESCO	Energy Service Company
ESOS	Energy Savings Opportunity Scheme
ETS	Emissions Trading System
EU	European Union
EUETS	European Union Emissions Trading Scheme
EV	Electric Vehicle
FMEAE	Federal Ministry for Economic Affairs and Energy (DE)
GDFC	Green Deal Finance Company
GDP	Gross Domestic Product
GHG	Greenhouse Gas Emissions
GLA	Greater London Authority
GW	Gigawatt
GWh	Gigawatt hour
HVDC	High Voltage Direct Current
ICCS	Industrial Carbon Capture and Storage
IDAE	Institute of Diversification and Energy Efficiency (ES)
IEA	International Energy Agency
IET	Informe sobre el Estado de la Tecnica (ES)
IRMC	Institute of Restructuration of Coal Mining
KPI	Key Performance Indicator
LME	Liberalised Market Economy
LNG	Liquefied Natural Gas
LOSEN	Law of Structuration of the National Electric System
MCM	Million Cubic Meters
MIBEL	Iberian Electricity Market
MINETUR	Ministerio Energía, Industria y Turismo
MS	Member State
MToe	Million Tonnes of Oil Equivalent
NEEAP	National Energy Efficiency Action Plan
NES	National Energy Strategy
NGO	Non-Governmental Organisation
NIMBY	Not In My Back Yard
NORA	National Oil Reserves Agency (IE)
NRA	National Regulatory Authority
NREAP	National Renewable Energy Action Plan
NZEB	Nearly Zero Energy Buildings
OCU	Organisation Consumers and Users
OECD	Organisation for Economic Co-operation and Development
OMIE	Iberian Electricity Market Operator (ES)

OMIP	Iberian Electricity Market Operator (PT)
OTC	Over-The-Counter
PIMEC	Petita i Mitjana Empresa Catalunya
PER	Renewable Energy Plan (ES)
PFER	Plan Fomento Energias Renovables
PIVE	Efficient Vehicle Incentive Plan
POPE	Programme Orientation Politique Energetique
PSO	Public Service Obligation
PV	Photovoltaic
RD	Royal Decree
REE	Red Eléctrica España
REFIT	Renewable Energy Feed-in Tariff
RES	Renewable Energies
RHI	Renewable Heat Incentive
SDI	Sustainable Development Indicators
SEAI	Sustainable Energy Authority of Ireland
SET	Sustainable Energy Transition
SF	Success Factor
SI	Statutory Instruments
SME	Small and Medium Enterprise
SNP	Scottish Nationalist Party
TICPE	Domestic tax on consumption of energy products (FR)
TW	TeraWatt
TWh	TeraWatt Hour
Toe	Tonnes of Oil Equivalent
TPER	Total Primary Energy Requirement
TSO	Transmission System Operator
UN	United Nations
VAT	Value-Added Tax
WhC	White Certificate
WP	Work Package

Executive Summary

Work Package 4 of the ENTRUST project focuses on the policy landscape of energy transitions in the European Union. This deliverable provides an up-to-date picture of the current situation concerning the policies and regulations related to the energy system in a range of European countries. Key technological, social and market factors are scrutinised in order to understand the various energy policy frameworks in Ireland, Spain, the United Kingdom, France, Italy, and Germany. An analysis of the national dialogues in each of the member states is provided with a particular focus on the key public discourses, along with an assessment of the main barriers hindering low carbon measures, in each country.

As the ENTRUST project looks at the human factor within the energy system, this deliverable seeks to identify the socio-political and economic components contributing to the political agenda on energy. The sustainable energy transition paradigm, that involves a gradual shift from conventional energy sources to renewable, more region-specific ones, is assessed using new institutionalism theory. This theory fits quite well into the overall approach being taken by the ENTRUST project and has helped the authors to gain a deeper understanding of how the political system deals with the complexity that is ingrained in the energy transition. Also, how the frameworks within which socio-political institutions and policy paradigms operate and influence the direction and speed of the transition is explored. As key influencers in the energy transition, institutions play a key role in governing the behaviours on multiple levels, from individuals to the communities they participate in. The term "institution" is somewhat amorphous in its usage. It has been commonly used to describe both the formal entities setup to regulate people (*e.g.,* supranational and national governments and the public services they provide) and the more informal practices associated with individual and group customs or behavioural patterns that have been valorised by societies over a period of time (*e.g.,* national cuisines, and adherence to specific religious or secular festivals). This relational perspective on how social order is both created and maintained is important as it helps us to gain a better understanding of the factors that contribute to the strengths and weaknesses of the various policies being implemented across the EU to promote the energy transition.

In taking this approach the strengths and challenges to energy transition are, in turn, highlighted in each country. Important national energy systems' characteristics are also discussed, such as energy security, climate change, and the resultant threats to human health and ecosystems. In the first part of the deliverable, a theoretical introduction of the different concepts developed for this task are presented, followed by a general overview of EU energy policy and the detailed assessment of the six Member States' energy systems. Key Performance Indicators, along with an assessment of the factors contributing to specific successful outcomes are used to reveal the differences between the six countries. The major findings, including the main challenges and political discourses are also summarised on the following pages, with a page taken for the EU and each of the six study countries.

European Union

The energy topic has been at the heart of the European Union project, although it has not always received the same emphasis throughout the years since its inception. Indeed, not long after the Second World War, 1951, the European Coal and Steel Community was formed with France, West Germany, Belgium, the Netherlands, Luxemburg and Italy agreeing to cooperate together to produce weapons, or any other materials, from their combined shared steel and coal deposits. By the 1960s, however, energy policy was largely focused at the national level. The oil shocks of the 1970s changed the Community's perspective again, with member states opening the way towards an integrated EU energy policy.

The most recent development in EU energy policy is the Energy Union Package. Adopted in 2015, it affirms and completes the liberalisation process begun decades earlier. The Energy Union Package relies on the definition and enforcement of the Energy Union; a European Energy Security Strategy; the creation of a resilient and integrated energy market across the EU (with new pipelines and power lines for gas and electricity) called the Internal Energy Market; a 2020 and 2030 energy strategies and a roadmap for 2050 (DG energy, 2015). The Energy Union is driven by three main pillars consistent with the Competitive, Secure and Sustainable frameworks as analysed by Maya Jegen (2014) and others (DG energy, 2015).

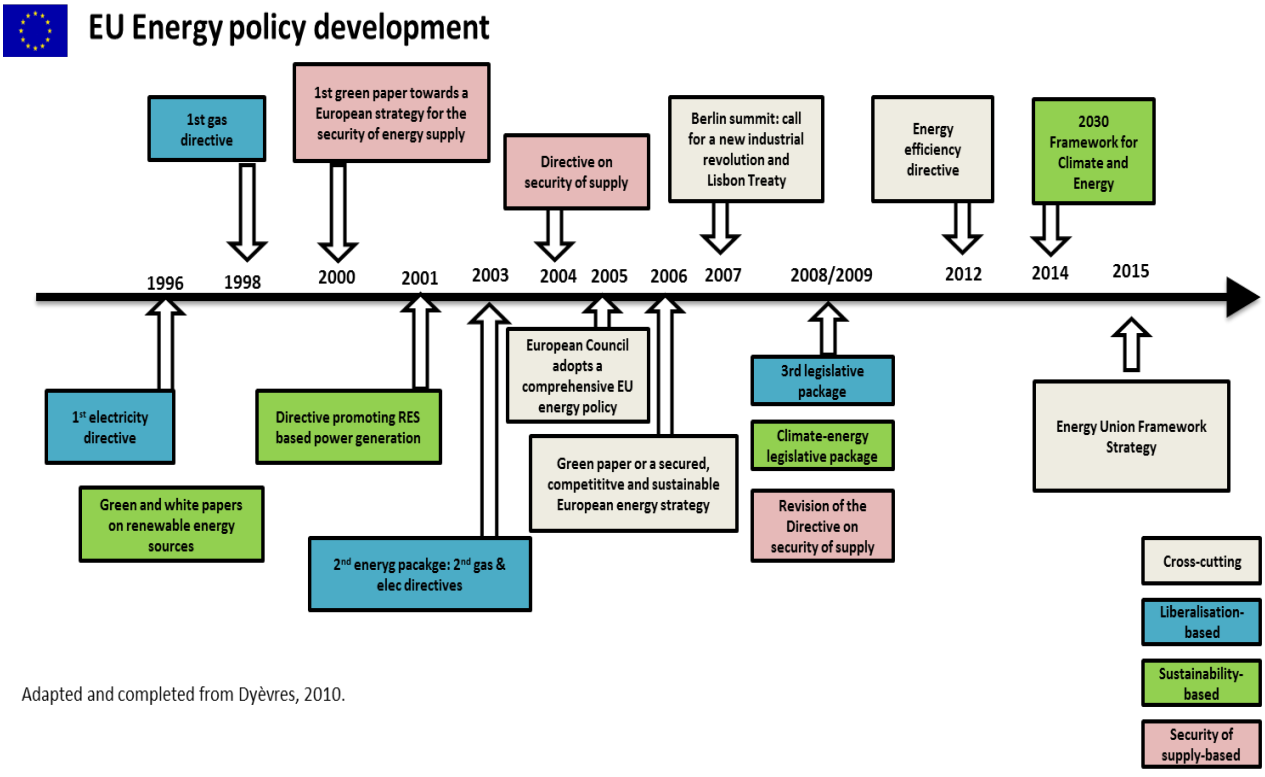

Figure 1: EU energy strategy (adapted from Dyèvres, 2010)

Ireland

Ireland's choice of indigenous energy sources has been rather limited going back to the foundation of the state. Apart from peat and some deposits of oil and natural gas that are now nearly exhausted or not fully on-stream its largest indigenous energy supply came from renewable energy sources (RES) most notably hydro-electricity. The main issues regarding energy in Ireland are:

- Security of supply, since the country is highly dependent on imported fuels, oil (100%), coal (100%) and gas (93.4%).
- Fossil fuels accounting for the majority of energy consumed: Oil (47%), Gas (29%), Coal (10%).
- Poor public transport infrastructure, and with dispersed settlement patterns, leading to a high dependency on private transport. Continued underinvestment in public transport system.
- One of the least energy efficient housing stock in Northern Europe, despite a third of this stock being built during the economic boom

The Irish national discourse consists of a debate on trade-offs or balancing of three key, often competing, policy objectives – security of supply, competitive prices and environmental sustainability. In addition the 2014 Green Paper on energy policy in Ireland discusses six priority themes, which include: empowering "energy citizens", markets, regulation and prices, delivering infrastructure, sustainability, and driving economic opportunity.

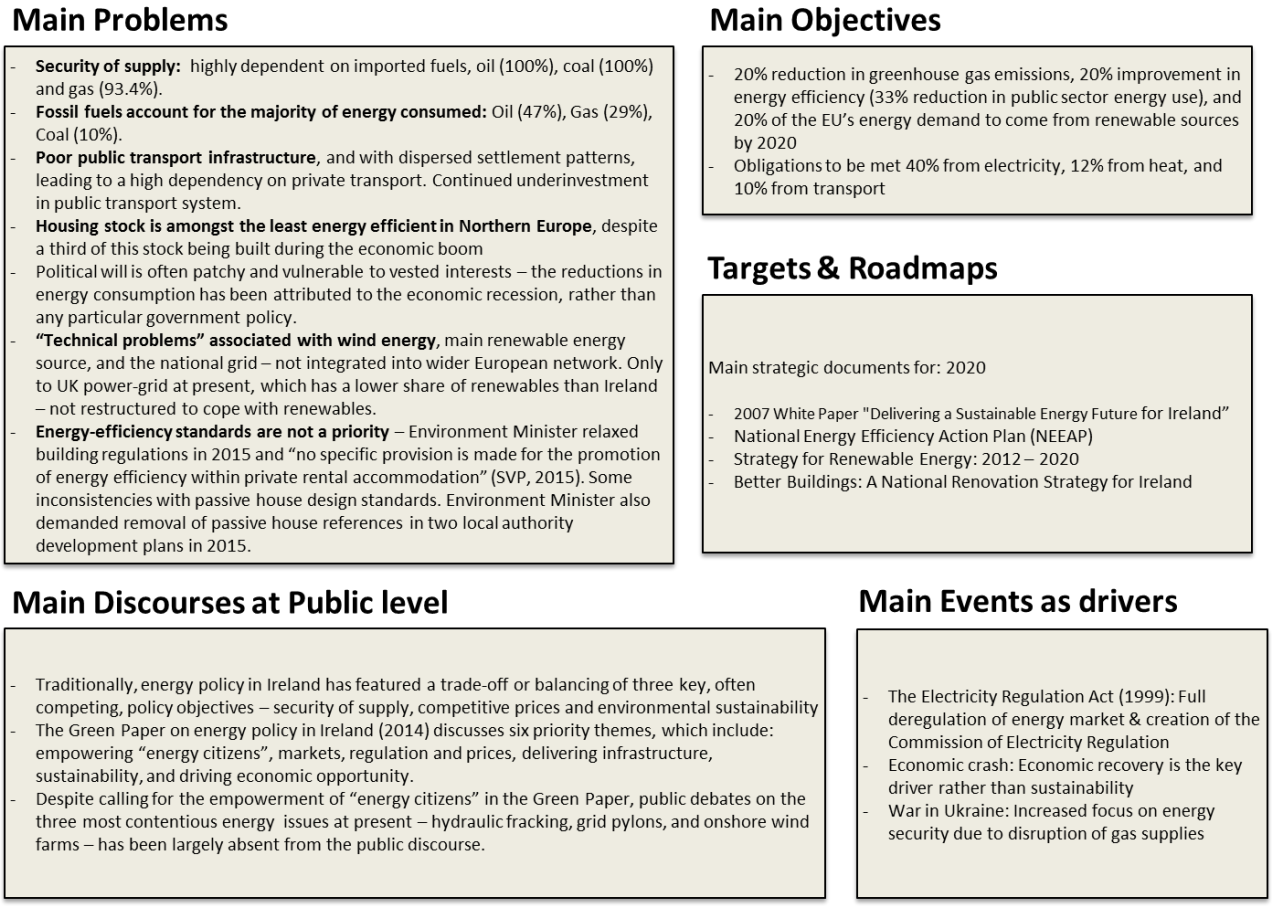

Figure 2: Irish strategy in energy policy making

Spain

For the last 40 years, the strategy on the Spanish energy mix has been changing continuously, having more interest in the short-term impact than a longer term vision. Due to the lack of local resources, Spain has always been dependent on oil imports, although all energy plans were focused on reducing its oil dependency. The ways to achieve this objective have varied continuously and nowadays imports of primary energy represent 70% of total. The main issues regarding energy in Spain are:

- Economic crisis in 2008, halting the development of many renewable or alternative sources of energy
- Deficit of tariff in the electric sector
- Highly Oil dependence (no national production)
- Unstable legislation

The current discourse relates to the economic situation, which prevents new investments or subsidies to foster renewables as it was the case before the economic crisis in 2008. The institutional discourse is focused on the reduction on energy consumption.

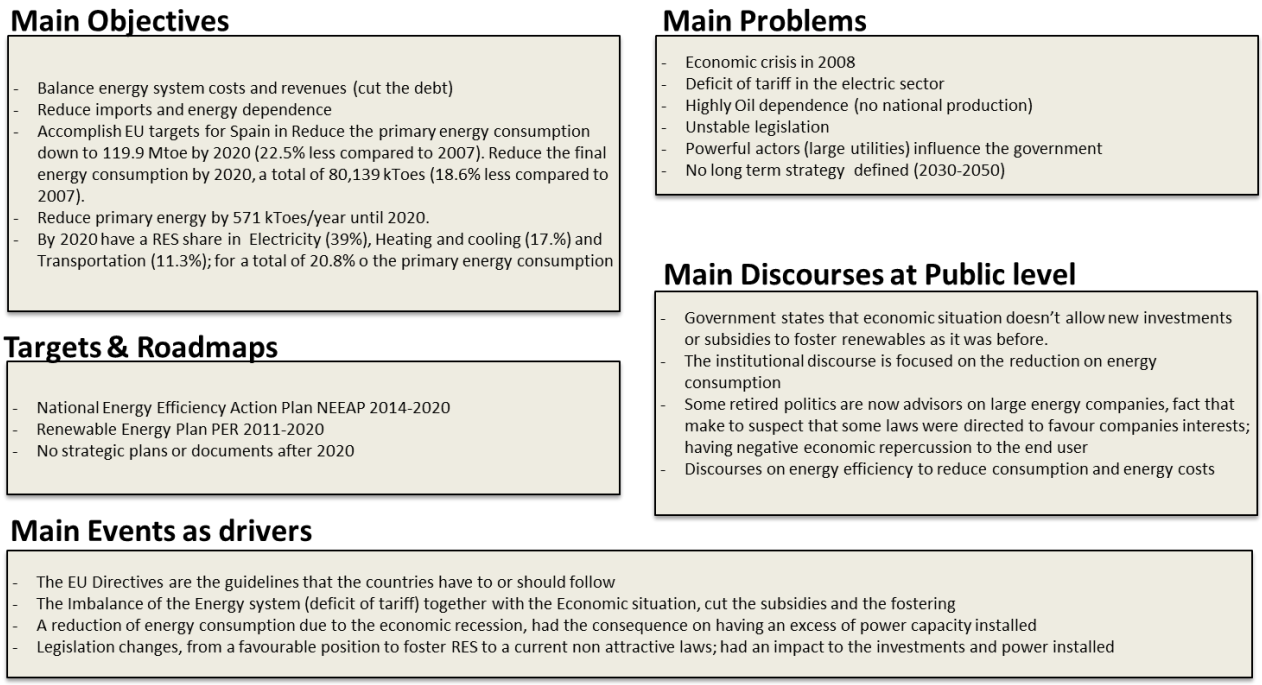

Figure 3: Spanish strategy in energy policy making

United Kingdom

The United Kingdom energy system comprises a diverse range of energy sources and consumption. The energy landscape of the UK is presently responding to the decline of domestic reserves and production of oil and natural gas. Combined with increasing instabilities in fossil fuel production, the UK is attempting to transition to a more secure and resilient energy system predicated on expanding nuclear power, shale gas, renewable energy and North Sea gas. The UK's energy landscape, however, is increasingly dominated by changes in governmental policy. Despite this, in recent years the UK has become a leading proponent to reduce global carbon emissions and is viewed as an international leader in addressing climate change. Climate change mitigation and energy security are the UK's core energy and climate policy goals (Dagoumas and Barker, 2010). A key number of policies introduced such as the UK Climate Change Act 2008 and the Low Carbon Transition Plan 2009 commits the UK to a low-carbon future (DEFRA, 2008; DECC, 2009). The main issues regarding energy in the UK are:

- Economic downturn in 2008 influenced energy and climate policies
- Investment in renewable energy technologies by Government has reduced in 2015 to concentrate on new nuclear and gas power stations
- Overruling local government decisions on blocking shale gas fracking development by central government undermines public views towards (sustainable) energy development for the UK, indicating multi-level governance structures and contentions

The main national policy discourses are various. For instance, public opinions towards nuclear energy generation and renewables is significantly high, with onshore wind farms facing some aspects of NIMBYism. Official government actions consisted in the removal of subsidies for renewable energy in 2015 at odds with the wider objective to create a low-carbon energy future, resulting in impacts affecting the sustainability of the UKs renewable energy sector. In addition, there is substantial opposition to fracking shale gas in the UK, particularly in areas of sites of special scientific interest and national parks.

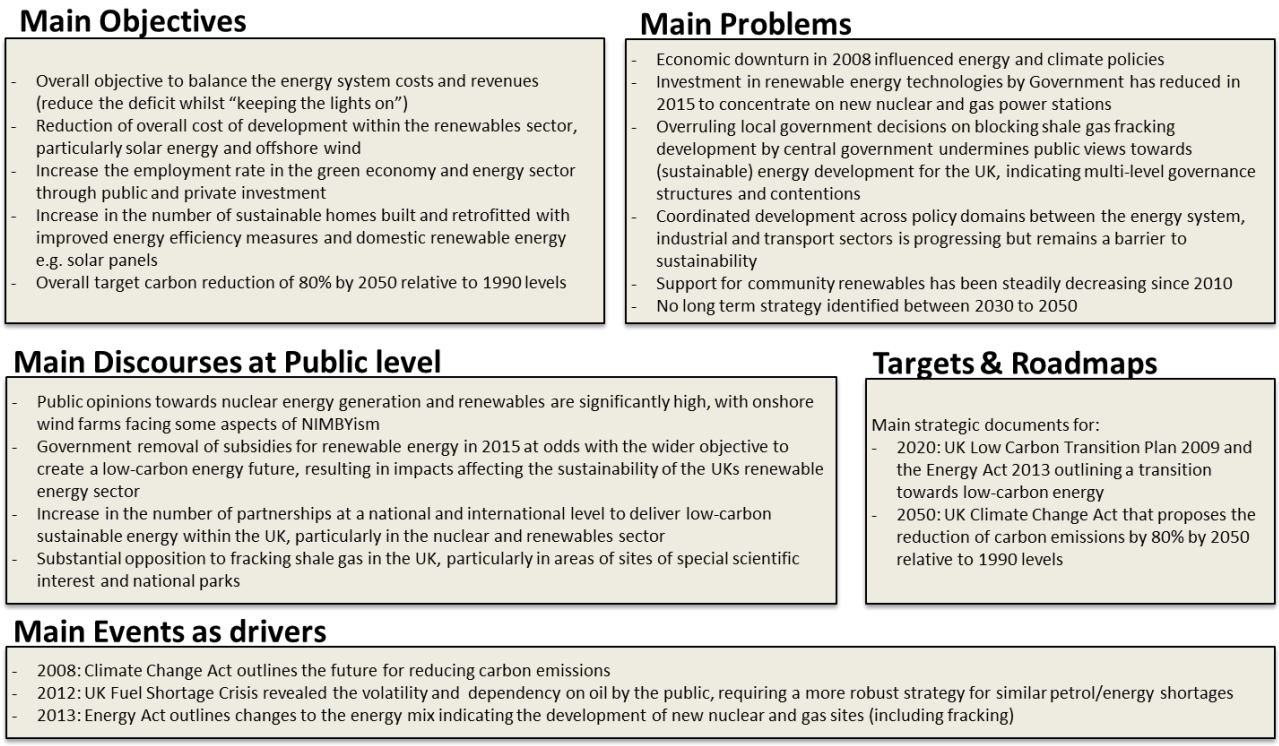

Figure 4: UK strategy in energy policy making

France

The French energy system is unique in Europe for its relatively low greenhouse gas emissions since only a minor part of the electricity is produced by fossil fuel. This is the result of a major transformation of the energy system in the 1970s, triggered by the oil crises, which caused a very fast departure from power plants running on oil and coal. At the same time, France developed one of the largest nuclear parks in the world. Nowadays, with nuclear energy dominating the French energy landscape, there is an emerging consensus that nuclear electricity production must gradually give way to renewables. France possesses the largest renewable resources in the EU: large wind energy potential because of its long coastal areas, a sizeable hydroelectric production thanks to several mountain ranges such as the Alps, sun-drenched areas in the South ideal for solar energy, and vast amount of land and forested areas with a potential for sustainable bioenergy. The main issues regarding energy in France are:

- Abundance of nuclear electricity maintained a surplus of electricity, leading to exports and not inciting electricity savings. However, the nuclear plants are getting old and will have to be replaced soon.
- Unstable legislation regarding support for renewable energy sources
- High oil dependence, particularly on transportation

The French energy discourses are, politically, about the energy transition from nuclear, as it is now being questioned although there is large support and will remain the largest source of energy for the years to come. Another key discourse is on the reduction of the energy trade bill, recently reduced thanks to low oil prices. Energy efficiency is gaining importance on political agenda but historically, France mostly looked at the supply of the energy system.

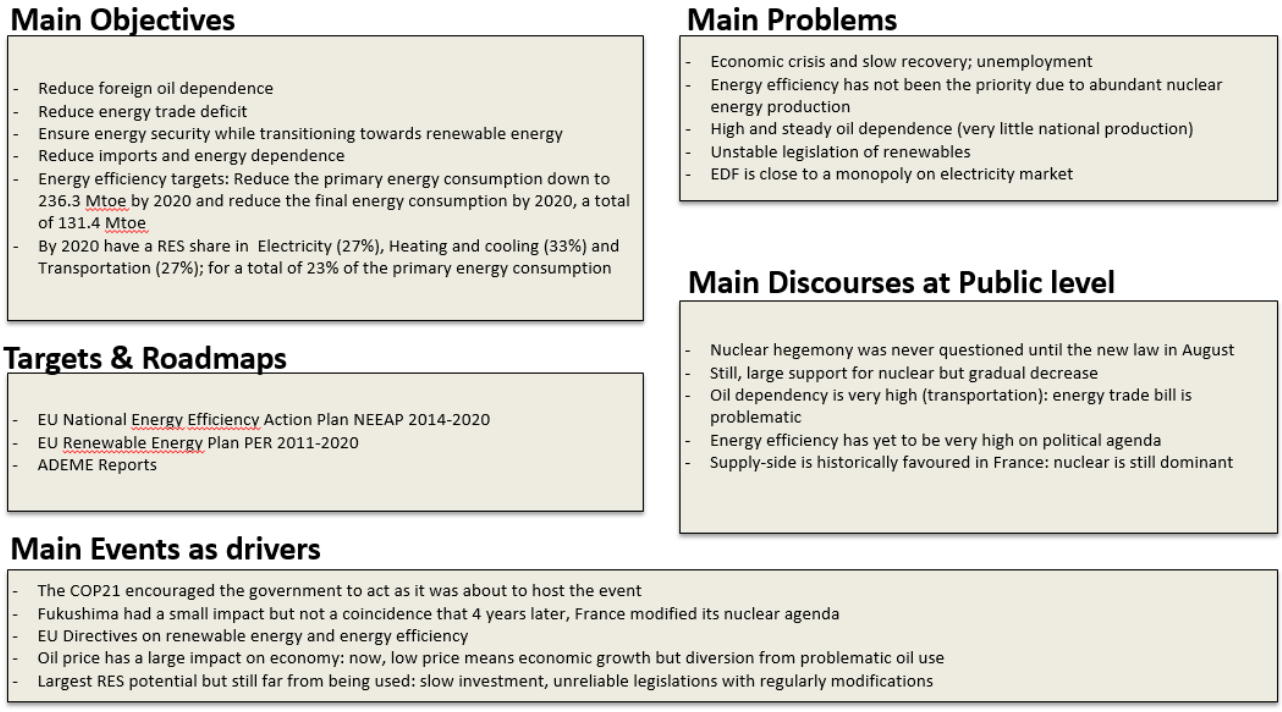

Figure 5: French strategy in energy policy making

Italy

The Italian energy system has historically been highly dependent on fossil fuel sources and extremely vulnerable to external energy shocks due to the dependency from energy imports. The Italian energy system is still based on a carbon intensive mix, with about 85% of energy demand fuelled by fossil fuels, basically oil and natural gas. Nonetheless, during last decades, several changes occurred in national energy policies, bringing the Italy system to a radical improvement in energy efficiency performance and to a growing interest in developing alternative energy sources. While traditional hydropower has constituted a large quota in the energy mix strategy from the beginning of the industrialisation process after the Second World War, the increasing interest in new clean energy sources as wind and solar ones has emerged only during the last decade, due to fast liberalisation process of the electricity market at the European level and the increasing attention toward climate change issues. The main issues regarding energy in Italy are:

- The coordination across different policy domains, especially between the energy system and the industrial activities, is still far from being complete.
- The multi-level governance structure of the Italian system represents a strong barrier to the rapid transformation of central decisions regarding the energy system into operative actions.
- There are selected sectors that are still lacking of substantial policy interventions in the direction of a low carbon trajectory, where the most crucial one is the transport system.

The national Italian discourse on energy is focused on the public commitment to increase the share of renewable energy in electricity generation, the increase efforts in the liberalisation process of the energy market in order to reduce energy costs for final consumers and the increase in public-private partnerships to foster investment flows in the national electric grid. This should reduce barriers in the final distribution process and improve the absorption capacity of electricity generated by renewable sources.

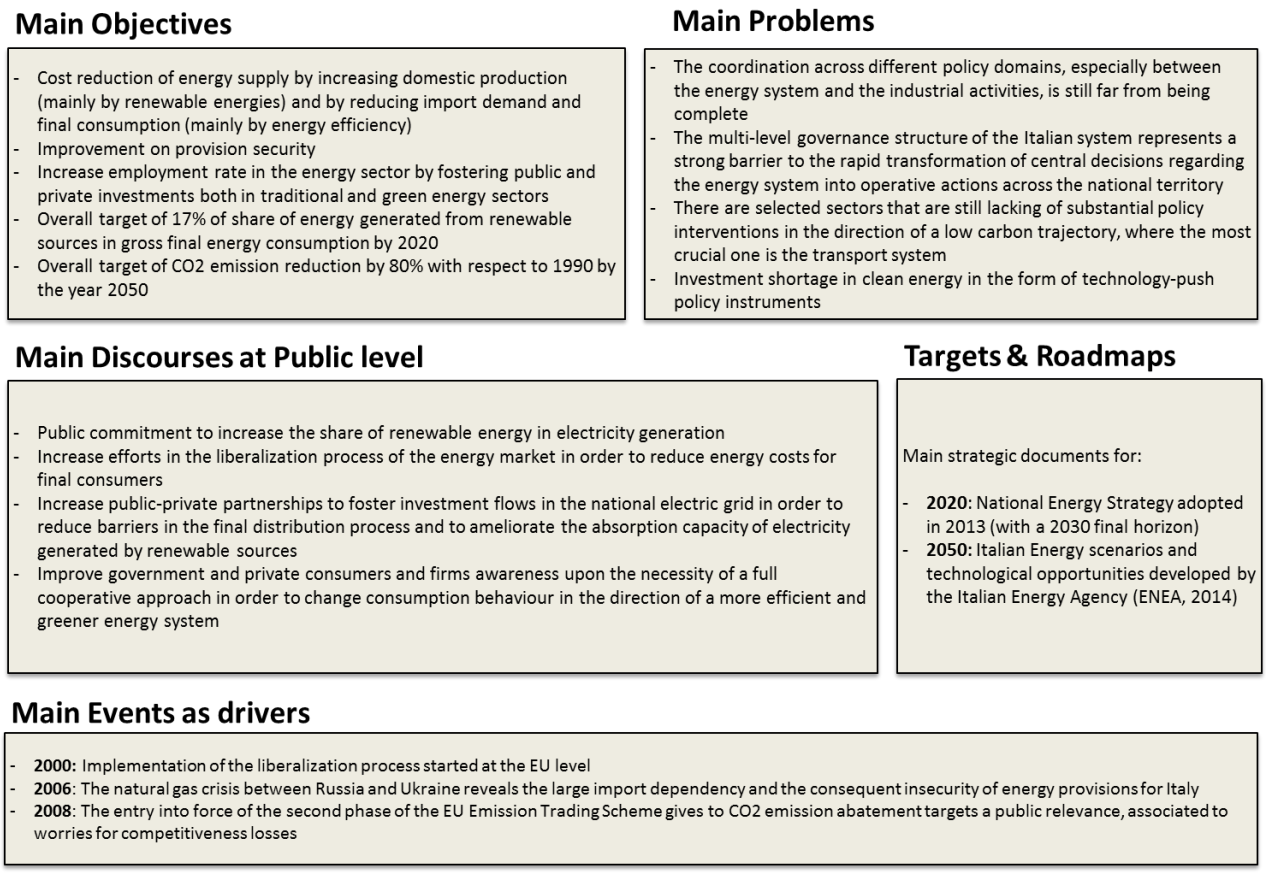

Figure 6: Italian strategy in energy policy making

Germany

The paradigm shift in Germany has been driven mainly by a comprehensive energy transition that is also known as Energiewende. The term was born in the 1970s in an attempt by opponents of nuclear power to show that an alternative energy supply was possible. A key milestone in this paradigm shift has been the Integrated Energy and Climate Program (IECP) of 2007, the so-called "Meseberg Programme", which gave an overall framework for climate friendly energy supply in Germany and provides explicit sectoral emission reduction targets until 2020. In 2010, the German government initiated a new Energy Concept, a comprehensive strategy covering both medium (2030) and long (2050) term strategies, which has driven the energy policy since then. It proposes a substantial transition of energy use to reduce carbon emissions in all these sectors simultaneously, which mixes previous strategies and climate policy packages in one national strategy. The nuclear catastrophe in Fukushima was an additional policy push to move forward this paradigm shift. A societal and political consensus in Germany emerged against nuclear and the energy transition was accelerated. The main issues regarding energy in Germany are:

- Germany's GHG emissions in 2013 were estimated at 954.7 million tons of CO_2 equivalents, the largest of EU countries.
- Highly oil dependence
- Energiewende is often narrowly associated with a power sector transformation

The main national discourse is the Energy Concept in September 2010, in which the Federal Government set out guidelines for ensuring an environmentally sound, reliable, and affordable energy supply, thus mapping the transition into the age of renewables.

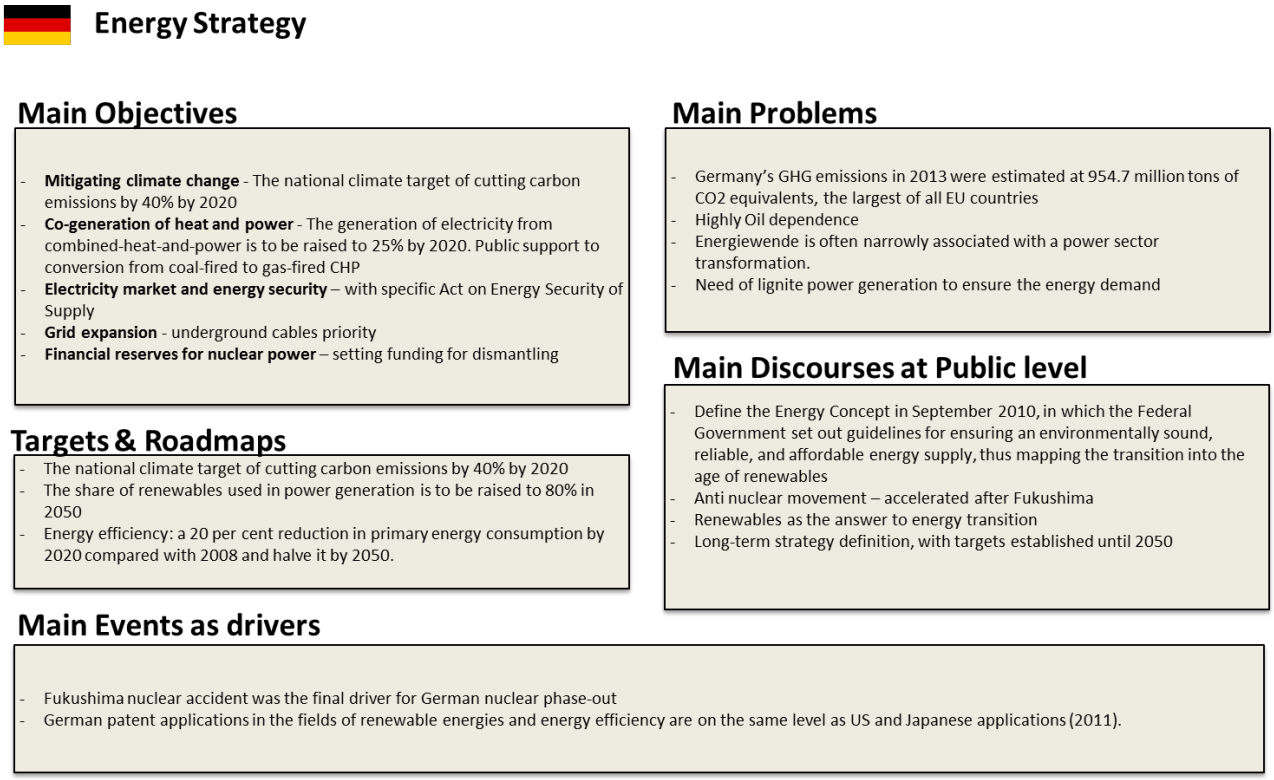

Figure 7: German strategy in energy policy making

Summary

The extensive research work on this deliverable show that there are many factors influencing energy policy-making and the transition potential of one country. Each country responds differently to these factors and their combinations (see Appendix 2), which explains the variety of energy systems, policy-making and transition potentials. Overall, it shall be noted that the six countries have entered an energy transition. Indeed, each country is diversifying its energy mix towards less fossil fuels, increased renewables and alternative energy supplies sources. While not all countries have developed a long-term and comprehensive energy roadmap for a low-carbon and sustainable energy system, they do have national plans on either energy efficiency or renewables or both, and the construction and transport sectors.

However, the levels of comprehensiveness of this transition, its sustainability and speed are however different for each country. This is due to the differences on how each factor is expressed in one country, which result in different strengths and challenges and likeliness to support a comprehensive low-carbon and sustainable energy transition. The objectives set by each country are often in relation with their main weaknesses. For example, in UK and Ireland, there is a strong emphasis on energy efficiency in the building sector because their building stocks are among the least performant in Europe.

The objectives set depend from the political orientations and interpretative frameworks of each country, according to the new institutionalism theory. These political orientations influence whether the overall energy policy is consistent, comprehensive, opens to public debate and envisions on the long-term the benefits of the energy transition. In this respect, Germany seems to have the most promising political orientations, while Spain appears to lag behind. UK and France presents some true strong elements in favour of energy transitioning but this is mitigated for UK for conservationists are now in power and have a different viewpoint on energy transitioning that is less favourable. Ireland has developed an interesting energy policy that shows that its political orientations are favourable to an energy transition. Italy's institutional political orientations have led to the development of an energy policy that should deliver an energy transition, but it appears a little less consistent.

1 Introduction

1.1 Introduction to the deliverable

The main objective of the ENTRUST project is to explore the **human factor in the energy system**. The project aims at leveraging new knowledge and insight on the technical, policy and socio economic aspects of the energy system to inform innovation and widespread stakeholder engagement for transitioning to a low-carbon and sustainable energy system.

Throughout human history, various forms of energy have been used to provide the basic requirements of food, warmth, shelter, etc. (Solomon & Krishna, 2011). There have been many different sources of this energy such as the sun, wind, water, and wood. While different forms of biomass energy have been dominant for most of human history, fossil fuels have dominated since the end of the 19th century (ibid.). **The current energy system faces various challenges including, energy security, climate change, and the resultant threats to human health and ecosystems. To address these issues, the energy system needs to transition from one based on fossil fuels to one with a more sustainable foundation, based around greater efficiencies in energy consumption and increased use of renewable energy sources (Creutzig *et al.*, 2014; Verbong and Geels, 2010).**

Currently, the term 'energy transition' is most commonly used to refer to this so-called sustainable energy transition (SET). The SET will require a complete transition from a system that depends on fuel to a system that depends to a large extent on energy flows, i.e., the amount of renewable energy available at any given time, along with any stored energy (Sgouridis and Csala, 2014). An energy transition has consequences not only on the energy system but on the whole society, for energy sustains almost every human activity.

Indeed, previous transitions (*e.g.,* wood to coal, and from coal to oil) have resulted in dramatic changes to economic activity, lifestyle, technology, *etc*. (Smil, 2014). Similarly, we can expect that the current energy transition, which involved a move from a centralised, carbon-intensive energy system to a decentralised, efficient, low-carbon system will require or result in significant socio-technical changes.

Planning, managing and delivering an energy transition is therefore an extremely complex task for it mixes **different socio-technical systems, *i.e.,* different representations of reality, different expectations from society and life, and different capabilities**; and as it is focused on energy systems that are different from one country to another, which **differences are partly explained by geo-physical disparities**.

The political level is an appropriate level for studying and enforcing energy transition, since politics has been described as the 'constant companion' of socio-technical transitions – serving as context, enabler, obstacle, arbiter, distributor of benefits and manager of repercussions (Meadowcroft, 2011). Some even refer to low carbon transition as being politically instigated, this normative dimension being one difference with the other past energy transitions (Kuzemko, 2013b).

WP 4 of the Entrust project focuses on the policy landscape of energy transitions in the European Union (EU). It contains four tasks.

- T4.1 Mapping of policy & regulation landscape
- T4.2 Assessment of Europeanisation in national policy dialogue
- T4.3 Identification and Characterisation of energy behaviour change initiatives
- T4.4 Policy tool-kit – typology of approaches

The first task, Mapping of policy & regulation landscape, results in **this deliverable which aims at providing an "updated picture of the current situation in terms of policies and regulations considering all the energy system in a range of European countries" and to "analyse their national dialogue, the main public discourse focus and their main barriers to deploy low carbon measures**". "The different policy frameworks [are] compared that is the inputs that have driven the implementation of these policies, from technology, social or market domains including the ex-post evaluations of its effectiveness and discourse analysis of the process shaping key national and European policy documents".

In order to fulfil the deliverable's objective, a specific theory has been used to analyse national dialogue, public discourse, barriers and inputs to policies development and implementation; namely the **new institutionalism theory**. It helps understanding how politics deal with the complexity of an energy transition, and how the very structure of political institutions and policy paradigms influence the path and the speed of the transition.

1.2 Purpose and method of the deliverable: Sustainable development, low-carbon energy transition and politics of energy transition

1.2.1 Short history of sustainable development and links with low-carbon energy transition

The history of sustainable development dates back the 1970's. The report "The Limits of Growth" published by the Club of Rome in 1972 was one of the first references to climate change and the need for sustainable development. In 1987 the UN Environment Commission, chaired by Gro Harlem Brundtland, defined for the first time sustainable development as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987: 41).

The Kyoto Protocol, signed in 1997, **set binding obligations to industrialised countries to reduce greenhouse gas emissions**. It was the first official commitment at the international scale to address climate change. Globally, **sustainable development has influenced energy policy in the past decades and will continue, given the close relationship between energy use and resulting greenhouse gases emissions and climate change** (Kuzemko, 2013a). Low-carbon energy transition can even be seen as a central part of the solution to climate change (Ibid.). However, despite debates and activities around the energy transition, **in 2012 (so 30 years after the publication of the "Limits of growth") fossil fuels still provided 87% of global energy consumption and were predicted to dominate significantly for decades to come** (IEA, 2012). While it seems that the current energy transition is likely to take place over considerable periods of time like previous energy transitions (Kuzemko, 2013a), it is actually different from the other energy transitions. Previous energy transitions are usually described as moving between eras of different energy sources, e.g., 'the coal era', 'the oil era', but the previous era's primary energy source has never been fully supplanted. With the current energy transition, fossil fuels – contrary to past energy transitions – will have to be removed almost completely. Given these facts and the urgent need to limit global warming, it is clear to see why the SET is considered one of the core challenges of the 21st century (Verbong and Loorbach, 2012).

Given that the energy transition is politically driven it is therefore important to determine **how the urgency of transitioning can be taken into account at the political level and how politics can transform itself to deliver quickly a low-carbon energy system**. While political engagements for ensuring a sustainable development exist, it cannot be expected that they drive the energy transition alone, the way they are translated into energy and other sectors policy-making accounts for a big part of their success.

In order to deliver mapping of current energy policies in European countries and at EU level, while taking into account the influence of sustainable development among others and analysing the possibility to speed up the political delivery of the low-carbon energy transition system, the applied methodology relied on environmental and climate policy integration and new institutionalism analytical frameworks.

1.2.2 Environmental and Climate Policy Integration

Environmental policy integration (EPI) refers to the incorporation of environmental considerations into policies affecting non-environmental domains, typically in relation to the overarching goal of sustainable development (Persson, 2004; EEA, 2005; Runhaar *et al.*, 2014). Sustainable development is a key objective of the EU (Rietig, 2013) and is enshrined in the Treaty of Maastricht (1993) and the Treaty of Amsterdam (1999). While the concept of integrating environmental issues into economic and other policy domains began to get traction in the 1970s, it was not until the 1990s that it entered popular discourse, following the publication of the Brundtland Report [1987]. The report highlighted the need to systematically integrate the competing goals of economic development, social development, and environmental protection (Jordan and Lenschow, 2010). EPI is now considered one of the key strategies to achieving sustainable development (Adelle and Russel, 2013) and is applied with the intention of preventing environmental damage, removing contradictions between policies, and realising mutual benefits (Solorio, 2011).

Climate policy integration (CPI) has emerged more recently and is conceptualised in two ways in the academic literature; by substituting the word 'climate' for 'environmental', or by adapting the definition of EPI to take account of the differences between climate change and the environment (Rietig, 2012). **Some authors consider CPI to be essentially a specific type of EPI,** focussing on how climate concerns can be integrated into existing policy sectors (Adelle and Russel, 2013; Runhaar *et al.*, 2014). **Others, however, suggest that EPI and CPI are not always compatible,** highlighting the competing environmental and economic interests associated with nuclear power, biofuels and hydropower (Rietig, 2013). As such, Rietig argues that CPI cannot be considered a sub-category of EPI.

Since 2000, increasing attention has been given to CPI in EU policymaking circles as climate change has become a key driver, largely replacing sustainable development as the paramount EPI-informed paradigm (Morata and Solorio Sandoval, 2013; in Mullally and Dunphy, 2015). Mullally and Dunphy (2015) support this view, highlighting the objectives outlined in the EU's Climate and Energy package as a clear illustration of this switch in focus with the key headline commitment of '20-20-20' – that is a 20% reduction in greenhouse gas emissions relative to 1990 levels, 20% energy consumption from renewable energy sources, and a 20% improvement in energy efficiency – by the year 2020 (European Union, 2008). The EU also introduced its Emissions Trading Scheme (EU ETS) in 2005, which was the world's first large-scale trading programme for CO_2 emissions (Ellerman and Buchner, 2007). **This change in overall framing, from sustainable development to low-carbon living, has inevitably resulted in a change in focus of EU policy.** While EPI and the sustainability paradigm conceive of the need to reduce the environmental impacts of the energy chain, **CPI and the low-carbon paradigm are primarily concerned with the reduction of greenhouse gas emissions, without consideration of wider social or environmental concerns**. As a result of this shift towards a low-carbon paradigm, nuclear energy is now viewed as a climate-friendly energy source that has made it back onto the EU's agenda (Söderberg, 2011), with biofuels also included in the EU's renewable energy strategy despite the negative environmental impacts associated with both fuel sources.

1.2.3 New institutionalism theory in the context of low-carbon energy transition

Most of the explanations provided here on new institutionalism have been developed in the frame of the IGov and Energy Policy Group (EPG) projects from the University of Exeter[1]. These two projects aim to explain the nature of change towards a sustainable energy system, focusing on the complex inter-relationships between governance and innovation. They examine institutions and practice through the lens of theories of change, with the aim of developing a framework for governance that better enables faster transition to sustainable, secure and affordable energy (IGov).

The theme of energy transition has been well investigated by transition thinking developed by Dutch and UK socio-technical researchers (John Grin, Jan Rotmans, Johan Schot, Grank Geels and Derk Loorbach). Transition studies have focused on the transformations of societal and socio-technical systems. Transition thinking is rooted in theories of complex adaptive systems (among others) and highlights the interdependency of institutions and infrastructures constituting socio-technical systems and the various types of lock-in that these systems create.

New institutionalism theory relies on transition thinking, especially on conceptualising the energy system, as being made up of interactions between a variety of social and material factors (Kuzemko, 2013a). However, new institutionalism advocates that transition thinking has not sufficiently explored the politics of transition (Kuzemko, 2013b). For example, transition thinking relies on the destabilisation of socio-technical systems but how and why destabilisation might occur is seldom explored in detail (Turnheim and Geels, 2012); neither have the potential adverse impacts and risks of such destabilisation.

New institutionalism theory applied to energy transition aims at constructing a framework for analysis that can flesh out some of the complexities of energy policy for transition and explain the ways in which these have constrained, enabled and coloured energy system transition so far (Kuzemko, 2013a). It explains why setting climate targets, and including these as objectives of energy policy, has not produced the desired results and why energy policy is changing in certain ways, but not in others (*Ibid*.). Energy policy is characterised, in new institutionalism, as containing elements that are contingent upon broader political ideas and institutions as well as aspects that are specific to the politics of energy within different socio-economic contexts; these institutions may or may not support the change required for transitioning (*Ibid*.).

[1] For more information see Exeter projects website: http://projects.exeter.ac.uk/igov/about/

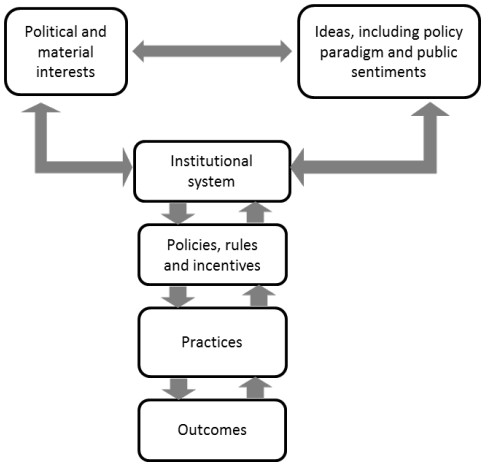

Figure 8: An institutionalist perspective on practices and outcomes. Lockwood *et al*., 2013.

Figure 8 represents the different elements that new institutionalism takes into account to explain the outcomes of policies. Outcomes are the result of a four-step process where political and material interests both influence and are influenced by ideas etc., i.e. whatever constitutes current paradigms. Political and material interests and the ideas they engage with, and their interactions, also influence the institutional system and are indeed influenced by it. The institutional system is responsible for developing policies, rules and incentives, resulting in policy outcomes. The nature of these outcomes in return influences the whole process in a feedback mechanism that either challenges or reinforces the process and elements of the system that led to these outcomes in the first instance.

New institutionalism theory prioritises the influence of ideas and the institutional system as being key in explaining the outcomes of policies. It advocates, based on **policy paradigm theory**, that governance and political choices are related to interpretive frameworks and concepts that then result in various institutional contexts delivering specific associated outcomes (Kuzemko, 2013b).

The reason why new institutionalism theory focuses more on ideas and institutions is that because they affect directly the speed and the path of the transition. For Lockwood *et al*. (2013) the speed of transition is determined by the dominant policy paradigm and the path of transition is determined by inertia in institutions that are specific to the energy system. In addition, the power of the interpretative framework is sometimes so strong that it can be taken for granted and thus is difficult to change (Kuzemko, 2013b).

To sum-up, new institutionalism theory can be used in the context of low-carbon energy transition to (Lockwood, 2011):

- Explain why path dependencies in institutions exist as well as type of path-dependencies
- Explain how and why change takes place and type of change
- Understand how governance institutions shape incentives by determining the distribution of resources
- Recognise the link between political and economic institutions and power (political actors have interests and incentives and are not neutral)
- Provide important analysis of regulation
- Understand that existing institutions can become ineffective or dysfunctional over time, can lose relevance as new problems arise, can be replaced or worked around by new institutions
- Recognise that institutional change requires coalitions seeking change that have (or can capture) sufficient formal political power under the current system, or sufficient informal political power to change the system

- Explores the relationships between basis institutional forms and issues of interest to transition (i.e. market entry of new technologies, innovation)

New institutionalism theory has also determined which elements are necessary for a successful transition:

- New practices are less costly or more profitable
- The risks of such practices and outcomes are sufficiently mitigated
- Institutional arrangements are inclusive
- New practices and outcomes are seen as opportunities for investors and are not too costly for the different energy users groups
- New policies for transition are self-reinforcing (economically and politically)
- Climate change is perceived as a major crisis
- Policy paradigm is consistent and gives strong values to sustainability

(Lockwood *et al.*, 2013)

Results of studies using new institutionalism theory on low-carbon energy transition have found that the current policy paradigm and institutional form that have influenced the current state of the energy system and transition are respectively the neoliberal economic paradigm and the various models of capitalism (Kuzemko, 2013a and 2013b). How new institutionalism theory has been used in task 4.1 is explained in the following section.

1.2.4 Task process and method

This section explains how the task 4.1 has been structured. The task has been divided in two parts: country analysis and energy policy and regulation landscape overview.

Country analysis

The country analysis aims at meeting the following objectives of deliverable D4.1:

- Providing an updated picture of the current situation in terms of policies and regulations considering all the energy system in a range of European countries: France, Germany, Italy, UK and Spain along with Ireland [2]
- National dialogue, the main public discourse focus and their main barriers to deploy low carbon energy measures will be analysed, considering the different stakeholders identified in WP2.
- The existing policies and the main factors that have triggered them will be mapped, considering existing infrastructures, the energy system, the main stakeholders, the main energy targets, etc. they will be analysed all along the supply chain, generation, transmission, distribution and commercialisation, but also in the demand side. Market-based instruments will also be part of the scope of this task.

(ENTRUST Project Description of Action (DOA))

The following six countries were included in the study, by the different Entrust partners: Ireland; Spain; UK; France; Italy; Germany

A template was sent to these partners with instructions on how to complete the first section on country analysis. The period chosen comprised from post-World War II out to 2050, with an emphasis on key dates and facts only. The template gave instructions to provide:

- A short introduction to the energy system, its infrastructures and history, summarised by two pictures called “National Energy Overview in Country X” and “Country X Strategy in energy Policy Making” where key policies with their strategic rationale and causal factors are presented.

[2] Poland, although listed in task 4.1’s description was not considered, as its inclusion in the text was erroneous – as illustrated by its absence elsewhere in the project description.

- The energy system of the country, with an emphasis on policies and regulations linked to energy supply, covering:
    - An overview of the energy system of the country; and
    - Regulations and facts according to energy source
- Key policies with regards to certain demand sectors (construction, transport and industry), and other policies impacted by energy policy:
- Some elements representing the energy and policy landscape

This section is presented in Annex

While not specifically mentioned in the DOA, a short synopsis of the European Union context and the development of an integrated EU energy policy have also been completed.

Energy policy and regulation landscape overview

The second part of this document addresses the following objectives of the deliverable D4.1:

- National dialogue, the main public discourse focus and their main barriers to deploy low carbon energy measures will be analysed, considering the different stakeholders identified in WP2.
- The different policy frameworks will be compared that is the inputs that have driven the implementation of these policies, from technology, social or market domains including the ex-post evaluations of its effectiveness and discourse analysis of the processes shaping key national and European policy documents
- The task will define key performance indicators (KPI); to enable the comparison between the different countries.

(Entrust DOA)

This second part employs New Institutionalism theory and environmental and climate policy integration frameworks to examine current energy transition pathways. As presented in section 1.2.3, in applying new institutionalism theory we can determine the following Success Factors (SF) to transitioning:

- New practices are less costly or more profitable (SF1)
- The risks of such practices and outcomes are sufficiently mitigated (SF2)
- Institutional arrangements are inclusive (SF3)
- New practices and outcomes are seen as opportunities for investors and are not too costly for the different energy user groups (SF4)
- New policies for transition are self-reinforcing (economically and politically) (SF5)
- Climate change is perceived as a major crisis (SF6)
- Policy paradigm is consistent and gives strong values to sustainability (SF7)

In addition, new institutionalism theory advocates that the institutional structure and its link to the economic structure, explains how the transition takes place; in particular, how the institutional structure is able to support niche innovation.

The second part of T4.1 established five KPIs relating to the success factors identified by new institutionalism theory. The important role of institutions and political and economic paradigms in shaping the energy transition and their influence on environment and climate policy integration frameworks are also recognised. The KPIs are presented below, with the success factors they refer to in brackets:

- **KPI 1: Energy transition definition (SF3, SF5, SF6, SF7)**
    - What are the main ideas of the energy transition? Are there official definitions?
    - Is it mainly economic – a short-term cost cutting, cost-efficiency measure – or is it also focused in the long term, considering social and health impacts?
    - Is there a real discourse?
    - Who's involved?

- **KPI 2: Urgency and pressure on the energy transition (SF6)**
  - Is climate change considered an urgent matter?
  - What is the total number of policies in the last 2 years favouring energy transition, supply/demand ratio, etc.?
- **KPI 3: Policy integration (SF2, SF5 + environmental and climate policy integration)**
  - Are policies in silos? Are there links with other policies in other sectors?
  - Is there a focus on specific technologies while neglecting others?
  - Are there inconsistencies among various policies with regard to the energy topic?
- **KPI 4: Institutional structure (SF3 + key role of institutions in shaping the transition)**
  - How diverse is the set of actors participating into energy policy?
  - Are public institutions linked to energy fragmented?
  - Is there a lack of transparency?
  - How engaged are the public in energy policy making?
- **KPI 5: Initiatives on new sustainable technologies and social innovation (SF1, SF2, SF4)**
  - Is there a political commitment to reducing the price of new sustainable technologies and to industrialise processes favouring sustainable solutions?
  - What actions have been undertaken to support innovation and governance change?

The ENTRUST partners were asked to provide a paragraph for each KPI. It shall be noted that the questions for each KPI only served as a guide, so the approach to writing this section varied with the different partners. Unlike for the first part, the EU was treated like the six other countries in this second part.

2 European Union

2.1 The development of EU energy policies

2.1.1 Chronological overview

This section presents a short overview of the main EU energy policies based on information gleaned from the EUR-Lex database, (Dyèvre 2010, Langsdorf 2011, Jegen 2014, Biesenbeder 2015). While the energy topic has not always received the same emphasis on the EU political agenda, it was at the heart of the European institution construction. Indeed, in 1951, the European Coal and Steel Community was formed where France and Germany had to cooperate to produce weapons, or any other materials, from their shared steel and coal. However, at the beginning of the EU, and in particular in the 1960s, energy policy was largely focused at the nation state level. The oil shocks of the 1970s changed this focus and opened the way towards an integrated EU energy policy. The oil shocks exacerbated the problem of the high EU dependency on oil and gas and moved the policy focus towards developing a common energy policy for safeguarding EU economies from external energy developments beyond their control.

In the 1980s environmental issues became more prominent and opened the dialogue on sustainable development, and energy policy with environmental and climate policies. At the end of the 1990s, with the economic recession, the energy sector became an important element in the strategy to establish an internal market as a response to increased competition and globalisation of markets. In addition, in the mid-1990s, it was apparent that in the electricity and natural gas sectors the existence of monopolies and oligopolies had various disadvantages for the economy and for consumers (Rokas, 2009). All these factors: oil shocks, environmental issues and competitiveness were progressively assimilated in the EU energy policy while the overarching policy objective was the liberalisation of the European energy system. However, energy policies in the EU in the first decades took mostly the form of broad policies objectives on this number of topics and the EU still lacked a consistent European energy policy (Jegen, 2014). For Jegen

(2014), a consistent European energy policy frame has been developed since the mid-1990s: the frame for a Competitive, Secure and Sustainable energy system.

The reason why a consistent frame took so long to be created is because European integration in the field of energy policy did not develop smoothly. Indeed, the liberal view of the Commission was not always compatible with Member States' national interests and in the first decades of European integration, European institutions' competence to act was limited. Not only did the importance of coal and therefore the European Coal and Steel Community diminish (with oil becoming the most important energy source), but the differences in energy mixes, transport routes or structures of energy markets resulted in the differing interests of the Member States (MSs) hindering energy policy cooperation. While closer collaboration was gradual, the speed of this development varied strongly depending on the periods. Many of the more ambitious plans of the European Commission for a coherent policy often failed in the face of opposition from MSs. The EU managed to materialise a European energy policy by referring to other competences than energy and by inscribing its power in new treaties (Jegen, 2014). Exclusive powers in the field of competition and shared powers over the internal market and the environment helped the Commission institutionalise its energy policy frame (Jegen, 2014).

In 1987, the Single European Act included the Environmental Policy Integration concept in EU law and in 1992, the Maastricht Treaty underscored the role of energy security and policy for the functioning of the EU by specifying that "measures" in the spheres of energy, civil protection and tourism constituted priority matters for the Community (Biesenbeder, 2015). These changes in treaties laws allowed EU policy makers to frame energy initiatives as environmental policies (Ibid.), for which it had competences to act. In the mid-1990s, the Commission began to take action and adopt directives to liberalise electricity and gas markets, using "competition" as its exclusive treaty power and also its internal market competence (Jegen, 2014). In 1996 – 1998, a first energy package comprised a regulatory basis of a minimum of common rules for the opening-up of European electricity and gas markets. The key principles were:

- Freedom of establishment of producers
- Freedom of choice of energy suppliers
- Unbundling of activities
- Third party access to networks/transmission grids.
- The Member States had obligation of result but not of means.

Following this, in 1998 and 1999, the Commission first established informal structures to bring together State and non-State actors to discuss the construction of an internal electricity and gas market: the Florence Forum (for electricity) and the Madrid Forum (gas). In 2000, the Council of European Energy Regulators (CEER) was created. The CEER regrouped the national regulatory agencies. Still informal, it was a more institutional venue for regulators as regular meetings facilitated the exchange of information (Jegen, 2014). Three years later, the process was formalised with the creation of the European Regulators Group for Electricity and Gas (ERGEG) as part of the second energy package. The results of the first energy package were not enough satisfactory (Rokas, 2009) so the second energy package (2003) aimed at an effective harmonisation process in order to improve the functioning of European energy markets. Two directives concerning the internal market in electricity and natural gas were passed. The second energy package also included regulations concerning conditions for access to the natural gas transmission networks and the cross-border exchange of electricity.

In 2005, as a consequence of the European Council meeting in Hampton Court in October 2005, heads of State formally agreed to develop a comprehensive European energy policy (Biesenbender, 2015). This

initiative was followed by the Commission in spring 2006 that published the green paper "A European Strategy for Sustainable, Competitive and Secure Energy" in which the Commission proposed concrete measures to realise a common European energy policy (Ibid.).

In 2008, the Member States backed the Commission's drive for a common energy policy and approved an explicit link between climate and energy policies by accepting the "climate and energy package" implementing the 20-20-20 targets for 2020 (Jegen, 2014). This was already implicit with the Lisbon Treaty in 2007 which, for the first time, introduced energy as a shared competence (Ibid.). This treaty provided a broad mandate for energy policy making, which enabled EU decision-makers not only to enact comprehensive regulation of the policy field as a whole but also to pursue a number of different energy-related policy goals (Biesenbeder, 2015).

The third energy package (2008-2009 and entered in force in 2011) represented a big step for further liberalisation in the energy market and the latest institutionalisation move in the field with the creation of the Agency for the Cooperation of Energy Regulators (ACER). This package had the following objectives:

- Giving more rights to customers
- Better protection for the "energy poor"
- Harmonising and reinforcing the independence and the competencies of the National Regulatory Authorities (NRA)
- Ensuring a non-discriminatory network access by Transmission System Operators (TSO) unbundling and a better TSO coordination at European level
- Intensifying investments in electricity and gas infrastructure
- Improving transparency and market functioning
- Coordinating action of NRAs via the creation of the Agency for the Cooperation of Energy Regulators. ACER coordinates and complements the activities of national regulators, contributes to the establishment of European network and market rules, and monitors the functioning of electricity and gas markets, as well as the work of European networks of transmission system operators (Jegen, 2014).

The third energy package was to be completed by 2014 and also in 2014 the European Council reconfirmed the linkage between energy and climate policies by the approval of the 2030 Framework for Climate and Energy.

2.1.2 Most recent energy policy development: the Energy Union

The most recent development of the EU energy policy is the Energy Union package, which affirms and completes the liberalisation process and was adopted in 2015. This Energy Union package relies on the definition and enforcement of the Energy Union, a European Energy Security Strategy, the creation of a resilient and integrated energy market across the EU (with new pipelines and power lines for gas and electricity) called the Internal Energy Market, a 2020 and 2030 energy strategies and a roadmap for 2050 (DG energy, 2015).

The Energy Union is driven by three main objectives, consistent with the Competitive, Secure and Sustainable frame as analysed by Jegen (2014) (DG energy, 2015):

- Secure energy supplies to ensure the reliable provision of energy whenever and wherever needed
- A competitive environment for energy providers that ensures affordable prices for homes, businesses, and industries
- Sustainable energy consumption, through the lowering of greenhouse gas emissions, pollution and fossil fuel dependence

The Energy Union framework was established in order to remedy to the following issues (among others) (EC, 2015d):

- The EU remains the largest energy importer in the world and six Member States depend on a single external supplier for their entire gas imports and therefore remain too vulnerable to supply shocks.
- 75% of the EU housing stock is energy inefficient. 94% percent of transport relies on oil products, of which 90% is imported.
- Wholesale electricity prices for European countries are at low levels, though still 30% higher than in the USA. Wholesale gas prices are still more than twice as high as in the USA. The price difference with other economies has an impact on the competitiveness of EU industries, in particular energy-intensive industries.
- The EU has energy rules set at the European level, but in practice it has 28 national regulatory frameworks.
- The retail market is not functioning properly. Many household consumers have too little choice of energy suppliers and too little control over their energy costs.
- Energy infrastructure is ageing and not adjusted to the increased production from renewables. The current market design and national policies do not set the right incentives for renewable energy investments and provide insufficient predictability for potential investors.

The Energy Union strategy has five mutually – reinforcing and closely interrelated dimensions designed to bring greater security, sustainability and competitiveness (EC, 2015d). These five dimensions are presented below, stressing on some of their key measures (from Ibid.).

- Energy security, solidarity and trust:

The Energy Union package assumes that the key drivers of energy security are the completion of the internal energy market, more efficient energy consumption and that energy security depends on more transparency as well as on more solidarity and trust between the Member States. Diversification of supply as a means to increase energy security is sought with a focus on gas available in various Central Asia and Eastern Europe countries, renewable energies, oil and gas from unconventional sources. For security of supply, the Energy Union package sets obligations to Member States to build up and maintain minimum stocks of crude oil and petroleum products (reinforcing 2009's legislation on this topic).

- A fully integrated European energy market:

For connecting markets, a specific minimum interconnection target has been set for electricity at 10% of installed electricity production capacity of the Member States. The Energy Union package reemphasises the legislation on regulation adopted in the 3rd energy package and will reinforce the powers and independence of ACER to carry out regulatory functions at the European level. The Energy Union package will ensure greater transparency in the composition of energy costs and prices by developing regular and detailed monitoring and reporting, including on impact of energy costs and prices on competitiveness. Enhanced regional cooperation is sought and existing arrangements such as the Pentalateral Energy Forum of the Baltic Energy Market Interconnection Plan are exemplary initiatives that will serve to push further regional cooperation.

One of the aims of the Energy Union is that consumers in one Member State should be able to make informed choices and buy their energy freely and simply from a company in another Member State. The Energy Union continues to push for standardisation and to support the national roll-out of smart meters and to promote the further development of smart appliances and smart grids, so that flexible energy use is rewarded. The Energy Union package encourages Member States to establish a road map for the phasing-out of all regulated prices. The Energy Union takes into account vulnerable consumers by stating that when

phasing out, Member States must propose a mechanism to protect vulnerable consumers, which could preferably be provided through the general welfare system.

- Energy efficiency contributing to moderation of demand:

The Energy Union package promotes energy efficiency in two sectors in particular: the building sector and the transport sector. In the building sector, the Commission has found out that the most probable tool for achieving energy efficiency is simplified access to finance. Thus, the Commission shall support ways to simplify existing financing and offer "off-the-shelf" financing templates for financial instruments to the European Structural and Investments Funds managing authorities and interested stakeholders. In addition, through the Energy Union package the Commission shall promote new financing techniques and support in terms of technical assistance. With regards to the transport sector, the Commission promotes alternative transport modes such as rail, maritime and fluvial transports. In addition, it will support the use of road charging schemes based on the polluter pays and user pays principles.

- Decarbonising the economy:

The Energy Union package states that the cornerstone of Europe's climate policy is a well-functioning EU Emissions Trading System. The European Commission wants the EU Emissions Trading System (ETS) to fully play its role as a technology neutral, cost-effective and EU-wide driver for low-carbon investments. The Energy Union package also recognises the need that national policies set decarbonisation targets to other sectors not included in the ETS system such as the land and forestry sectors.

A key objective of the EU for decarbonising its economy while increasing its competitiveness is to make the EU the number one in renewables. The Commission will facilitate cooperation and convergence of national support schemes leading to more cross-border opening through in depth discussions with Member States on the respective Commission Guidance and the Environmental and Energy Aid Guidelines.

- Research, Innovation and Competitiveness:

On research and innovation, the Energy Union package promotes the improvement of smart grid, smart home technology, transport, clean fossil fuel and safes nuclear generation and carbon capture and storage and carbon capture and use technologies. The package recognises that current research and innovation system is a long way from being fully coordinated and effectively combining EU and Member State programmes around common goals and deliverables. Therefore, the package calls for an integrated approach to funding and exploration of how public procurement can exploit its potential to act as a catalyst for industrial and business innovation and green growth both within the EU and beyond its borders.

To ensure full implementation of the Energy Union package, the Commission has designed an Energy Union governance, in particular the Commission will ensure an annual reporting to the European Parliament and the Council on the state of the Energy Union in order to address the key issues and steer policy debate. In November 2015, almost a year after the implementation of the Energy Union package a first "state of the Energy Union" report showed that much progress has already been made since the adoption of the Energy Union Framework strategy. According to the European Commission, the Energy Union Framework strategy created a momentum to bring about the transition to a low-carbon, secure and competitive economy, which support the EU in leading the transition to a low-carbon economy (EC, 2015c).

The Energy Union package represents an important development of an integrated EU energy policy. As seen in the previous section, the EU competence on the energy topic has remained really limited until mid-2000s, when Member States accepted to work together towards common energy policy and recognised the linkage between energy and climate policies. The third energy package and the climate and energy

packages of 2009 and 2014 gave more power to EU institutions. The Energy Union package builds on these powers to reach a high level of EU competences on energy, a far reaching liberalisation process and a variety of measures destined to achieve the internal energy market and to connect Member States energy infrastructures, energy flows and to increase collaboration among them to reinforce the bargaining power of the EU as a whole. In addition, the Energy Union is the first energy policy globally to directly link energy, climate and a low-carbon and sustainable economy (Deloitte, 2015).

According to the consultancy Deloitte (2015), the 20-20-20 energy and climate package attracted criticisms in its early years for failing to bring the expected results and for having numerous unexpected, or unintended, impacts on energy markets and the industry.

In beginning of the 2010s, many countries were on track to meet their 20-20-20 targets and the EU as a whole had made considerable progress towards realising the objectives. But it remains questionable whether this is due to dedicated policies or to external factors. In particular, the economic crisis of 2008 reduced the energy demand, making achievements towards energy policy goals look better than they otherwise might have been (Deloitte, 2015). Any improvement in EU business activity could rapidly push CO_2 emissions up and reverse the good trajectory that most countries seem now to be on (Ibid.).

The consultancy assesses that overall, the 20-20-20 targets have contributed to distorting electricity markets by driving renewables development by policy support and incentives rather than by supply and demand adequacy and market signals. Furthermore, the then abundant electricity supplies on the market have sent the wholesale price of electricity to record low and resulted in significant overcapacity in arithmetic terms. Several electricity TSOs then pointed the risk of blackouts (Ibid.).

The Energy Union, while representing a truly progressing step towards the liberalisation and securitisation process asked for by EU institutions shall then be better monitored to not reproduce the unexpected and unintended impacts of the previous energy package, for most of the objectives have a similar nature.

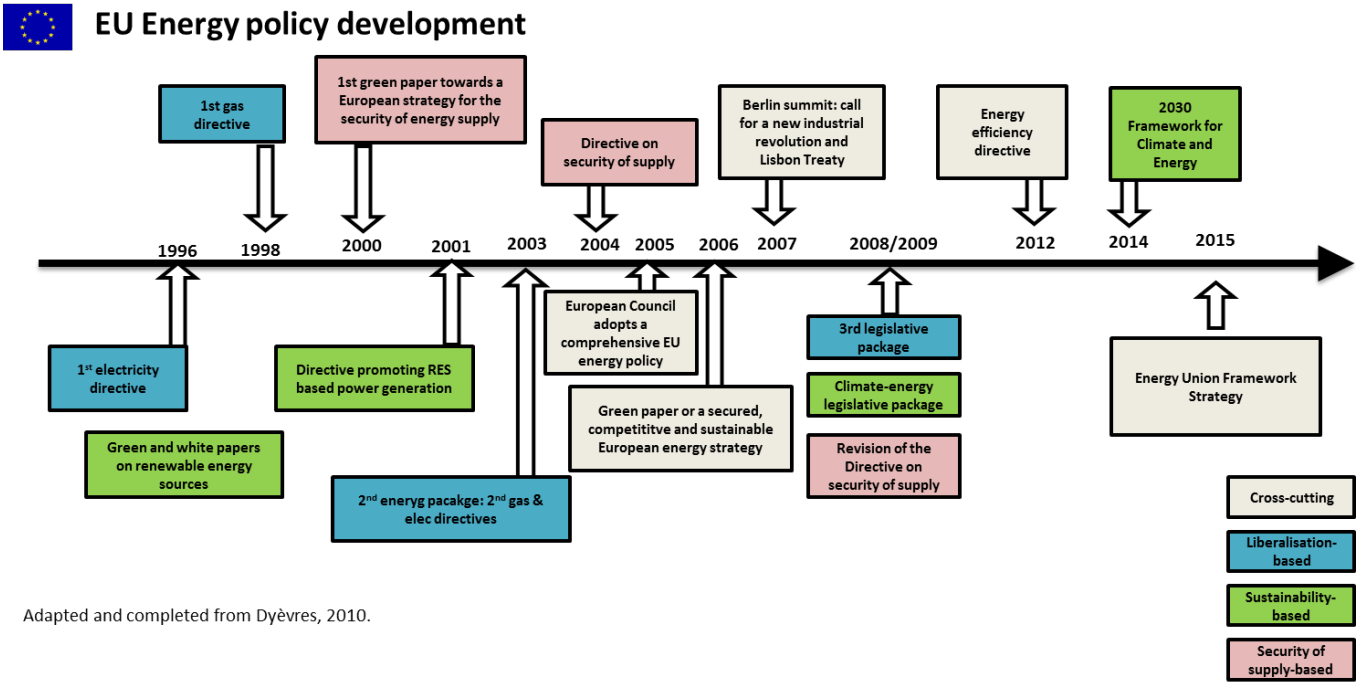

Figure 9: EU energy strategy (Adapted and completed from Dyèvres, 2010)

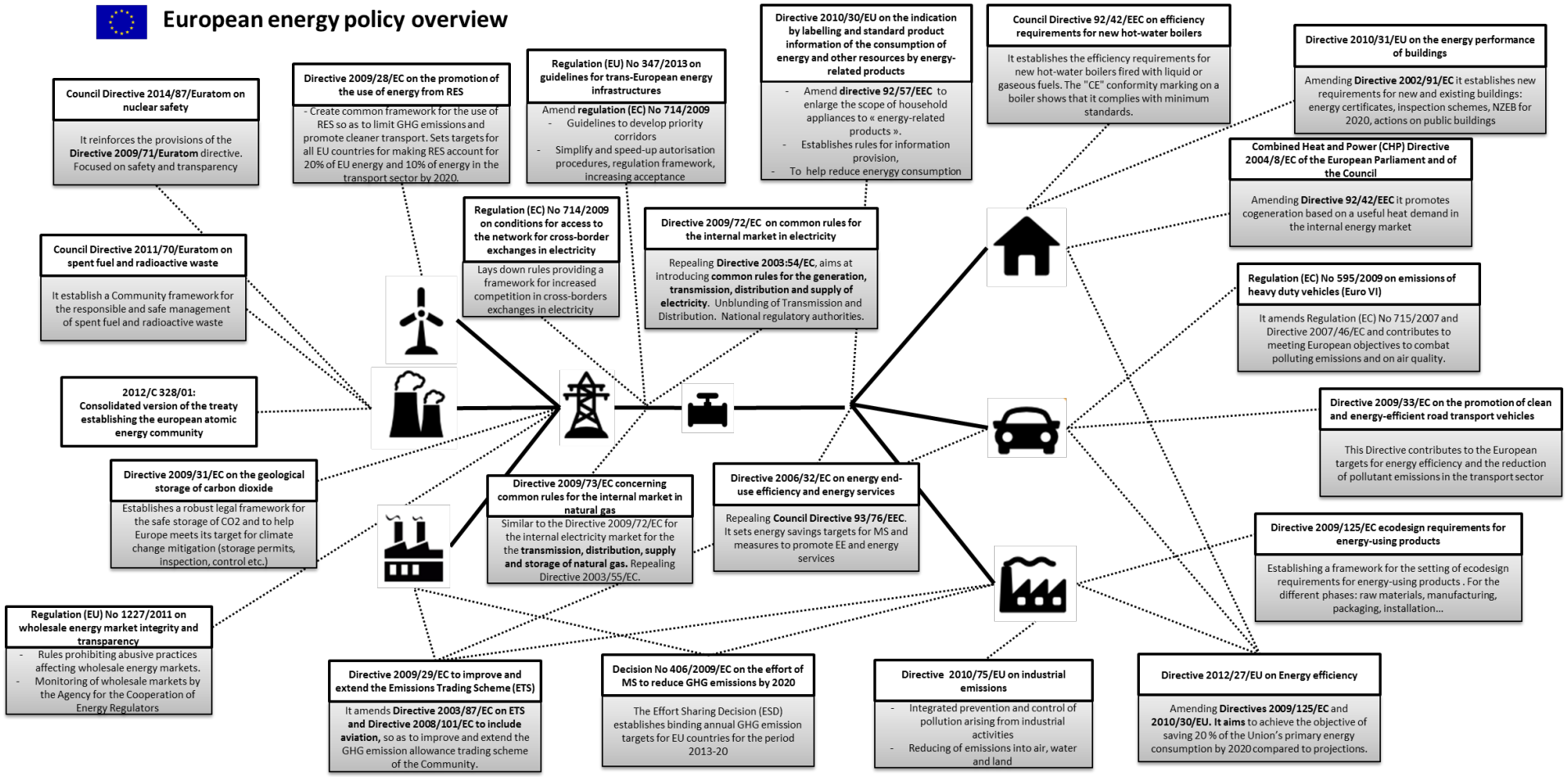

Figure 10: European energy policy overview

2.2 European Union Energy Policy and Regulation Landscape Overview

2.2.1 Energy transition definition

In the EU, the expression "energy transition" has been seldom used; sometimes it is replaced by "energy transformation", "low-carbon energy or economy" or "sustainable energy/economy". In the last development of an integrated EU energy policy, the Commission gives its vision of the Energy Union and that is linked with energy transitioning (EC, 2015d):

- " Our vision is of an Energy Union where Member States see that they depend on each other to deliver secure energy to their citizens, based on true solidarity and trust, and of an Energy Union that speaks with one voice in global affairs;
- Our vision is of an integrated continent-wide energy system where energy flows freely across borders, based on competition and the best possible use of resources, and with effective regulation of energy markets at EU level where necessary;
- Our vision is of the Energy Union as a sustainable, low-carbon and climate-friendly economy that is designed to last;
- Our vision is of strong, innovative and competitive European companies that develop the industrial products and technology needed to deliver energy efficiency and low carbon technologies inside and outside Europe,
- Our vision is of investor confidence through price signals that reflect long term needs and policy objectives;
- Most importantly, our vision is of an Energy Union with citizens at its core, where citizens take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable consumers are protected.
- To reach our goal, we have to move away from an economy driven by fossil fuels, an economy where energy is based on a centralised, supply-side approach and which relies on old technologies and outdated business models. We have to empower consumers through providing them with information, choice and through creating flexibility to manage demand as well as supply. We have to move away from a fragmented system characterised by uncoordinated national policies, market barriers and energy-isolated areas."

As we can see, especially from the last paragraph, the energy transition is necessary to achieve the type of economy (& society) wished by the Commission. The term "energy transition" is not used and instead the expression "moving away from a [type] of economy" is used. We argue that the reason why there the expression "energy transition" seldom appears in EU texts is that there is no affinity at the EU level for a deep meaning of transition associated with a paradigm shift. For decades, the energy policy of the EU has relied on a strong rationale for economic growth and the liberal economic paradigm and continues to rely on it. Examples of this can be found in Appendix 1 where some texts of EU institutions have been withdrawn from the EUR-Lex database to show the evolution of the energy policy-making from the 1970s. It can be argued that there is no will to change drastically, rather the will to optimise the energy system so that it does not hinder economic development and rather achieve a better economic output. This can be shown by the fact that in the various EU texts, including the one on the Energy Union, energy is seen as the motor of the economy. Economic growth and competitiveness are the watchwords in EU institutions and while there is a development of concepts such as energy citizenship, the "energy consumer" concept is still largely used. The energy transition should therefore bring economic freedom and business opportunities but the concept is not linked with specific social values. In addition, the energy transition of the EU is difficult to define precisely for it has a number of simultaneous drivers:

- Security of supply

- Economic paradigm seeing economic growth as necessary to the good functioning of societies
- Liberal paradigm seeing liberalisation as a means to improve the functioning of markets
- Climate change and environmental problems

It could be said that the goal of an energy transition is the result of a convergence of energy, economic and climate crises, which have created the need for a fundamental overhaul of the energy system, rather than of any overarching political plan. The initial objectives of energy security and competitiveness are reinforced by the problem of climate change.

2.2.2 Urgency and pressure on the energy transition

Environmental concerns are present in EU institutions communications at least from 1985. This can be ascertained by looking at Appendix 1 where some texts of EU institutions are presented. However, effective legal measures came late, 2001 for the first RES directive, while the need to develop RES was already stated in 1988. The DG Climate was set up only in 2010 (DG Climate, 2015). In 2015, the EC and the Council expressed their position on climate change in the frame of the COP21 conference. They both appear to be very aware of the urgency of the situation:

- "All decision-making levels are involved in implementing European energy and climate policies, be they local, regional, national or European to combating climate change" (EC, 2015a).
- "Leading experts have shown the exorbitant cost of climate change if the world does not immediately start to reduce its greenhouse gas emissions" (EC, 2015a).
- "The council of the European Union underlines the critical importance of the 2015 Paris Conference as a historical milestone for enhancing global collective action and accelerating the global transformation to a low-carbon and climate-resilient society, underlines that global warming is unequivocal and that it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century, stresses that, consistent with recent IPCC findings, in order to stay below 2°C, global greenhouse gas emissions need to peak by 2020 at the latest, by reduced by at least 50% by 2050 compared to 1990, and be near zero or below by 2100" (CEU, 2015).

While there is now a good understanding of the urgency of the situation and while there was an interest for renewable energies since the mid-1980s, the urgency was not really felt before mid-2000s.

2.2.3 Policy integration

With regards to environmental policy integration, the EU's sustainable development strategy (SDS) was created in 2001 and adopted in 2006. Eurostat, the statistical office of the EU, is tasked with producing a report every two years to measure progress across member states. This is assessed on the basis of over 100 sustainable development indicators (SDIs) (Eurostat, 2015). The SDIs, cover ten themes including: socioeconomic development, sustainable consumption and production, social inclusion, demographic changes, public health, climate change and energy, sustainable transport, natural resources, global partnership, and good governance (ibid.). While these ten themes address ecological, social and environmental concerns, Mullally and Dunphy (2015) note that 'Europe 2020: A European strategy for smart, sustainable and inclusive growth' has become the overarching strategy for European policies, to the detriment of the EU SDS. This has not proved to be an ultimately positive development. They also concur with Söderberg (2011) "that EPI does not necessarily ensure environmentally beneficial outcomes in multi-sector context[s]" (Mullally and Dunphy, 2015: 63), highlighting the need for a re-evaluation of EPI as it is currently applied. Reframing the debate around a 'sustainable transition' narrative, with an emphasis on 'transitions management' may, they suggest, address this shortcoming.

With regards to climate policy integration, a study conducted in 2012 by Dupont and Oberthür showed that a long-term perspective for climate policy integration (CPI) was necessary and that CPI was insufficient in the EU energy policy (Dupont and Oberthür, 2012). They defined CPI as promoting climate policy objectives in the policy process, including in non-environmental policy sectors, in order to achieve the long-term policy objective of ensuring global temperature rise does not exceed 2°C. They focused their study on two themes: renewable energy development and gas supply.

For renewable energies they concluded that the current target of a RES share of 20 per cent by 2020 reflects a medium level of CPI in the policy output. A very high level of CPI would have led to a RE share of 30-40 per cent in 2020. In the policy process, they found that the extent of CPI is high. Such a level is due to the prominent consideration of climate policy objectives in the policy process and the active involvement of internal and external climate stakeholders based on established procedures. The co-benefits of achieving RE and climate objectives were clearly recognised from the beginning of the policy discussions.

For gas supply, they found that most existing gas import infrastructure capacity will remain in 2050 between 600 and 800bcm. While this range of infrastructure capacity does not take account of planned additions, it is several orders of magnitude greater than the requirements under high CPI decarbonisation scenarios. Therefore, the promotion of unnecessary gas import infrastructure bears the concrete risk of diverting the EU away from a decarbonisation path, towards one of "carbon lock-in", where the infrastructure in place promotes the continued use of fossil fuels. Policies to promote such infrastructure are contrary to the objective of decarbonising the energy system by 2050.

Table 1: Current and future EU gas import capacity (Dupont and Oberthür, 2012).

	2011	2020	2050
Total import capacity (LNG plus pipeline)	626.5 bcm	825.4 bcm	*c.* 600-800 bcm
Actual imports in 2011	390.3 bcm		
Ideal CPI gas consumption	440-457 bcm	330-380 bcm	0-150 bcm
Actual Consumption 2011	447.9 bcm		

Therefore, they estimated that CPI was thus non-existent in the policy output of EU gas pipeline policies. Full CPI in gas infrastructure planning would mean abandoning support for new import infrastructure. They stated that the potential short-term synergies with climate policy objectives had hidden the long-term conflicts for arguments favoured gas as the "transition fuel" in the short-term (Eurogas, 2011). Energy security concerns were the prime motivation for promoting gas import pipelines, which seemed to block climate concerns from seriously entering the discussions. In addition, the negotiations for supplies of gas took place among the gas companies and at member state level, meaning EU-level policy discussions were not the focus. Climate and decarbonisation arguments had, thus, not garnered attention in relevant EU policy discussions.

Another study carried out in 2014 on climate policy integration and energy security policies found that the two policy fields were mostly coherent but that policy subareas require attention where coherence is dependent on ancillary measures (Nilsson *et al.*, 2014). They estimated that real conflicts are few: e.g. the interactions between reducing emissions and strategic reserves, and between increasing renewable energy and demand response. Many energy security aspects that may, upfront, appear to be in conflict with climate mitigation, such as gas infrastructure and strategic reserves, have the potential to become synergistic.

This shows that in two years, between the two studies in 2012 and 2014, climate policy integration has improved. They also identified some interactions that policy makers need to look at closely so that synergies can be exploited: neighbourhood policy and increasing renewables, gas transport infrastructure and increasing renewables, internal market and increasing renewables, power transmission and improving efficiency, and new sources of energy and improving efficiency (*Ibid*.).

However, they remained concerned with the fact that how individual member states securitize energy issues determine coherence at the EU level. While member states re-evaluate their priorities and the risks/threats toward their energy systems, they might try to reframe energy security in a more national-based way, where decisions are based on shorter-term assessments and where the agency is mainly attributed to the national institutions, rather than to a combination of European and national institutions (*Ibid*.). This could encourage short-term solutions that privilege the development of fossil fuels, thus putting at risk the coherence between energy security and the promotion of renewables and reduction of emissions. A current example is Poland, where there have been attempts to redefine energy security, based on a much more national and fossil fuel oriented framing. In 2014, the Prime Minister of Poland argued that greater energy security in Europe must be promoted through a greater flexibility towards fossil fuels, despite environmental concerns (Tusk 2014).

Finally, a third study, carried out in 2015, proposes a critical view of the Energy Union concept, stating that the integration between energy and climate policies is too low (Szulecki *et al*., 2015). For them, the growing fragmentation and renationalisation in EU energy and climate policy puts the question of integration into question. In addition, they argue that the "Energy Union" concept is mostly an empty box in which every stakeholder tries to put whatever is on the top of their priority list. However, they do estimate that with a better focus on EU governance, the concept could reach far beyond what is expected and provide welcome coherence in Europe's energy and climate policy (Ibid.).

The European Climate Foundation also shares the point of view that there should be more integration between the Energy Union and climate policy and that the Energy Union should not be limited to an energy and climate policy silo (ECF, 2015). For them, there should be no disconnect between Europe's climate diplomacy and its energy diplomacy, yet EU energy diplomacy remains focused on access to fossil fuels. They deem necessary a reset of the EU Energy Diplomacy Strategy after COP21 to recognise the new global energy and climate realities (Ibid.).

2.2.4 Institutional structure

Key institutional actors – EU

This section presents the main EU organisations that have an impact on energy and climate policies:

European Commission: has the right to initiate legislation. In the legislation process the Commission has limited power as it may withdraw a legislative draft, but it has no decisive say. The Commission is also the executive body.

The European Parliament: is the second legislative body, has gained more power in the recent years with the Lisbon Treaty. The EU parliament is organised in political factions, but decisions of Members of parliament are usually also strongly influenced by their country of origin.

The Council: consists of the respective ministers of energy from Member States. In the past, the council used to decide all energy legislation unanimously. This brought many initiatives to a sudden end (Langsdorf, 2011). Following changes in the Lisbon Treaty, today most issues can be decided with a qualified majority.

ACER: Agency for the Cooperation of Energy regulators. ACER deals with NRA (National Regulatory Agencies), TSOs, provides other monitoring tasks and may submit an opinion on possible measures to remove existing barriers to an integrated European energy market to the European Parliament and to the Commission (Dyèvres, 2011).

DG Energy: the Directorate General on Energy focuses on developing and implementing the EU's energy policy.

DG Climate Action: the Directorate General on Climate Action leads the European Commission's efforts to fight climate change at EU and international level.

Key non-institutional actors

This section presents the main non-EU institutions organisations and actors that have an impact on energy and climate policies:

The Member States (MSs) are the most important actors outside the EU institutional level. They influence energy policy via their energy ministers in the EU Council. Moreover, the EU can only act in areas for which the MSs gave the EU the competence to act. For example, the energy mix is still a Member State competence. National preferences, available natural resources, industrial reasons and energy foreign policy all influence which kind of mix a country has.

(Inter-) national energy companies: they lobby at all kind of levels. Due to the delays the liberalisation of the market endured, some national champions such as EDF, RWE, EO.N or ENEL, seemed to have profited economically and even gained more influence (Langsdorf, 2011). The grid-connected energies (gas and electricity), however, proved difficult to liberalise (Langsdorf, 2011). Some MSs were reluctant to open their markets, as electricity and gas supply is traditionally a task of the State (Ibid.). During implementation of the third package (2009), France and Germany opposed the unbundling of ownership in the grid (the separation of supply and production activities). The combination of ownership of the transmission network and energy production activities in big companies hinders the access of small energy suppliers (often RES producers) to the grid. A compromise has emerged where big energy companies keep ownership of the grid, but the grid is handled by an independent system operator (ISO), or where the two sectors are separated within the company (Langsdorf, 2011).

Energy regulators (NRA): the role of NRAs is to promote a competitive, secure and environmentally sustainable internal energy market, ensure the effective opening-up of the market, and guarantee appropriate conditions for the effective and reliable operation of electricity and gas networks, taking into account long-term objectives (Dyèvres, 2011).

- In the first energy package (96-98), MSs were required to designate an independent authority to settle disputes between energy undertakings (Dyèvres, 2011). The aim was to "create appropriate and efficient mechanisms for regulation, control and transparency" (*Ibid*.)
- In the second energy package (2003), MSs were required to establish regulatory authorities which are independent from the industry to monitor and deal with the management of interconnections and possible congestions, account unbundling, access to national networks and related contracts, transmission and distribution tariffs, evaluation of the level of transparency and competition in the markets, publication of an annual activity report (Dyèvres, 2011). Regulators had to contribute to the development of the internal market and of a level playing field by cooperating with each other and with the Commission in a transparent manner. The EC set up the European Regulators Group for Electricity and Gas with a mission of advising and assisting it in its action to consolidate the internal market and of encouraging co-ordination among national regulators (Dyèvres, 2011).

- In the third package, one of the aims was harmonising and strengthening the independence and the competencies of the NRAs.

Transmission System Operators (TSOs): With the third energy package, MSs have the choice between three unbundling options in electricity and gas:

- Ownership Unbundling
- Independent System Operator
- Independent Transmission Operator

Distribution System Operator (DSOs): The third package has stricter requirements to ensure DSO independence.

Civil society actors such as environmental protection associations: These have gained influence, as they provide valuable science and thus data on climate change and energy issues and enjoy a high level of credibility. The channels of lobbying for these actors are very similar to those of the energy companies.

EU citizens:

- While EU citizens, in their role of consumers are being given more importance in EU energy policy, their interest into EU elections is decreasing over years (European Parliament, no date). It could be asked whether EU citizens remain attuned to the development of EU policy and whether they are fully able to understand the complexity of EU energy policy given their apparently poor interest into EU policy-making.
- As part of the Energy Union package, the Commission proposed in July 2015 a 'new deal' for energy consumers. (EC, 2015e). The aim is to empower European consumers and recognising that citizens must be at the core of the Energy Union. This new deal is based on a three-pillar strategy: 1. Helping consumers save money and energy through better information; 2. Giving consumers a wider choice of action when choosing their participation in energy markets and 3. Maintaining the highest level of consumer protection (Ibid.). The Commission states that consumers need to become just as well-informed and empowered as buyers and sellers on wholesale markets through clearer billing and advertising rules, trustworthy price comparison tools and by leveraging their great bargaining power through collective schemes (such as collective switching and energy cooperatives). The new deal, with its second pillar, also assumes that consumers can become prosumers: "consumers need to be free to generate and consumer their own energy under fair conditions in order to save money, help the environment, and ensure security of supply" (Ibid.).
- In terms of civic participation, since the Treaty on EU and the Treaty of Lisbon, and following a regulation of the EP and the Council in 2011, European citizens have been given the possibility to submit citizens' initiatives (Biesenbeder, 2015). The Commission also regularly launches public consultation on key topics, and did so also for the new market design, part of the Energy Union package.

Institutional structure analysis

EU institutions rely on the liberal economic paradigm. Liberalisation of the energy sector has been seen as the only way to integration (Ranci, 2003). Reliance on liberalisation and privatisation was deemed to help in meeting public finance needs, tackling the power of big companies, increasing innovation and competitiveness while being cost-efficient. While liberalisation has positive arguments in its favour, it seems to have become locked-in within EU discourse. Indeed, the same discourse has applied for decades, repeatedly stating that liberalisation is the key to solving EU problems, but most of the problems remain even if some progresses have been made. In its defence, the EU is a unique institutional construction and faces the problem of coordinating the actions and policies of many countries. The diversity of problems at national level is important and explains the time needed to find common agreements. In addition, the EU

has continuously expanded to include even more countries, which did not simplify the various negotiation processes. Also, the Member States keep their competences in certain legislative areas, which weakens the power of EU institutions. The influence of lobbies seems also too important and threatens the power of EU institutions. This could be compensated for by giving more power to citizens. The Lisbon Treaty of 2007 included special clauses for participatory democracy but not all participatory democracy forms are implemented. For example, there is no Citizens' jury at EU level.

Following this, it could be asked whether the liberal paradigm is the most effective one to achieve a sustainable energy system since, as seen in this entire section on the EU, progresses are made but at a low pace and more efforts and drastic changes will be needed to achieve the objectives set for 2030 and 2050. This question will not be dealt with in its deliverable but could be interesting to study, since, according to Deloitte (2015), the outcomes of the 20-20-20 climate and energy package, while being built on liberal principles, had some outputs that were at the opposite of the expected results. Another question can be asked, which concerns the means with which EU institutions manage to overcome the barriers (uniqueness of the EU construction, increasing number of countries, lobbies, etc.) to energy policy integration and liberalisation of the energy system.

A study by Jegen (2014) proposes an analytical frame to assess how the Commission managed to push for the liberalisation of European electricity and gas markets, gradually linking energy and climate policies, and asking for a common voice in energy relations with third parties. She proposes a model to show how the Commission constructed a "Competitive, Sustainable and Secure (CSS)" frame in order to justify its intervention in a policy domain which member states used to consider as a purely domestic one (Jegen, 2014). The model includes the Commission's framing (ideas), the Member State's energy situation (interests), and the existence of an EU regulatory space (institutions). How these three elements combine, strengthen or undermine each other helps explain how far the Commission was able to push its agenda (Jegen, 2014).

For Jegen, the Commission framed the need for a common energy policy by linking three issues that initially were not related and upon which the Commission had unequal authority: the internal market for energy, climate change, and external action with regard to security of supply. This is also verified by Biesenbeder (2015) who found that the framing of the EU's energy policy agenda has become more diverse since the late 2000s. Problem perception did not remain centred on the internal market but increasingly linked the debate to issues of climate change and considerations of environmental policy (Biesenbeder, 2015). For Jegen, this process of integrating several policy problems with the energy topic started in the mid-1990s and resulted in what she calls the CSS market frame. This innovative frame has allowed the Commission to set the agenda in the field of energy policy from the mid-1990s on (Jegen, 2014) and she assesses that this frame have been used in almost every document produced by the Commission since the mid-2000s (Ibid.).

She estimates that the CSS frame has been successful because it has been taken over and incorporated in the everyday discourse of national policy makers (Jegen, 2014; Jacquot and Woll, 2008).She attributes the success of the CSS frame to be largely based on its polysemic nature (Jegen, 2014). Indeed, the frame is built on a strategic repertoire of ideas that link free circulation of services and competition with the environment and external security, resulting in a seemingly coherent discourse (Ibid.). This is also found by Wood (2010:318), who states that with the CSS, the Commission managed to create a set of policy ideas that look coherent: in a quasi-syllogism, sustainability is necessary to reduce insecurity, but competitiveness is necessary to tackle climate change This seemingly coherent discourse allows the CSS

frame to resonate with different categories of actors in different Member States, from environmentalists to nuclear producers, and from conservative politicians to liberal economists (Jegen, 2014.).

However, there is a counterpart to this apparent effective strategy, which is that the ambiguity of this frame has allowed national actors to emphasise the specific elements that were congruent with their national interests (Chester 2010), resulting in different degrees of institutionalisation of the CSS frame in Member States. For Natorski and Herranz Surrallés (2008), this has even resulted in different adoption levels of the CSS frame within the Commission itself, where different DGs naturally have different priorities when it comes to energy policy. For Biensebeder (2015), there is even a difference between the Commission and the Parliament. While the Commission and the Council have worked on general principles and overarching issues of energy policy since the 1970s, the Commission considered the internal energy market as the main instrument to realise the stated targets of a comprehensive EU energy policy, while agenda-shaping activities by members of the EP repeatedly focused on the environmental and climate-change implications of energy policy (Biesenbeder, 2015).

According to this, the adoption of the CSS frame depends from its polysemic design. But Jegen, with her model and a comparison between Germany, Poland and France has elucidated other conditions for the buy-in of the CSS frame. She has found that the Commission's framing is most effective when it is linked to the Commission's strongly institutionalised competence, whether because it is exclusive vis-à-vis Member States (competition) or because it is well established (internal market). The sustainability dimension, while less institutionalised at the EU level, became more integrated in energy policy because it has a strong resonance with some member state interests. Security, on the contrary, does not rely on formal institutions nor on the interest of large states, that is the reason why, according to Jegen, it has remained the weak link of the EU energy policy.

The analysis proposed by Jegen is interesting in the sense that it shows well how the EU, and in particular the Commission, has gradually increased its power to finally be able to make such an important package as the Energy Union adopted. This process has relied on the followings drivers altogether activated: increase of the EU's competence by subsequent changes in EU treaties, linking of different issues together to form an apparently coherent frame that resonates with a large scale of actors and the new changes in EU treaties, thus facilitating its buying-in, and using the EU's competence in the other linked issues to bypass the limited power of the EU on the energy topic. It can be therefore said, that it is the liberal paradigm of the EU, which gives EU institutions their power (internal market, competition), that has been able to push for changing the fuel of the EU's economy and therefore a change in the energy system.

2.2.5 Initiatives on new sustainable technologies

Support for renewable energy at EU level dates back to the 80s. In particular, the Altener programme of 1993 provided more than 40 million ECU to support RES development. In 1996, the Commission published the Green Paper for a Community Strategy where they viewed RES as energy sources for the future. The last directive promoting RES was voted in 2009. Overall, the development of RES is slow but in line with the strategy. The Commission states that Europe has installed three times the amount of renewable power per capita than the rest of the world. It needs to be asked, however, why, despite awareness of the potential of RES for more than two decades, they have not experienced a stronger market uptake. In addition, the development of RES is uneven (EREC, 2011). Some technologies have progressed quickly while others are lagging behind. Progress in the field of heating and cooling has been much slower than in the field of electricity, which can be explained by the lack of dedicated legislation. With the RES Directive, this gap was

closed. However, a strong effort will be required in the next decade to bring the heating sector up to the same level as the electricity sector where progress over the last years has been impressive (Ibid.).

It can reasonably be hoped that the new development of the Energy Union and related programmes such as Horizon 2020 will better support the development of innovative and sustainable technologies. Indeed, a document of the Commission on what the EU does for the climate gives the following insights on the current and future support and funding to fighting climate change through new technological developments (EC, no date):

- "In the period 2014-2020, the EU will support renewable energy, electrification and energy efficiency projects with about €3.5bn in grants and further leverage of €15-30bn in loans and equity investment
- Through Horizon 2020, the EU has committed to allocate at least 35% of the programme's approximately €80bn budget to climate-related objectives. One important strand of research and innovation activities is focused on supporting the building of a sustainable Energy Union, with just under 6bn foreseen from Horizon 2020 over seven years. This will allow investments into research on greater energy efficiency, technological breakthroughs in renewable energies and decarbonising the fossil fuel power sector and carbon intensive industry
- With a budget of €24bn for 2014 – 2020, the EU's Connecting Europe Facility (CEF), supports key infrastructure projects, promoting sustainable transport modes, multi-modality and integration of intelligent and innovative technologies in transport".

3 National policy & regulation landscape

3.1 Ireland

3.1.1 National energy system and regulation review

For the most part, Ireland has traditionally relied on imported coal, oil and (more recently) natural gas to meet its energy needs, with a smaller portion supplemented by indigenous peat production and hydroelectric power. A notable diversion from this path occurred in the 1970s in response to the oil shocks brought on by numerous crises in the Middle East. The government at the time passed the Nuclear Energy (An Bord Fuinnimh Núicléigh) Act in 1971, establishing the Nuclear Energy Board (NEB) with responsibility to develop a nuclear power station in Carnsore Point, County Wexford. In 1974 the Electricity Supply Board (ESB) announced plans to construct a nuclear power plant at Carnsore Point in Co. Wexford. Despite receiving broad political approval from the main political parties this development was met with almost immediate opposition from non-establishment groups and from the general public largely informed by nuclear accidents such as the 1957 Windscale (now Sellafield) fire disaster in the UK. Hostility to nuclear power was galvanised by a number of anti-nuclear action groups culminating in a series of protest marches and concerts at the Carnsore Point site between 1978 and 1981 titled "Get to the Point" and "Back to the Point". The partial nuclear meltdown at Three Mile Island, USA, during this period contributed to taking nuclear power off the political agenda entirely as politicians saw popular public support evaporate for the project. After the NEB failed to develop a nuclear power plant at Carnsore Point its role changed from a nuclear advocate to that of an environment-focused nuclear watchdog. It sponsored a number of reports on nuclear power plants in the United Kingdom, most notably the Sellafield Power Station in Cumbria. In 1992 it was succeeded by the Radiological Protection Institute of Ireland (RPII), which was itself subsequently merged with the Environmental Protection Agency in 2014. The generation of electricity by

nuclear fission for supply to the national grid is currently illegal under the Electricity Regulation Act, 1999 (Section 18).

The 1990s in Ireland saw the country develop out of a crippling economic recession that occupied much of the 1970s and 1980s, to become one of Europe's success stories. Annual rates of economic growth, from the mid-1990s onwards, were consistently two to three times the EU and OECD average. Employment rose from 1.1 million to 1.9 million in the fifteen-year period from 1990 to 2005 and the persistent prospect of emigration that had informed Irish society from the foundation of the state was replaced by unprecedented levels of inward migration. This rise in activity largely resulted from a combination of political will to attract Foreign Direct Investment (FDI) into the country (as a result transforming Irish economy into an open, highly competitive, globalised system to accommodate this) and the ready availability of capital from lending institutions in other Member States including Germany, the UK and France. As economic activity intensifies so too does the demand for energy services, as was the case for Ireland's recent economic boom. By 2007 the Gross Domestic Product (GDP) for the country was nearly three times that of 1990. Levels of energy consumption followed this trend with a strong short-term emphasis on importing more hydrocarbons.

Then in 2008 the boom ended with a downturn in economic growth deepening into 2009. As a result of this a number of sectors, namely industry and transport, experienced drops in energy use. However, as the tail end of the property bubble, which fuelled the later part of the economic boom, began to contract energy growth in the residential and services sectors continued to rise. The cold winter of that year may also have contributed to the higher than expected energy demands for those sectors given the heating requirements involved, since the following year was warmer and energy demand subsequently dropped as a result. The importance of weather to national energy demand is illustrated in the subsequent years where demand spiked and dropped in reaction to the colder and warmer weather conditions associated with each year.

National energy supply is usually understood in terms of changes made to the total primary energy requirement (TPER), which is defined as the total amount of energy used in any given year. Calculations on the national TPER also include the energy needed to convert primary energy sources into more useful forms for final consumers such as electricity generation or oil refining. For example nearly 50% of electricity produced is eventually lost in the network before the end user has a chance to utilise it. Also, these conversion activities often act independently from the economic activity that usually affects energy use. They are as much dependent on the levels of efficiency in the transformation process and the technologies applied.

A noticeable trend in terms of energy use has been the rise in RES, especially wind and biomass, and natural gas in contributing to the overall share. This has been followed by a relatively sharp decline in peat, both in terms of production and its share of the energy mix. Another noticeable trend can be seen with electricity imports increasing by 413% in 2013 to 182 ktoe (Howley *et al.*, 2014: 12), resulting from the inter-connector to the UK becoming operational in that year. Greater integration between the national grids is planned for the future and this figure is set to increase.

In the Green Paper on Energy Policy in Ireland (2014) the Department for Communications, Energy, and Natural Resources (DCENR) sets out six energy policy priorities for discussion. These are: Empowering Energy Citizens; Markets and Regulation; Planning and Implementing Essential Energy Infrastructure; Ensuring a Balanced and Secure Energy Mix; Putting the Energy System on a Sustainable Pathway; Driving Economic Opportunity. Clearly, there are some subjects that are relevant for several policy priorities. For example, priorities 5 and 6 — Putting the Energy System on a Sustainable Pathway, and, Driving Economic Opportunity — are cross-cutting themes that are relevant for all energy policy priority areas. Following consultation on the key policy areas, and feedback from relevant parties, and the public, the White Paper On Energy Policy in Ireland is due to be published in the 4th Quarter 2015.

Ireland's target under the EU Renewable Energy Directive (2009/28/ EC) is for 16% of the country's gross final energy consumption to come from renewable energy sources by 2020. In order to achieve the 16% target the Government set a 10% target for all transport energy, and a 12% renewable heat target and a 40% renewable electricity target. Due to the size of Ireland, and its population, and as an island nation, the energy landscape is somewhat limited, both in terms of diversity of sources of energy, and in the extent of policy. Ireland imports the vast majority of its energy, and therefore the production landscape is sparse.

There are 119 Statutory Instruments (SIs) and Acts on energy, per se, in Ireland listed on The Statute Book, the official website of Irish Legislation as produced by the Office of the Attorney General. Of these, there are Seven Acts in total as follows:

- Energy (Miscellaneous Provisions) Act 2012
- Access to Central Treasury Finds (Commission for Energy Regulation) Act 2011
- Energy (Biofuel Obligation and Miscellaneous Provisions) Act 2010
- Energy (Miscellaneous Provisions) Act 2006
- Sustainable Energy Act 2002
- Energy (Miscellaneous Provisions) Act 1995
- Nuclear Energy (An Bord Fuinnimh Núicléigh) Act 1971

There are 186 documents (Acts and SIs) on electricity alone in Irish Legislation, 47 of which are Acts, or Amendments to the Acts. The primary acts are The Electricity Regulation Act 1999, and acts relating to electricity supply dating back to 1924. Legislation on renewable energy in Ireland tends to encompass several energy types; for example, there is no one single Act specific to Solar Power, Tidal Power, or Wind Power. However, there are several statutory instruments that refer to renewable energy (i.e. SI Numbers 161/2015, 482/2014, 483/2014, 158/2012, 147/2011 and 148/2011). There are 41 SIs relating to fuel in general, from transport of fuel, to sulphur content of fuel, and 12 relating to hydo-electricity.

There are 82 documents (Acts and SIs) relating to coal, many of these are minor revisions to the acts regarding pricing – the Acts themselves date back to before the establishment of the Irish State (1887, 1894 and 1905). There are 149 documents (Acts and SIs) relating to Oil, 9 of which are Acts from the Oil in Navigable Waters Act of 1926, right up to the National Oil Reserves Agency Act of 2007. There are 257 documents (Acts and SIs) relating to Gas, the first Gas Regulation Act dates back to 1920, followed by updates in 1928, 1929 and 1957. This Act was changed to the Gas Act in 1976, this was amended several times between 1980 and 2009. The current Act is again entitled the Gas Regulation Act (2013). There are 12 documents in relation to Peat – although half of them relate to Peat Moss (gardening/potting compost) rather than Peat for Fuel and Energy Purposes.

An overview of the Irish energy system and landscape is presented here. This mapping outlines the energy sources; infrastructure; demand; market structure; and policies of Ireland, and further outlines substantial

changes that have occurred since the late 20th Century. An overview of energy policies indicates the future of the Irish energy landscape over the next couple of decades. The Irish main objectives regarding energy strategy, its main problems, targets and roadmaps, main discourses at public level and main events that have driven the change to a more sustainable energy system are summarised in Figure 11.

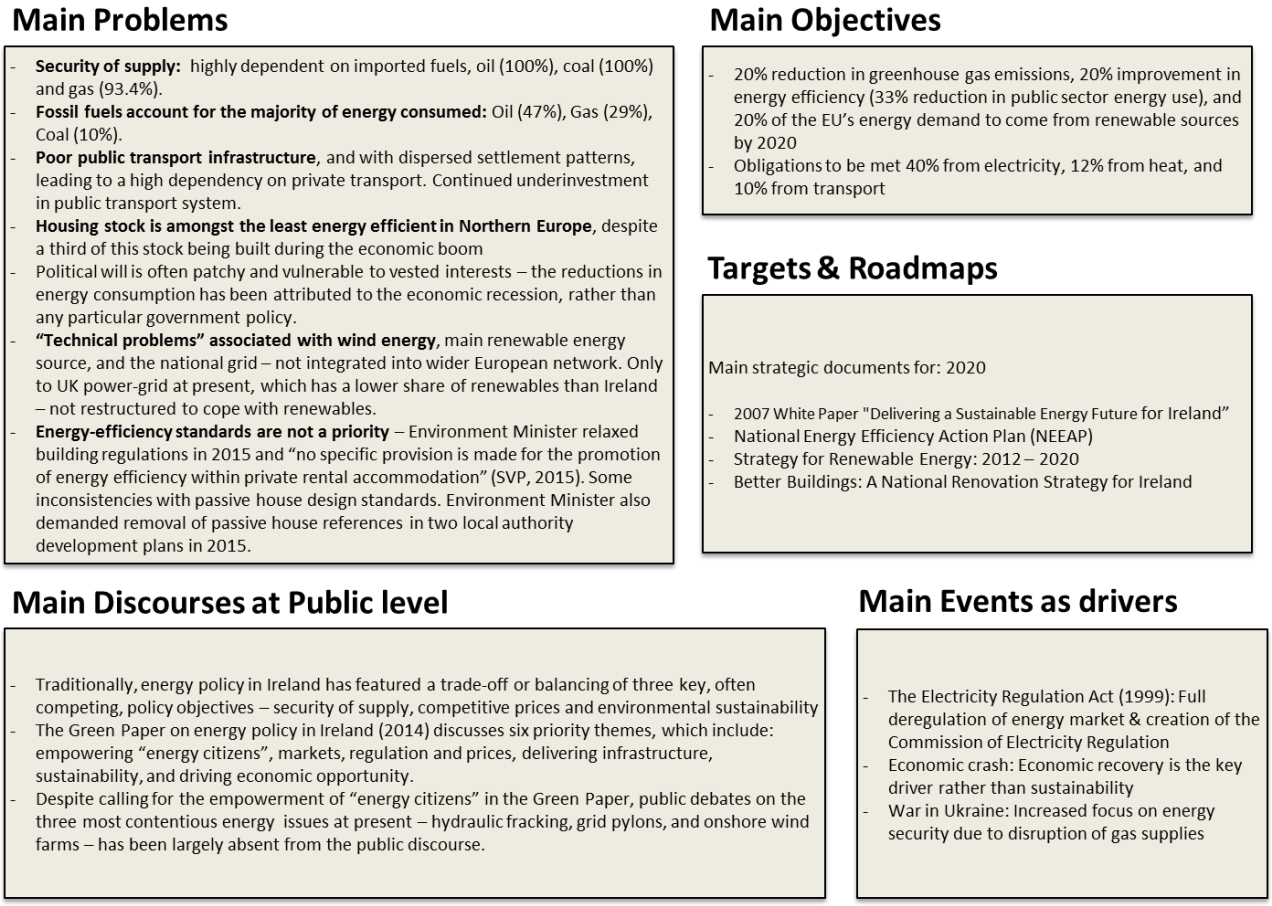

Figure 11: Irish strategy in energy policy making

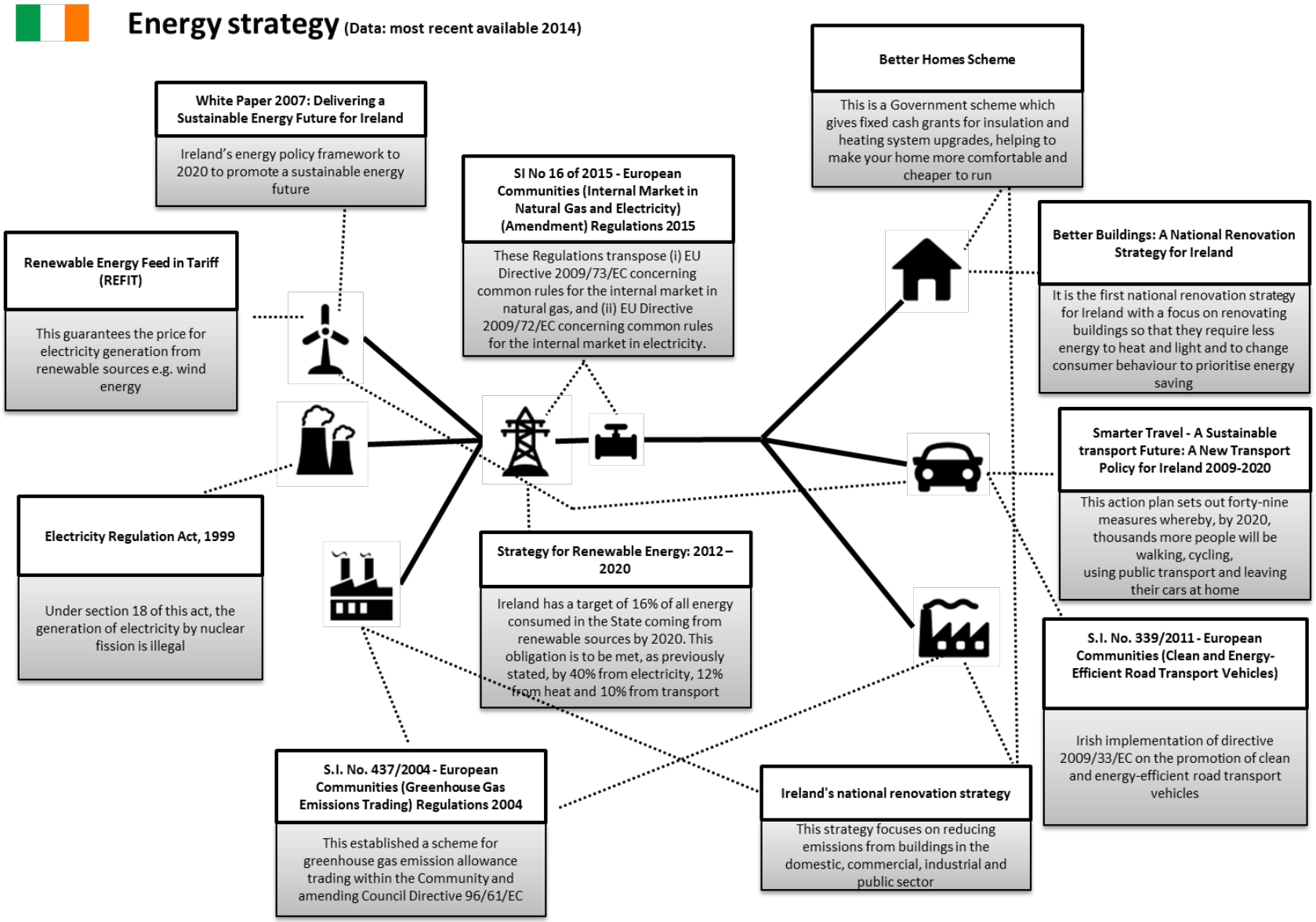

Figure 12: National energy policy overview in Ireland

3.1.1.1 Energy political orientation & social, environmental and economic objectives and barriers

Political & societal orientations with regards to the energy topic

The government's energy policy has a clear focus on the development of renewable energy sources, which is evident in the white and green papers on energy (2007 and 2014 respectively). Societally, energy is an ambiguous topic in Ireland with public opinion on energy matters best described as indifferent, save for particular 'hot topic' issues such as the Corrib gas project, wind energy, and fracking for shale gas. In these instances, local opposition groups often clash with developers and the government over energy developments.

Wind energy is central to the government's plans to develop renewable energy, as Ireland has one of the best wind resources in the world. Since the first commercial wind farm project in 1992, Ireland's wind energy industry has developed rapidly, accounting for 21 per cent of Ireland's domestic energy production in 2014. As of June 2015, there are 228 wind farm developments on the island of Ireland and the growth trend is set to continue for the near future. This level of development has resulted in growing levels of concern at the potential visual and environmental impacts on the affected communities. Due to these concerns and a perceived lack of community engagement by the developers, local anti-wind groups are becoming increasingly common.

The recent development of a natural gas pipeline from the Corrib gas field through a local parish resulted in protests and the creation of the organisation Shell to Sea. Shell to Sea consists of campaigners who view the project as dangerous and are fought to have the gas refined at sea rather than on land. This led to numerous clashes between the protestors and Shell, with campaigners being arrested, as well as legal action taken by the protestors against the Garda Síochána.

Fracking is currently being considered in areas of Ireland rich in shale gas, such as Fermanagh. As traditional oil and gas supplies are becoming increasingly scarce and also costlier to access, fracking for shale gas is being proposed as a potential alternative. Proponents of fracking suggest that it is a secure energy source that could provide cheaper energy as well as thousands of jobs. However, opponents of fracking are concerned about the potential environmental impacts such as the contamination of aquifers. The Irish government is open to the potential exploitation of this resource, though it is possible that fracking will generate the same opposition as wind energy development has in the past.

Objectives for 2020 and beyond for a sustainable and low-carbon energy

The Irish energy targets to 2020 are presented below and are shown in relation to how they fit in to winder EU targets, also to 2020.

Irish Targets for 2020:

Ireland's target of 16% of final energy consumption will be made up of contributions from renewable energy in electricity (RES-E), renewable energy in transport (RES-T), and renewable energy for heat and cooling (RES-H).

There are also individual targets for RES-E, RES-T and RES-H. These targets include:

- Renewables contribution to gross electricity consumption of 15% by 2010 and 40% by 2020.
- Renewables (biofuels and the renewable portion of electricity) contribution to transport energy to rise from 3% by 2010 to 10% by 2020.

- Renewable contribution to heat (Thermal requirement: heating and cooling) to amount to 5% by 2010 and 12% by 2020.

European targets for 2020:

Since the publication of the 2009 Renewable Energy Directive (2009/28/EC), the mandatory European targets are that 20% of all energy, and 10% of transport energy, will have to come from renewable energy sources by 2020 (12% by 2010). Each member state has been given different targets in order to meet these overall figures, with Ireland's target standing at 16% of total energy consumption.

Irish targets for 2050:

Looking forward to 2050, a series of Energy Roadmaps have been produced by the Sustainable Energy Authority of Ireland (SEAI), which will inform national policy makers going forward. They include roadmaps for wind energy, bioenergy, electric vehicles, smart-grid, ocean energy and residential energy to 2050. Most pertinent to the ENTRUST 2020 project is The Residential Energy Roadmap that projects residential CO_2 emissions being reduced by 90% in 2050 through a series of sustained retrofit programmes and regulation improvements. Each roadmap lays out a series of scenarios, from low to high, where the uptake of renewable energy technologies is portrayed as being slow or rapid in its application. The following roadmaps show how different elements of the energy landscape will be expected to respond to Ireland's transition to a low carbon economy.

Smart-Grid Roadmap to 2050 explores how a smart grid can become effective in Ireland by 2050 and presents an assessment of its contribution towards decarbonising the country's electricity supply. It is envisaged that by 2050 smart grids will be a significant component in efforts to reduce energy related CO_2 emissions by 250 million tonnes. This will involve greater integration of indigenous renewable energy sources that will help to achieve a reduction in energy imports of some 4.3Mtoe, therefore saving between €3.8 - €7.5 billion in direct fuel offset by 2050. Implementation of a smart grid infrastructure is also estimated to see job creation in the region of 10,000 Irish jobs over this period to 2050.

Wind Energy Roadmap to 2050 examines the potential of further developing renewable energy infrastructure, especially in terms of offshore and onshore wind, which will continue to be central to Ireland's energy policy. They estimate that onshore and offshore wind could create in the region of 20,000 jobs by 2040, with the potential economic value of electricity generated by wind increasing to almost €15 billion by 2050. They also estimate that by 2050 Irish wind energy may possibly contribute 2.5% to EU electricity demand and just over 5% of EU wind energy generation, subject to the successful rolling out of the smart grid infrastructure.

Electric Vehicles Roadmap to 2050 is another key policy platform for Irish energy policy makers. At present, transport accounts for a third of Ireland's energy requirement and energy related CO_2 emissions. This is almost entirely dependent on imported oil. Given the abundance of accessible wind and (potential) ocean energy and the relative short distances between population centres in Ireland the authors suggest it is well positioned to be an early adopter of electric vehicle technology. Implementation of this roadmap could see a reduction of up to 50% (compared to 2011 figures) in imported fossil fuels directly linked to transport and an estimated annual CO_2 reduction of 4 million tonnes for the country's passenger car fleet alone. Also, the cumulative cost saving to Irish society could be anywhere from €2.3 billion to €12.4 billion by 2050.

Ocean Energy Roadmap to 2050 presents how a potential 29GW of installed energy capacity may be harnessed from developing ocean energy technologies to 2050. Estimates of 70,000 jobs and a potential cumulative economic benefit of some €12 billion by 2030, rising to €120 billion by 2050 have been put forward in this roadmap.

Finally the **Bioenergy Roadmap** lays out the potential contribution further development of the bioenergy sector will make to the Irish energy landscape to 2050. At present biomass and renewable wastes account for 13% of Ireland's indigenous energy production. This is set to increase in the coming years and the Bioenergy Roadmap will form part of Irish rural policy given the 8,000 new jobs projected from the sector.

3.1.2 Irish Policy and Regulation Landscape Overview

Energy Transition

The most recent expression of the Irish government's approach to the SET is the green paper on energy policy, which was published in 2014 (the resultant white paper is due to be published by the end of 2015). The green paper defines the sustainable energy transition as

'transforming Ireland's economy from one based on a predominantly imported fossil fuel to a more indigenous low carbon economy centred around energy efficiency, renewable energy and smart networks' (Department of Communications, Energy and Natural Resources, 2014; p. 4).

The green paper states that this transition is at the core of the government's energy policy, with '…the three key pillars of Ireland's energy policy are security, sustainability and competitiveness' (p. 4). The document also outlines six priority areas of policy see as central to achieving the transition: 1) Energy Citizenship, 2) Markets and Regulation, 3) Planning and Implementing Essential Energy Infrastructure, 4) Ensuring a Balanced and Secure Energy Mix, 5) Putting the Energy System on a Sustainable pathway, 6) Driving Economic Opportunity.

1. Energy citizenship: The government wants to transform the Irish population from passive consumers of energy to engaged, active energy citizens. They feel that such energy citizens can engage with the two identified pathways to decarbonising the energy system: increased energy efficiency and the increased deployment of low-carbon energy sources.
2. Markets and Regulation: The Electricity Regulation Act 1999 (S.I. 23 /1999) fully deregulated the Irish electricity market and created the independent body the Commission of Electricity Regulation, which has a range of responsibilities e.g. economic and customer protection. The creation of the single energy market (SEM) for the island of Ireland in 2007 and the introduction of the EU's Third Energy Package in 2009 further opened the electricity markets. The 2014 green paper on energy policy in Ireland proposes assessing how best to build on these to increase competition so as to keep prices low.
3. Planning and Implementing Essential Energy Infrastructure: This priority area outlined in the green paper focuses on electrical, oil, and gas infrastructure, as well planning and public engagement. Given the increasingly interlinked and interdependent nature of the energy system, the government proposes focusing on the integration and resilience of the energy sector.
4. Ensuring a Balanced and Secure Energy Mix: This priority area addresses fuel diversity and ensuring energy security though exploitation of the State's natural resources e.g. the Corrib gas field. This section of the green paper also covers energy use in heating and transporting (which together account for 2/3 of Ireland's energy consumption), and how best to increase efficiency and displace carbon-intensive fuels.
5. Putting the Energy System on a Sustainable pathway: This section of the green paper discusses how best to put Ireland on a pathway to a sustainable energy system. It highlights the issue of climate

changes due to greenhouse-gases (GHG), as well as the EU targets to achieve a 40% reduction in GHG by 2030 compared to 1990 levels.

6. Driving Economic Activity: The final priority area outlined in the green paper is based on the economy. The focus is on how to maximise economic growth, looking at investment in research and development, job creation in the renewable energy industry, and minimising the cost of energy to businesses.

Urgency and Pressure on the Energy Transition

Based on the EU Renewable Energy Directive (2009/28/EC), Ireland has targeted 20% reduction in greenhouse gas emissions, 20% improvement in energy efficiency (33% reduction in public sector energy use), and 16% of the Ireland's energy demand to be from renewable sources by 2020. Further, these obligations are to be met by renewable sources accounting for 40% of electricity, 12% of heat, 10% of transport. Currently, the policy documents that are driving the energy transition include: 2007 White Paper 'Delivering a Sustainable Energy Future for Ireland', National Energy Efficiency Action Plan (NEEAP), Strategy for Renewable Energy; 2012 – 2020, Better Building: A National Renovation Strategy for Ireland.

While climate change appears to be an urgent matter for the Irish government, there is some inconsistency as a result of strong lobbying from the farming sector. During the Taoiseach's speech at the COP21, Mr. Kenny said that the EU has set 'unrealistic' climate targets, particularly with reference to the agricultural industry in Ireland. He said that the 2020 targets were 'unreachable' and suggested that the EU had overestimated the possible reductions in GHG that are achievable in the farming sector.

Policy Integration

Similar to many EU countries, Ireland has pursued wind energy as its main renewable energy source for the generation of electricity. The wind energy capacity in Ireland has increased from 100MW in 2000 to 2,400MW in 2015, with 199 wind farms currently operating (IWEA, 2015). Wind energy accounted for 18.2% of Ireland's electricity in 2014 and was the second largest contributor to electricity generation behind natural gas. It was also significantly more than other renewable sources of electricity such as hydro (2.6%) and biomass (1.9%) (SEAI, 2015). There has been some limited support for biomass, which was included in the Renewable Energy Feed-in Tariff 3 (REFIT). Biomass accounted for 1.9% of gross electricity consumption in 2014 (ibid). The 2007 white paper on energy promoted co-firing biomass at peat and coal power stations, and Bord na Móna will stop harvesting peat by 2030.

While wind energy has grown significantly in Ireland since 2000, there has been growing public opposition. Similar to other countries such as UK, Germany, Australia, USA, which have experienced public opposition, there is a lack of public engagement in the planning process. Part of the problem is Ireland is due to the responsibility for wind farm planning being split across two government departments, the Department for Environment, Community and Local Government, and the Department of Communications, Energy and Natural Resources. Because of this, efforts to remove large developments from the remit of local planning departments have resulted in distrust from some sectors of the public, in terms of transparency, procedural justice and accountability. Improving public engagement is mentioned the 2014 green paper on energy as part of the 'Planning and Implementing Essential Energy Infrastructure' priority area.

There have been some inconsistencies in policy, particularly with regard to energy efficiency in housing. Dublin City Council proposed adopting the passive house standard but the Minister for the Environment Alan Kelly and the Housing Minister Paudie Coffey wrote to the four Dublin local authorities warning them against doing so (Conroy, 2015). The Dún Laoghaire-Rathdown council adopted the passive house, though

Nama has requested that this be repealed (ibid, PHAI, 2015). Further, the Minister for the environment relaxed building regulations in 2015 and "no specific provision is made for the promotion of energy efficiency within private rental accommodation" (SVP, 2015).

Institutional Structure

Historically the Irish energy system has been dominated by national monopolies e.g. The ESB group, Bord Gáis Eireann, and Bord na Móna. The ESB, as a state-owned company, had a monopoly on electricity in Ireland. With the electricity deregulation in 1999, as well as the creation of the single energy market (SEM) in 2007, the ESB group[3] now functions as a state-owned body operating in a competitive market. However, the ESB group still operates 10 hydro stations, 10 thermal stations and 17 wind farms across the Republic of Ireland and Great Britain. As of 2013, the ESB group had a generation market share of 46% and a supply market share of 37%. The transmission grid in Ireland is now operated by EirGrid, a state-owned company. Since 2009, Eirgrid has owned the System Operator Northern Ireland (SONI Ltd), which is responsible for the transmission of electricity in Northern Ireland. The Single Energy Market Operator (SEMO), which is a joint venture between Eirgrid and SONI, administers the single energy market in the island of Ireland. The cross border nature of the all-island electricity system is unusual in the EU context, in that the same companies own (ESB Networks) and manage the electricity transmission (Eirgrid) and distribution (ESB Networks) networks.

Bord Gáis Eireann (the Irish Gas Board) was founded in 1976, as a state-owned company, with responsibility for the supply and transmission of natural gas in Ireland. As part of the EU's Gas Directive (2009/73/EC), Member States were required to separate transmission and supply functions. Bord Gáis Eireann was separated into Bord Gáis Enegy (supply) and Gas Networks Ireland (transmission). Bord Gáis Energy was sold to Centrica plc in 2014, as part of the EU/IMF bailout programme for Ireland. Gas networks Ireland is part of Ervia, a state-owned company in charge of gas and water infrastructure in Ireland. Ervia also owns Gas Networks Ireland (UK), which owns and manages the gas network in Northern Ireland. As with the electricity system, the all-island nature of the gas network is unusual in the EU context.

Bord na Móna is a state-owned company that was set up in 1946 to develop Ireland's peat (turf) resources and is responsible for the management of peat production in Ireland. Bord na Móna provides peat for industrial power generation, as well providing solid fuels (peat, coal, wood) for home heating. Peat is a fuel made of partially decayed vegetation, which forms in wet areas where a lack of oxygen slows the rate of decomposition. Peat is a precursor to coal formation and grows at approximately 1mm per year with the right conditions. Coal forms when peat is buried by sediment and increased heat and pressure cause it to become more carbon dense. From lowest to highest energy density, there is a plant-based fuel continuum from peat, through lignite, bituminous and anthracite. Because of this, there is some debate on whether to define peat as a fossil fuel or a slow renewable fuel (Schilstra, 2001; Tanabe, 2007; Vaisanen, 2014). Peat based solid fuels are not cover by the 1990 solid fuel smoke emission standard, and is classified are classified as smokeless fuels in Ireland. Bord na Móna operates Edenderry power plant, one of three peat power plants in Ireland. The other two, West Offaly and Lough Ree power plants, are operated by ESB though they are supplied with peat by Bord na Móna. More recently, Bord na Móna has diversified into wind, biomass, waste management, and horticulture.[4]

[3] ESB Group comprises 11 companies, with the following key entities: Electric Ireland, ESB Networks Ltd., ESB International, ESB Telecoms, Hibernian Wind Power Ltd.

[4] Currently, Bord na Móna plans to stop harvesting peat by 2020.

Other key players in the Irish energy system include the Sustainable Energy Authority Ireland (SEAI), the Department of Communication, Energy and Natural Resources (DCENR), and the National Oil Reserves Agency (NORA). The SEAI was established in 2002 with a mission to play a leading role in transitioning Ireland to a sustainable energy society. The DCENR is the government department with responsibility for Ireland's energy systems. NORA is responsible for ensuring that Ireland meets its EU obligation to maintain a 90-day supply of oil in case of a shortage of supply. It is also responsible for administering the biofuel obligations scheme.

Initiatives on New Sustainable Technologies

The Irish government has several initiatives in place to encourage the development of sustainable technologies.

- Better Buildings: A National Renovation Strategy for Ireland [2014] This strategy document addresses the Directive on Energy Efficiency (2012/27/EU). It includes an overview of the Irish housing stock, identification of cost effective renovation methods, identification of policies to stimulate the renovations, as well as estimates of the expected energy savings. This strategy feeds into the National Energy Efficiency Action Plans (NEEAP)
- Ireland Offshore Renewable Energy Development Plan (OREDP) [2014] The OREDP outlines Ireland's strategy for the development of its offshore renewable energy resources. It outlines a framework for governance, funding, a market support tariff, developing the supply chain and export markets, infrastructure, and environmental concerns.
- The Renewable Energy Feed-in Tariff 1, 2 & 3 (REFIT) [2006, 2012, 2014] The original REFIT scheme was introduced at the end of 2006 and was designed to provide price certainty for electricity generation from renewable sources. It covered small wind, large wind, hydroelectricity and biomass/landfill gas. REFIT 2 succeed REFIT 1 in 2012 and covered the same renewable source, though wasn't as remunerative as the original scheme. REFIT 3 was also introduced in 2012 and covers biomass related energy, including: anaerobic digestion, biomass CHP, biomass combustion, and co-firing.
- Ireland Biofuel Obligation Scheme [2010, updated 2013] This scheme obliges mineral oil suppliers to ensure that 6.383% of the motor fuel they provide comes from renewable sources.
- Carbon Tax [2010] Ireland introduced a carbon tax in 2010, which applies to fossil fuels such as kerosene, marked gas oil, liquid petroleum gas, fuel oil, natural gas and solid fuels. The charge started at €10 per tonne of CO_2, rising to €20 per tonne as of 1 May 2014.
- Microgeneration Support Programme [2008] This covers domestic customers producing their own electricity and exporting the surplus into the electricity network. The payment rate is 9.0 cent per kWh and the scheme runs until the end of 2016.

3.2 Spain

3.2.1 National energy system and regulation review

From the second half of the 20th century, the Spanish energy strategy has been changing continuously focusing on the short-term needs than having a longer term vision. Due to the lack of local resources, Spain has always been dependent on oil imports, so that all energy plans were focused on reducing its oil dependency.

First, in the late 1970s, Spain embraced the nuclear energy, an ambitious plan of building a total of 25 new nuclear power plants was created, although only 10 were finally constructed. In the 1980s, arised a clear commitment to promote the national coal, but the incentives for coal production were restricted by the end of the decade. Hence, in the 1990s Spain opted for natural gas, its imports sharply increased due to the

connection with the North of Africa and many hydrocarbon and gas treatment plants were also constructed, in an effort to improve the increase the Spanish energy security of supply.

At the beginning of the current century, two technologies emerged, first the gas combined cycled plants and later on the renewable energies. The boom of renewable energies became a reality, mainly wind and solar, by offering substantial incentives using a feed-in-tariffs schema, fact that allowed these technologies to expand. However, in 2008, there was a reduction of renewables incentives and the RES deployment slowed down. Another effect the economic crisis brought was a constant decrease of the primary energy consumption since 2009.

Nowadays, Spanish energy strategy is focused on fostering energy efficiency and energy consumption reduction, through the National Energy Efficiency Action Plan 2014-2020 and also on promoting the renewable energies through the Renewable Energies Plan 2011-2020. Spain is aligned with the 20-20-20 objectives, it accounts for a diversified energy mix, even though the fossil fuel dependence is still higher than the EU average.

An overview of the Spanish energy system and landscape is presented below. The mapping outlines the Spanish energy sources, infrastructure, demand, market structure, and policies; and further outlines substantial changes that have occurred since the late 20th Century. An overview of energy policies indicates the future of the energy landscape in Spain over the next couple of decades. The Spanish principal objectives regarding energy strategy, its main problems, targets and roadmaps, main discourses at public level and main events that have driven the change to a more sustainable energy system are summarised in Figure 13.

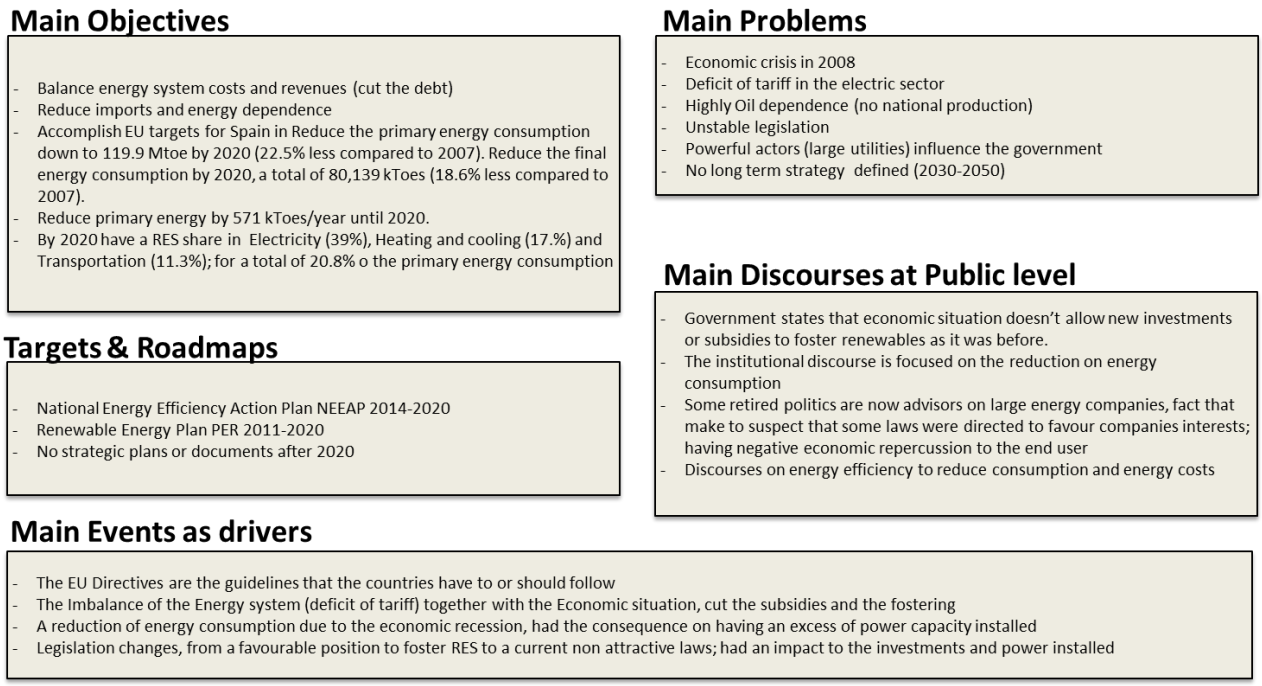

Figure 13: Spanish strategy in energy policy making

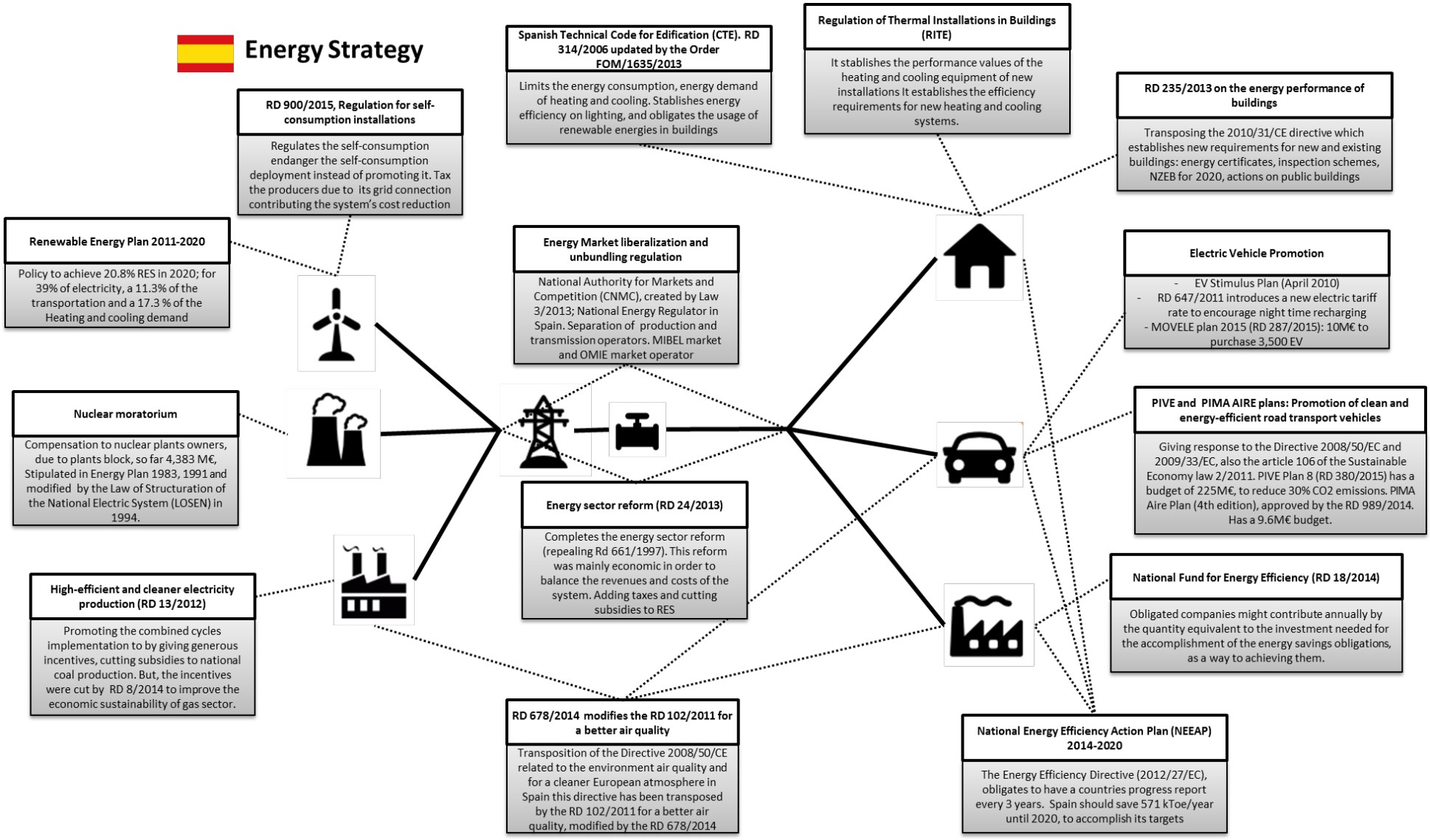

Figure 14: National energy policy overview in Spain

3.2.1.1 Energy political orientation & social, environmental and economic objectives and barriers

Political & societal orientations with regards to the energy topic

By and large, Spain is an extremely regulated country in all areas, also in the renewable energy sector in which the regulation has been unstable, from the first law regarding renewables in 2007 until the present days, 22 Laws and Royals Decree were approved. This fact gives a hint that the Spanish renewable energy strategy differed during this period, at the beginning with a favourable economic situation in Spain and in order to align the Spanish legislation to the European Directive objectives, the Spanish government at that time (2007) the Partido Socialista Obrero Español- PSOE, with RD 661/2007 created a fiscal incentives and established the so called "Feed-in-tariffs" schema which implies a retribution for the energy produced by renewable energy means for whole lifetime of the plant.

So the regulation had a clear commitment to foster the implementation of the renewable energies. Due to the extremely supportive conditions, this policy attracted national and international investment to set wind farms, solar PV, solar thermoelectric, biogas plants, etc…; producers and banks believed on a safe investment covered by the government. The success exceeded the expectations, in terms of investment and power installed, due to the soft control on the permits for the new installations it ended up surpassing the limit of installations permitted and being one of the causes of the actual situations. However, this had a short-term positive repercussion on the national companies and Spain emerged in one the leaders of the solar thermoelectric (Concentrated Solar Power-CSP) and wind power.

However, the combination of the economic crisis hit hardly the renewable sector together with the not sufficiently well-planned subsidies structures fact that increased the deficit-of-tariff of the electric sector and it ended up, by 2009-2010; with a new Royal Decree 6/2009 that approved harsh subsidies cuts to the retribution of the renewable producers.

Immersed on the economic crisis, with deficit on the Spanish economy and the austerity politics; the 2011 elections brought a change of the government, so a new party Partido Popular –PP from the right wing was elected. The cuts on the energy sector were even harsher with the unique aim to compensate the Spanish deficit of tariff, for instance RD 1/2012 established that no more incentives for any new renewables plants and also in RD 15/2012 it applies a 7% tax to any kind of electricity production (including renewables). To end up, last October, 9th 2015 the regulation regarding the self-consumption in Spain was approved (Royal Decree 900/2015), with many controversies among the RES pro-discourses agents, which see this RD endanger the self-consumption deployment instead of promoting it.

Objectives for 2020 and beyond for a sustainable and low-carbon energy

The Spanish national objectives by 2020, are collected in the "National Action Plan of Energy Efficiency 2014-2020", where it can be seen that its objective is to reduce the primary energy consumption down to 119.9 Mtoe by 2020, which represents a 42.8 Mtoes (26,4%) compared to the base scenario consumption of 162.8 Mtoes, in 2013 the consumption was 121.6Mtoes already below the 20% reduction from the base scenario (130.2Mtoe). The road to achieve it, by source is presented in the following Table 2 (Minetur, 2014b, p. 33).

Table 2: Primary Energy consumption targets by 2016 and 2020 in Spain (Minetur, 2014b, p. 33)

By source in kToe	2013	2016	2020
Coal	10,531 (9.1%)	13,541 (11.6%)	13.652 (11.4%)
Oil	52,934 (45.5%)	48,255 (41.4%)	46.026 (38.4%)
Natural Gas	26,077 (22.4%)	26,482 (22.7%)	30.276 (25.3%)
Nuclear	14,785 (12.7%)	15,549 (13.3%)	15.549 (13.0%)
Renewable energies	17,209 (14.8%)	18,519 (15.9%)	20.406 (17.0%)
Waste (non-renewable)	160 (0.1%)	237 (0.2%)	319 (0.3%)
Total (excluding final non-energy uses)	116,262 kToes	116,609 kToes	119,893 kToes

Looking at the final energy consumption by 2020, a total of 80,139 kToes excluding the no energetic uses are estimated, distributed as Figure 15 shows.

Forecasted Energy Consumption breakdown by source in Spain by 2020

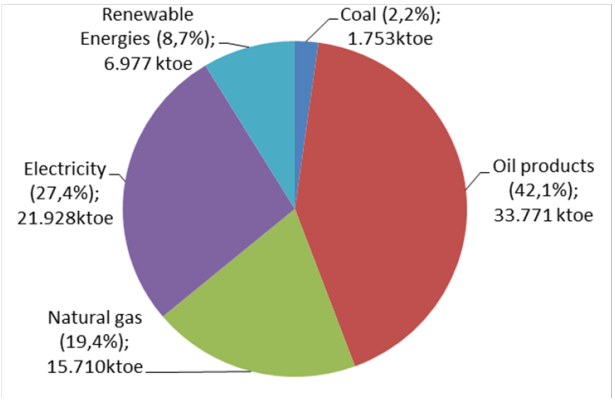

Figure 15: Prevision of final energy consumption in Spain by 2020. (CNMC, 2014, p. 34)

The final energy consumption's saving objectives, accounted by 571 kToes/year, are distributed by sector in as Figure 16 presents:

Annual Final Energy Consumption Savings' objectives by sector in Spain by 2020

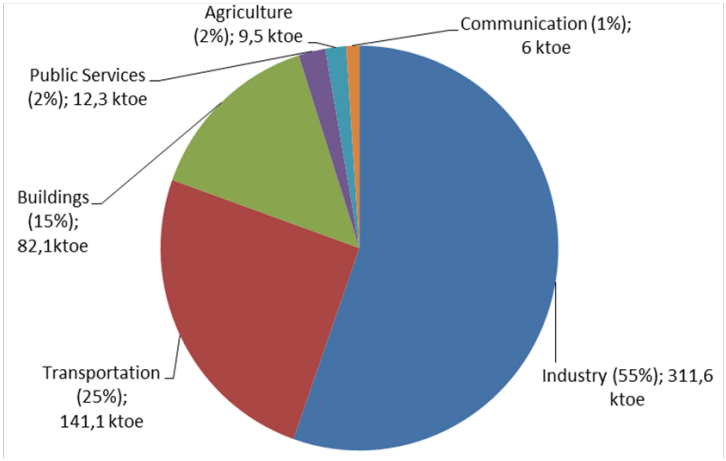

Figure 16: Break down of the annual energy savings objective on final consumption by 2020 (CNMC, 2014, p. 66)

In Renewables the current Spanish "PER 2011-2020" is aligned to the European Commission objectives. As well in 2012 each EU state launched a progress report regarding its real advances on the renewables objectives, Spain achieved a 13.5% of renewable share for the total primary energy demand.

With the latest data of the renewable energy shares, Spain achieved a 14.1% (17.06Mtoes) of the primary energy demand on 2013 and 14.6% (17.27 Mtoes) on 2014. Also in 2013, the RES technologies contributed by 42.4% of the total electricity production, being 119.6TWh; already higher than the objective by 2020.

3.2.2 Spanish Policy and Regulation Landscape Overview

Energy transition

The downturn on the Spanish public economy also affected the energy sector; which already presented an imbalance between the costs and revenues, which reached was estimated in 25,056M€ by December 2015 representing almost a 3% of the GDP. The measures and actions during this recession after the 2009 until today have been focused on reducing the huge energy sector debt. The deep reform of the electricity sector, between 2012 and 2014, brought many Royal Decrees and laws, ending up with a new Electric Sector Law (Law 24/2013).

National energy plans in Spain (in PEN-1983, PEN-1991, PEFR-2001, PER-2011) were directed to address the short-term problematic, almost no common guidelines nor following the same direction (in some cases going in opposite directions) and without having a long term view. Spain moved from nuclear and hydropower in the 1970s, fostering the national coal in the 1980s, promoting the gas sector in the 1990s and embracing the renewables sector in 2000s. Spain focused the energy transition discourse on financial measures to promote renewable energies, instead of including a complete energy reform and setting new targets or plans to be achieved by 2030.

These recent years, the government has prioritised financial aspects on finding an economic balance on the energy sector, rather than focusing and planning the transition to a low-carbon society. The government's discourse is that no new cost (investment) will be added without a revenue increase. So, the energy transition is secondary nowadays, the energy transition is advocated most strongly by those who have almost no decision-making power, like NGOs, green utilities, clean tech companies, ESCOs, RES associations, municipalities.

Urgency and pressure on the energy transition

In Spain the pressure and urgency on the energy transition is being dictated by EU policies and directives. The Spanish government has prioritised the financial stability of the energy sector rather than focusing on planning the transition to low-carbon economy and society; the government's immediate and priority focus since 2011 has been restoring the financial stability in the electricity and gas systems.

However, Spain is benefiting today from the previous favourable measures on renewables energies, low-emissions and high-efficient technologies. For instance, the Renewables Energy Plan (2005-2010) brought a massive investment in wind power, solar thermoelectric and photovoltaic capacity installation. Wind power became a primary source of electricity production reaching a 21.1% share of total in 2013 (REE, 2013, p. 11). The second and fourth main sources for electricity generation were, nuclear power with a 21.0% share and hydropower with a 14.4% share, both low carbon emission technology promoted since the 1970s.

As it is described above, most of the energy transition promotion was devoted to electricity production from clean sources, leaving aside actions and measures on other sectors more critical in using fossil fuels, like the transportation sector where few actions were implemented (Energía y Sociedad, 2014). Renewables sources in transportation only comprised 4.8% of the total demand, compared to the almost 40% reached by the RES in electricity production. The urgency for Spain should be to put pressure on reducing the use of oil in transport, as oil represents 42.2% of the total primary energy demand in Spain (European Commission, 2015, p. 2), where 63.4% of which is consumed in the transport sector (IEA , 2014, p. 408). Almost 90% of freight transportation is by road and 80% of passenger transport is done by private cars (European Commission, 2015, p. 7).

So, Spain is on track to achieve the 20% of renewable energy share by 2020, in 2013 it was 15.4% (European Commission, 2015, p. 8); considering the fact that the distribution of these shares by sector differs a lot; and should be addressed.

A long term target on GHG emissions should be established, so far the current measures of Spain to reduce the energy-related CO_2 emission are focused on renewable energies and energy efficiency. Although it was the decrease on the economic activity due to the recession which contribute that Spain is on track to meet the target of reducing GHG emissions by 10% from 2005 to 2020 in the non-ETS sector. In 2014 the reduction is already at 17% compared to 2005, and the projections estimated that with the current measures this value get worse to 'only' a 12% reduction by 2020 (European Commission, 2015, p. 8). This means that measures until 2020 need to be taken, as the current trajectories imply an emissions increase.

Policy integration

The economic crisis has affected the Spanish energy context, in terms of the energy demand reduction, the excess of installed capacity and the deficit of tariff. Moreover, the cross-border interconnections don't achieve the minimum interchange capacity of 10% that the EC recommends, not even after the new set of planned interconnections.

Although Spain has achieved the share of renewables in the electricity mix, in 2013 the European Commission had issued a statement as the Spanish government hasn't completed the transposition process of the European Directive on Renewable Energies. And also in 2014, an expedient was opened for not transposing on time (before 5th June 2014) the Energy Efficiency Directive. These late transpositions and notifications of the EU directives place Spain in position of not accomplishing with the procedures that the EU establishes.

Energy planning in Spain is nowadays indicative but not mandatory as it was years ago. So, it cannot limit news installations for energy policies reasons, except for the administrative authorisation based on security and environmental issues. Mandatory regulations are devoted to the electric, gas and hydrocarbons infrastructure.

Mandatory planning is related to the electricity and gas infrastructures, basically the electricity interconnection with France and Portugal and the gas interconnection with France –MIDCAT project- (IEEE, 2014) and the North of Africa. Regarding the indicative planning, it can be summarised on the National Energy Efficiency Action Plan 2014-2020 and the Renewable Energy Plan 2011-2020; both plans are complementary one to the other.

The NEEAP 2014-2020 (Minetur, 2014b), adapts to the 2012/22/UE Directive, stablishes the reduction a 22.5% of the primary energy consumption and an 18.6% regarding final energy consumption, during the period from 2007 to 2020. Including diverse policies, on low-emissions transport and building renovations… The Renewable Energy Plan 2011-2020 (Minetur, 2011), adapted the objectives stablished by the 2009/28/CE to achieve this 20% overall renewable energy increase and 10% renewable energy increase in the transport sector by 2020. However, to cut the deficit of tariff the above mentioned legal framework modification between 2011 and 2014, affected the investment and the profitability of the renewable energies installations, so basically tributary measures which discourage Renewable Energies promotion.

Another side effect of the economic crisis was that fact that the electricity production capacity was higher than the demand, the electric demand coverage index was 1.29 in 2011 (CTESC, 2015, p. 81), as many new installations were already planned or under construction, which made to revise the 2011-2020 planning; for instance, now the combined cycle plants are working only at 10% of its capacity.

Institutional structure

The responsibility in Energy policies and legislation in Spain is the Ministry in Industry, Energy and Tourism; inside it the State Secretary of Energy is the institution that coordinates the energy policy through its General Directorate subdivided in Hydrocarbons, Electric Energy, Nuclear Energy, Mining and Energy planning and Monitoring.

The “Instituto para la Diversificación y Ahorro Energético” - IDAE is the Institute for Diversity and Energy Efficiency in Spain; dependent on the State Secretary of Energy contributing to achieve the targets in energy efficiency and renewables, by performing actions on diffusion, education, training, programs development, financing projects in innovation. IDAE controls the National Energy Efficiency Fund; manages the PIVE, PIMA, MOVELE; disseminate the Renewable Energy Plan (2011-2020), the National Energy Efficiency Action Plan (2014-2020).

However, these last years the Ministry of Finance also had a role in the energy sector reform by taxing certain fuels and taxing electricity production technologies, in order to reduce the imbalance between the costs and revenues on the energy sector (deficit of tariff) and make it sustainable. Also, the Ministry of Economy and Competence is involved in the energy sector as it is the responsible of giving public aids to subsidise research and innovation centres such as CDTI, CENER, CEIMAT.

The last laws’ modifications and the new royal decrees on the energy sector haven’t had a democratic process. There has been a lack of public consultations, no inclusive process and without participative workshops. Those changes were unilaterally taken by the government having an economic and finance orientation to cut the debt of the energy sector, with measures contrary to the energy planning vision on

promoting the renewable energies, moreover the legislation changed an affected the incentives perceived by the installation owners, fact that brought many judicial demand against the Spanish government in international instances.

On the other side, the regional and local governments have the competence to launch plans and projects at a local scale related to renewables, energy efficiency always according and subjected to the national legislation.

Initiatives on new sustainable technologies

Spain has been a reference in the renewable energy from the last years. First, it was the solar and wind power industry 2007 and 2008, and lately the thermoelectric industry. The renewable energy regime was possible due to the favourable economic situation in Spain, were different actors have an important role, the government subsidising and giving aids for the creation of R&D institutes and fomenting the collaboration between them, universities and the industries and companies in the renewable sector. And the incentives were the most relevant for the boom of the sector.

The Spanish wind and solar technologies and industry experienced a boom in 2007 and 2008, respectively (Minetur, 2015, p. 175). In the wind sector the growth and decrease has been more gradual from 1995 until 2005-2007, after which a decrease of annual power installed until 2013; the case of the Photovoltaic sector showed that huge new capacity was installed in 2008 (2,750 MW) with relative small new annual power installed for the previous years to 2005 and in the later years, lower than 500MW/year. These peaks are coincident with the new legal framework on subsidies cuts, additional taxes to electricity production (RD 1/2012) and the energy reform law in 2013.

During that period Spanish solar photovoltics and wind companies were internationally recognised, some of them still are for instance Gamesa, MTorres, Iberdrola, Acciona, Ecotècnia; also sector associations like AEE (Wind Enterprise Association) or UNEF (Photovoltaic Enterprises Union) appeared and played an important role to protect and promote the wind and PV sector; from the governmental side the R&D was fostered by the creation of specific research centres or departments inside the above mentioned CENER and CEIMAT with close collaboration with the industry.

Regarding the thermoelectric, Spain was a leader in this technology, from the first plant installed in 2007 (PR-10); in April 2015 a total of 50 solar thermoelectric plants are in operation for a total capacity installed of 2,300MW (ProTermosolar, 2015); with a production that is able to cover a 3% of the demand (Minetur, 2015, p. 176). Plants such as, GEMASOLAR and ANDASOL include innovative technologies, either in storage or heliostat typology. In a short-term, no new plants are projected in Spain. However, the Spanish solar thermoelectric industry has exported their knowledge and it is present in around 75% of the world-wide projects (Energías Renovables, 2015). Actors such as: Protermosolar (Spanish Termoelectric Industry Association); the department on Solar Thermal inside the CENER (National Center of Renewable Energies) creating a Joint Program Concentrating Solar Power (JP-CSP); the current thermoelectric R&D projects are described in the 2014 Spanish Energy report (Minetur, 2015, p. 279); companies like Abengoa or Acciona; among others, helped to the stablish solid bases for the thermoelectric industry in Spain.

Currently, sustainability initiatives are focused on reducing the GHG emission and fostering renewable energy technologies, energy efficiency and CO_2 capture (Minetur, 2015, p. 215). The Research and Development in the energy sector have many branches and initiatives:

- Retos-Colaboración (Challenges-Collaboration) inside the R&D National program oriented to society; focused the scientific investigation in universities and industry R&D (Minetur, 2015, p. 217). In 2014, 37 projects (33.2M€) were financed, plus the INNPACTO calls the overall aid concede were 329.4M€. There is a large variety on projects' topics covering all kinds of energies (Minetur, 2015, p. 220)
- Plataformas Tecnologicas (Technology Platforms), also inside the R&D National program oriented to society. These are working platforms leaded by the industry to integrate science –technology-innovation; able to define a short, medium and long term vision, to generate employment, favouring the competence, and a growth in the industrial sector. From 2005 to 2015 the aids were 6.1M€. Some platforms are FUTURED, BIOPLAT, GEOPLAT, REOLTEC, SOLAR CONCENTRA, CEIDEN… The complete list is in (Minetur, 2015, p. 221)
- ALINNE, Alliance for Energy Investigation and Innovation; aiming to give a solution to the R&D challenges in the energy sector. This programme is aligned with the Spanish strategy in Science, Technology and Innovation (2013-2020) (Minetur, 2015, p. 222)

And also in the promotion of research centres and embracing innovative projects:

- Centro de Desarrollo Tecnologico Industrial- CDTI (Industrial Technology Development Center), has the objective to increase the competence level of the Spanish companies by providing financial aids to both national, European projects (EEA grants), 2020 Horizon. In 2014, CDTI financed 54.92M€ diversified in 102 projects.
- Centro de Investigaciones, Energéticas, Medioambientales y Tecnologias – CEIMAT (Research, Energy, Environmental and Technologies centre), has an important department related to the renewable energies and energy efficiency with financial aid to:
  - PV research: HELLO project on amorphous silicon cells, GRAFAGEN project using graphene; CHEETAH project for increasing cells efficiency and reliability; ATON project…
  - Wind research: LIGNUM project for testing special turbines; WINDOSMOSIS project developing a turbine for inverse osmosis; EERA-DTOC and KIC-NEPTUNE projects for easing the off-shore wind plants;
  - Biomass research: DECOCELL, BIORAISE, ENERBIOSCRUB, CLEANBIOM projects for testing the biomass behaviour, efficiency and emissions control.
  - Biofuels research: CLAMBER pilot test for a bio refinery plant.
  - Thermosolar, INNPACTO_H2, HYDROSOL projects using the solar concentration for industrial processes and production of H2; in collaboration for with EU-SOLARIS and STAGE-STE. PV/Rankine project for detoxification of residual water. ZCR and ZCR2 for a solar desalination of marine water. Among many others, INNOFOTO, SOLARCAT, DNICast, TAVS related to photo catalysis.
  - Energy efficiency: OMEGA-CM, PRENDE, GREENMAR projects
- Centro Nacional Energias Renovables (CENER), is a technologic centre specialised in research, development and promotion of renewable energies. Counting on a significant number of R&D projects in wind (WINDTRUST, AVATAR, WINDUR…), solar PV (OPTISOLAR, nanoSOL-STA, BIFSEME, SOLARROK, SIGMAPLANTAS), thermosolar (MIRASOL, EUROSUNMED, ANTHOPHILA,FRIOSOLAR), biomass (S2BIOM, ENERMASS, PRO-VALUE, ENERGREEN)…
- Centro Nacional Experimentación de Tecnologías de Hidrogeno y pilas de combustible (CNH2), doing research on hydrogen technologies. Projects like HyACINTH, RENOVAGAS, COOPERA, EXSIVA, among many others.

3.3 United Kingdom

3.3.1 National energy system and regulation review

The United Kingdom energy system comprises a diverse range of energy sources and consumption. The energy landscape of the UK is presently responding to the decline of domestic reserves and production of oil and natural gas. Combined with increasing instabilities in fossil fuel production, the UK is attempting to transition to a more secure and resilient energy system predicated on expanding nuclear power, shale gas, renewable energy and North Sea gas. The UK's energy landscape, however, is increasingly dominated by changes in governmental policy. Despite this, in recent years the UK has become a leading proponent to reduce global carbon emissions and is viewed as an international leader in addressing climate change. Climate change mitigation and energy security are the UK's core energy and climate policy goals (Dagoumas and Barker, 2010). A key number of policies introduced such as the UK Climate Change Act 2008 and the Low Carbon Transition Plan 2009 commits the UK to a low-carbon future (DEFRA, 2008; DECC, 2009).

An overview of the UK's energy system and landscape is presented here. This mapping outlines the energy sources; infrastructure; demand; market structure; and policies of the UK, and further outlines substantial changes that have occurred since the late 20th Century. An overview of energy policies indicates the future of the UK's energy landscape over the next couple of decades. The British main objectives regarding energy strategy, its main problems, targets and roadmaps, main discourses at public level and main events that have driven the change to a more sustainable energy system are summarised in the following figure.

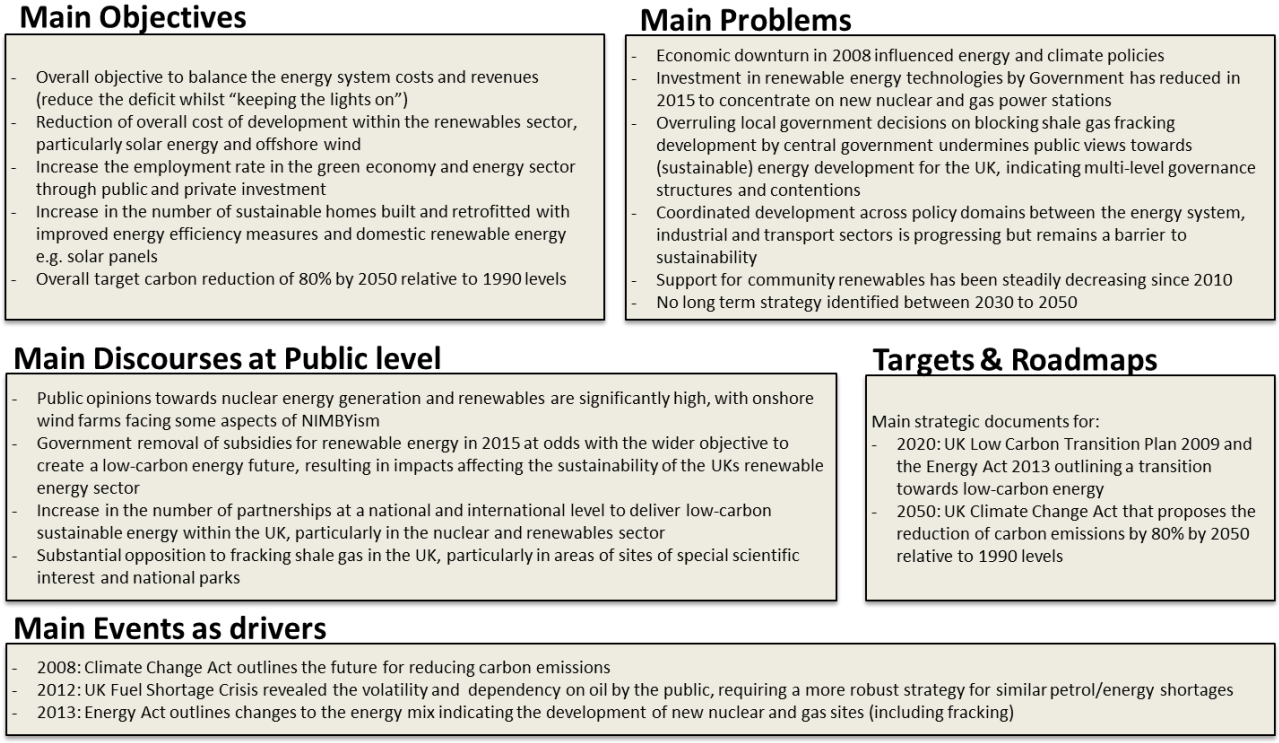

Figure 17: UK strategy in energy policy making

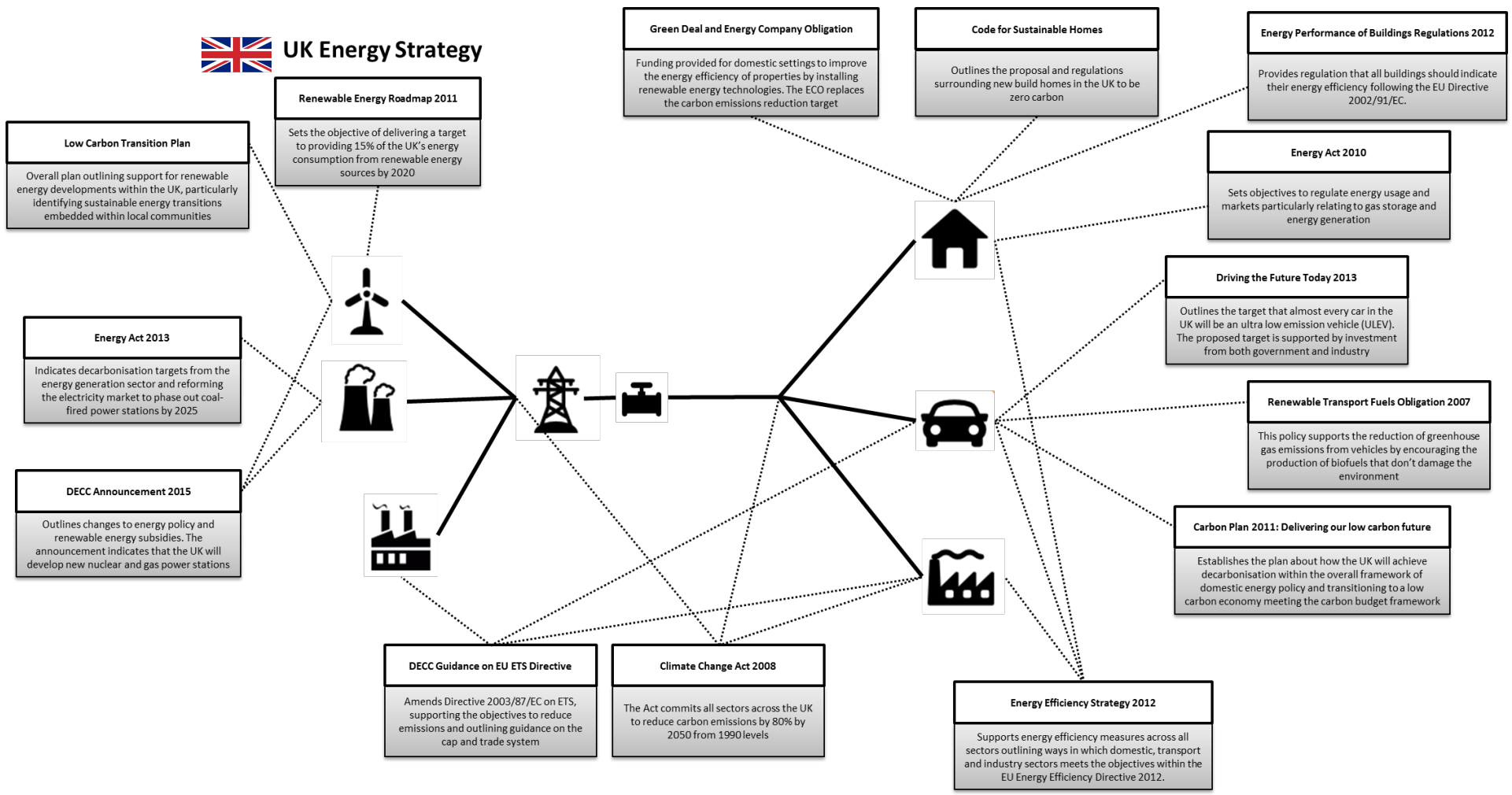

Figure 18: National energy policy overview in the UK

3.3.1.1 Energy political orientation & social, environmental and economic objectives and barriers

Political & societal orientations with regards to the energy topic

Similar to other EU Member States, the UK is bound by the terms set out in EU regulation, particularly with directives being interpreted and fitted into national legal frameworks. It should be acknowledged that since devolution, the Scottish parliament in Edinburgh retains certain rights and privileges over aspects of UK energy and planning policy. At present, UK government energy policy is set out in a series of white papers including the 2007 Energy White Paper, itself preceded by the 2003 Energy White Paper; the 2011 Planning Our Electric Future: a white paper for secure, affordable and low-carbon energy; and the 2008 White Paper on Nuclear Power.

The regulatory framework in Great Britain (England, Wales and Scotland) operates through system EU/national legislation, licencing and industry codes with an independent regulator responsible for the sector and enforcing the rules. Both the electricity and gas markets are regulated by the Gas and Electricity Markets Authority, which operates from the Office of Gas and Electricity Markets (Ofgem). Ofgem's role is to act in the interests of UK consumer, by promoting competition and minimising the negative effects of monopoly networks in the energy sector.

Climate change mitigation and energy security are the UK's core energy and climate policy goals (Dagoumas and Barker, 2010). The introduction of the UK Climate Change Act 2008 aims to facilitate and establish the transition to a low-carbon society and economy which focuses on the long-term target of reducing carbon emissions by at least 80% by 2050 from a 1990 baseline (DEFRA, 2008). This political discourse has been well-established in the UK, particularly under the Labour government (1997-2010) that introduced the Climate Change Act and developed a series of policies aimed at encouraging the growth of sustainable transition and renewable energy technologies.

From 2010, there has been a marked difference with the Coalition Government (Conservative-Liberal Democrat coalition) taking office. While some policies were protected, other organisations and schemes had their funding markedly reduced or stopped as a result of austerity measures in the aftermath of the global economic downturn. In the general election of 2015, the Conservative Party won a small majority. Since the May election, the Conservative government has cut a number of "green" policies including: scrapping support for onshore wind power; stopping solar power subsidies; selling off the green investment bank; ceasing the flagship green homes scheme; dropping the green tax target; and preventing the target of all new homes to be zero carbon from 2016 to be scrapped (The Guardian, 2015).

While green policies have either been cut or stopped, other environmentally questionable policies have come to the fore with further reforms likely. Decisions on fracking not to be allowed in sites of special scientific interest (SSSIs) were changed in 2015, if shale gas companies can overcome planning policies and regulations. Further reforms are being considered to impact on offshore wind power. While substantially more expensive than onshore wind farms, there are some critics to this energy sector that seek to reduce funding and prevent applications for further offshore wind power to go ahead. Conversely, the Conservative government are maintaining their investment in future nuclear power plants (such as Hinkley Point C in Somerset, the first planned for 25 years) yet there are challenges that exist with nuclear energy in terms of ever-increasing costs and delays, legal challenges and uncertain equity investors (The Guardian, 2015). Despite this, the rhetoric on environment and sustainability appears to be one congruent with

definitions of sustainable development, yet the actions of the government reducing funding for green policies and initiatives stems from changes in Treasury funding as a result of reducing the national deficit and a reduction in the addressing climate change and renewable energy policies.

The impacts of these policies are recently being highlighted. In October 2015, two of the largest renewable energy companies in the UK went into administration after hours of one another citing the governments' change on energy policy and the cuts to home energy efficiency subsidy schemes such as The Green Deal (The Independent, 2015). The removal of subsidies for renewable energy and energy efficiency programmes has also impacted upon those who are employed within the industry, with the loss of business resulting in job losses for those at Climate Energy and Mark Group (The Independent, 2015). Further impacts of the changes to the Government's energy policy will affect the approach taken by the UK at the Paris Climate Summit in December 2015. With such substantial policy changes in addressing climate change and energy inefficiency, the UK Conservative Government will require a different approach in order to maintain progress on a national and international level.

Since the 1980's there has been a steady increase in environmentalism in the UK. This movement has increased rapidly in the last 5-10 years with more attention paid to (addressing) climate change, sustainable energy generation and environmental degradation. This has been reflected in the growth of support for the Green Party in the 2015 election and increasing engagement with environmental issues such as The People's Climate March 2014. This is supported by studies demonstrating an increased awareness of climate change among the UK public (Whitmarsh, 2009) and shifting attitudes that reflect whether, and how, climate change should be addressed (Axon, 2015).

Research and public engagement activities by local governments, universities and national market research agencies remain the key measures of engaging the UK public with energy and environmental issues. However, within the last ten years there has been an exponential growth of community-based projects that have allowed residents in their own communities to engage with participatory democracy processes, discussing and deciding on how individuals wish to be involved with issues surrounding energy, the environment and sustainability. These influential community groups have a key role to play not just with engaging individuals in a participatory process but also fit firmly within the Multi-Level Perspective as a method to transition towards sustainability (Axon, 2015). The most prominent influential groups remain those engaged with grassroots initiatives. These groups include community groups (as previously mentioned) and protest groups. For example, a second People's Climate March will take place on 29th November to call for greater action towards addressing climate change. These protests will, again, occur in cities across the globe. Other influential groups include prominent climate sceptics provided substantial media attention, the Green Party and Greenpeace.

With respect to alternative energy generation, across the UK there appears to be a diversity of opinion. There exists a strong case of NIMBYism for fracking and renewable energy (particularly onshore wind power) near communities. While national government is in favour of fracking shale gas, despite local communities' opposition, the government will be able to fast-track applications through a dedicated planning process (DECC, 2015b) that can overrule decisions taken by local governments. Public perspectives towards fracking indicate caution over the safety and environmental sustainability, while opposition to onshore wind power cites noise pollution and changes to the countryside. For these reasons, the British public are more accepting of offshore wind power and domestic solar energy.

The political landscape in the UK is in a period of change where an increasing polarisation is being formed between left-wing and right-wing parties. Political parties that are on the left-wing spectrum such as the Labour Party; The Scottish Nationalist Party (SNP); Plaid Cyrmu (Welsh nationalist party); and the Green Party all favour substantive action to address climate change, while those located to the right such as the Conservative Party and the UK Independence Party favour limited or no action. In some cases, there are MPs who deny that the climate is being changed and that a return to coal power is a viable long-term energy policy. Future political orientations look set to debate how the legally binding targets of the UK Climate Change Act 2008 can be met through energy policies and other initiatives (such as public education and behavioural change initiatives). The polarised political viewpoints on energy, the environment and sustainability demonstrate that a number of barriers exist prior to key energy policies being implemented in the future.

Objectives for 2020 and beyond for a sustainable and low-carbon energy

Given the recent cuts to green policies the current Conservative Government has recently announced (i.e. subsidies for solar power, home energy efficiency and onshore wind), there are fewer objectives for 2020 and beyond that now exist around low-carbon energy. However, there are a number of objectives that remain. For example, the UK Government is committed to expanding the role of nuclear energy to comprise a substantial amount of the UK's energy mix. The development of Hinkley Point C will be the first nuclear power station in a generation and is expected to begin electricity generation in 2023. However, ever-increasing costs, delays and legal challenges continue to mar the initial development of the site (The Guardian, 2015). The site in Somerset (South West England) is one of eight announced by the UK Government in 2010 that will replace almost all coal power stations in the UK. Hinkley Point C will provide 7% of the UK's generation needs (EDF Energy, 2015).

With respect to fossil fuel consumption, the Government is committed to reducing the reliance on non-renewable energy resources. The UK Government aims to achieve this through developing new nuclear power stations such as Hinkley Point C and creating new sites for fracking shale gas. While over 60% of the UK population believe that nuclear energy has an important role to play in the UK's energy mix, many are less convinced of the safety and sustainability of fracking. Irrespective of public opinion, the Conservative Government has made fracking shale gas a key energy priority. For the Conservative Government, this demonstrates a transition in energy policy towards a sustainable and secure low-carbon energy transition.

A number of objectives for low-carbon energy exist beyond 2020 with respect to renewable energy generation. The UK Government is in favour of enhancing the role of renewable sources of energy, aiming for renewables to contribute to 15% of national energy consumption. In 2014, 7% of energy consumption came from renewable sources, up from 5.6% in 2013. The role of renewable sources of energy in the UK is set to increase in line with EU targets and domestic energy policy to address issues around energy security.

The energy policy of the UK fully accords, and to some extent, exceeds EU objectives in terms of generating EU objectives. Despite the cuts to a number of renewable energy sources, the development of new nuclear power stations and continued support for community energy, offshore wind and wave and tidal power indicates that low-carbon and sustainable sources of energy generation can meet overall domestic energy consumption.

3.3.2 UK Policy and Regulation Landscape Overview

Energy Transition Definition

The current position held by the UK Government to addressing climate change through energy policy has recently changed in 2015. Previous energy policy has outlined the need for renewable energy sources to play a substantial part in such an energy transition with significant funding from Government to increase the uptake and development of such technologies. However, the current energy transition is predicated on a dual philosophy. While no Government definition of energy transitions exist, it is well noted that the current energy system is required to change in order to address the challenges of climate change, peak oil and sustainability. To this end, the energy transition promoted by the UK Conservative Government is predicated on economic principles combined with previous legally binding political objectives (notably those in the UK Climate Change Act).

Urgency and Pressure on the Energy Transition

An increasing number of policies over the past 2 years relating to energy system transitions such as the Energy Act 2013 and the Energy Efficiency Strategy 2013 have outlined ways in which a sustainable energy transition could be supported. Whilst addressing climate change is considered to be an important issue, its status has somewhat declined following the recent election of the UK Conservative Government in May 2015. The policies of the current Government have seen cuts to renewable energy technologies in favour of expanding the UK's nuclear and gas power stations (DECC, 2015b; The Guardian, 2015).

Policy Integration

Previous UK Governments have heavily invested in renewable energy technologies to support a sustainable energy transition. This investment in developing the renewable energy infrastructure of the UK has been underpinned by former energy policies such as the UK Climate Change Act 2008, the Low Carbon Transition Plan 2009 and the Energy Act 2010 (DEFRA, 2008; DECC, 2009). The current UK Government has indicated that subsidies and investment for renewable energy sector is to cease given that the industry has developed strongly over the past 10 years. The Government's energy policy and investment now relies on new nuclear and gas energy to be further developed alongside offshore wind (DECC, 2015b; EDF Energy, 2015). While DECC argue that this will deliver a sustainable energy future that addresses climate change in the UK, there are some analyses that warn that this could increase emissions given recent subsidy cuts for other renewable energy technologies (BBC News, 2015b).

Institutional Structure

Announcements made by the Government are not always consulted with the public beforehand. Rather, such announcements are made indicating the ways in which the Government decides to enact laws and policies. Within current energy policy of the UK there are consistencies between policies and strategies. The Climate Change Act 2008 commits the UK to reduce its carbon emissions by 80% in 2050 from 1990 levels and successive plans and strategies have outlined ways in which this can be achieved through a sustainable energy transition (DEFRA, 2008). In this context, recent announcements by DECC aiming to phase out coal-fired power stations by 2025 in favour for new nuclear and lower carbon gas power stations commit the UK to a more sustainable energy future (DECC, 2015a). However, inconsistencies do exist over support for renewable energy sources and continued investment in technologies for wider domestic dissemination

(BBC News, 2015a; DECC, 2015b). In this sense, policy makers favour an energy transition at the national level whereby a top-down approach to an energy transition is employed and delivered to the public.

Initiatives on new sustainable technologies

Over the past 10-15 years, the UK Government has delivered substantial political and financial commitments and investments to the development of low-carbon energy sources and technologies (DECC, 2015b). Principally, such investment has been targeted at households, transport and the energy sector. For example, increasing and improving energy efficiency within domestic buildings; encouraging the development of, and investment in, sustainable transport; and substantially investing in the growth of the low-carbon energy market in the UK to decrease the production costs of renewable energy. The subsidies that the Government has provided for renewable energy, aside from offshore wind power, have been cut to reduce the economic deficit of the UK (DECC, 2015b; The Guardian, 2015; The Independent, 2015). In response to criticism, the UK Government has argued that the level of subsidies have improved uptake of renewable energy technologies and supported the growth of the industry.

3.4 France

3.4.1 National energy system and regulation review

With about 13.8% of the total energy consumption in the EU, France is the second largest energy consumer after Germany. The French energy system is unique in Europe for its relatively low greenhouse gas emissions since only a minor part of the electricity is produced by fossil fuel. This is the result of a major transformation of the energy system in the 1970s, triggered by the oil crises, which caused a very fast departure from power plants running on oil and coal. At the same time, France developed one of the largest nuclear parks in the world. Nowadays, with nuclear energy dominating the French energy landscape, there is an emerging consensus that nuclear electricity production must gradually give way to renewables.

Yet, the challenges to a completely GHG-free energy system are important. For instance, France's transportation sector still relies almost entirely on fossil fuel. Energy efficiency gains have also been relatively slow, as demonstrated by the very high reliance on old, inefficient electric heating due to the electric surplus from nuclear energy. Nonetheless, France possess the largest renewable resources in the EU: a large wind energy potential because of its long coastal areas, a sizeable hydroelectric production thanks to several mountain ranges such as the Alps, sun-drenched areas in the South ideal for solar energy, and vast amount of land and forested areas with a potential for sustainable bioenergy.

With ambitious 2020 targets as part of the EU Renewable Energy Directive, France has to mobilise tremendous efforts in the coming years to reach its binding objectives. Coupled with a decline in support for nuclear energy, it is clear that the French energy system is starting to transform once again. After the initial coal era, the post-World War 2 oil era, and the nuclear phase launched in the 1970s, France might soon experience a renewable era.

ADEME, the French Environment and Energy Management Agency, is a public agency reporting to the Ministry of Ecology, Sustainable Development and Energy and the Ministry of Higher Education and Research. It regularly writes practical reports on energy management but also more theoretical long-term energy scenarios. In 2012, the agency wrote a report on "Energy Transition Scenarios 2030-2050". This

publication encourages a proactive approach including a wide range of stakeholders (scientific experts, the general public, politicians, etc.) and targeting two types of actions: energy conservation management and the development of renewable energy production technologies. Using separate methods and time-scales, one vision follows a more pragmatic approach to optimise energy efficiency and renewable by 2030, while the other vision looks at the ways greenhouse gas emissions can be divided by four by 2050. The main conclusions of this document are that France has the capacities to achieve these goals, although they rely on important economic growth (1.8% annually) (ADEME, 2014).

In 2014, ADEME wrote a report titled "Mitigating the environmental footprint of French consumption: towards a deep evolution of production and consumption modes" (ADEME, 2014a). Unlike the previous report, this one concludes that deep, structural changes are needed. Furthermore, ADEME is cautious about the potential environmental impact of new economic forms, such as collaborative trends, brought in by new technologies. It also admits that current tools, such as life cycle analyses, are limited and may never be strong enough to assess the long-term impacts of products. This is why ADEME calls for a deep change in life habits.

Another interesting report by ADEME was recently published in October 2015 and is titled "A 100% renewable electricity mix? Analyses and optimisations: Testing the boundaries of renewable energy-based electricity development in metropolitan France by 2050" (ADEME, 2015a). This report was highly cited in the media because it explains that electricity generation mix relying entirely on renewable energy sources is technically possible. The report considered all conditions and economic aspects, such as the costs to public authorities and social acceptance. The point of this report is to show the hurdles that exist and what measures should be adopted to massively develop renewable-based electricity: strong demand-side management to control peak loads, falling technology costs, and social acceptability are among the most crucial aspects to emphasise according to the report.

An overview of the French energy system and landscape is presented here. This mapping outlines the energy sources; infrastructure; demand; market structure; and policies of France, and further outlines substantial changes that have occurred since the late 20th Century. An overview of energy policies indicates the future of the French energy landscape over the next couple of decades. France's main objectives regarding energy strategy, its principle problems, targets and roadmaps, the discourses at public level and the events that have driven the change to a more sustainable energy system are summarised in the following figure.

Main Objectives

- Reduce foreign oil dependence
- Reduce energy trade deficit
- Ensure energy security while transitioning towards renewable energy
- Reduce imports and energy dependence
- Energy efficiency targets: Reduce the primary energy consumption down to 236.3 Mtoe by 2020 and reduce the final energy consumption by 2020, a total of 131.4 Mtoe
- By 2020 have a RES share in Electricity (27%), Heating and cooling (33%) and Transportation (27%); for a total of 23% of the primary energy consumption

Main Problems

- Economic crisis and slow recovery; unemployment
- Energy efficiency has not been the priority due to abundant nuclear energy production
- High and steady oil dependence (very little national production)
- Unstable legislation of renewables
- EDF is close to a monopoly on electricity market

Targets & Roadmaps

- EU National Energy Efficiency Action Plan NEEAP 2014-2020
- EU Renewable Energy Plan PER 2011-2020
- ADEME Reports

Main Discourses at Public level

- Nuclear hegemony was never questioned until the new law in August
- Still, large support for nuclear but gradual decrease
- Oil dependency is very high (transportation): energy trade bill is problematic
- Energy efficiency has yet to be very high on political agenda
- Supply-side is historically favoured in France: nuclear is still dominant

Main Events as drivers

- The COP21 encouraged the government to act as it was about to host the event
- Fukushima had a small impact but not a coincidence that 4 years later, France modified its nuclear agenda
- EU Directives on renewable energy and energy efficiency
- Oil price has a large impact on economy: now, low price means economic growth but diversion from problematic oil use
- Largest RES potential but still far from being used: slow investment, unreliable legislations with regularly modifications

Figure 19: French strategy in energy policy making

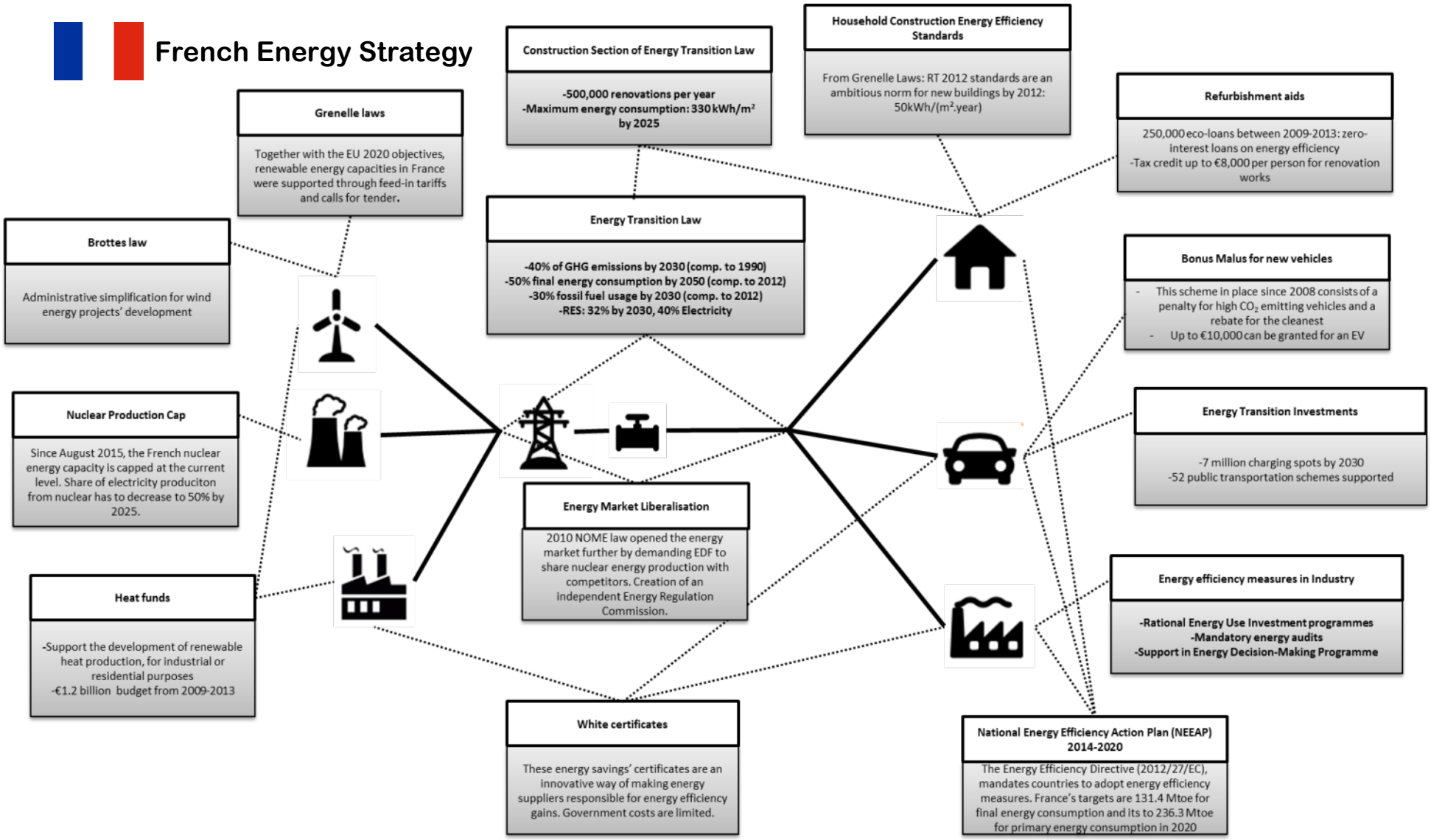

Figure 20: National energy policy overview in France

3.4.1.1 Energy political orientation & social, environmental and economic objectives and barriers

Political & societal orientations with regards to the energy topic

A recent law, "on energy transition for green growth," embodies the current government's policy on energy transition. Discussed since October 2014, the government promulgated the law in August 2015 after a lengthy debate. The largest controversy concerned the future of nuclear energy in France and the law set, for the first time in French history, an objective for the reduction of nuclear energy, while promoting energy efficiency and renewable energy sources.

Although the Fukushima accident has completely upset Germany's nuclear programme, the French maintained a stoic attitude and did not dramatically change their mind on the safety and usefulness on a large nuclear sector. Nonetheless, there were longer term trends that affected the nuclear paradigm in France. Undisputed and unquestioned for decades, the concept of limiting and/or reducing the French dependency on nuclear energy became a political objective, if not a campaign promise, of François Hollande during the 2012 presidential elections. The Fukushima tragedy has probably had some influence over that decision, but it was more particularly the initial coalition with the Green party – historically the strongest anti-nuclear party – that incited the Socialists to engage the post-nuclear transition.

The rate at which the reduction of the nuclear hegemony in electricity production would take place was the most controversial aspect of the law. The precise timeline and objectives will be discussed in the next section, but the debate revealed the difficulty in reforming nuclear power, even in a modest manner. The cap on nuclear energy production was not the only highly debated issue. The closure of the Fessenhein nuclear power plant, the oldest plant still active in France, was another campaign promise in 2012, but it is looking increasingly difficult for the government to fulfil it as there are significant delays in the construction of a new generation nuclear plant.

Concerning other potential energy sources in France, French public opinion and successive governments have all rejected shale gas in spite of the large untapped potential. The official position is that fracking is banned and any alternative in shale gas exploitation would be accepted, assuming that environmental damage is limited and well understood.

Objectives for 2020 and beyond for a sustainable and low-carbon energy

As shown in Table 3, France's target of 23% renewable seems gradually harder to reach. Progress towards the objectives on heating and cooling is particularly behind, trailing 4 points behind the interim target. Interestingly, France is over-achieving on the typically most difficult objective, transportation.

Table 3: France 2020 objectives

Share of RES	Objective %	Achieved		Expected
	2020	2005	2014	2014
Transportation	10.5	1.7	7.7	7.6
Heating/cooling	33.0	11.6	18.1	22.0
Electricity	27.0	13.8	18.4	19.0
Total	23.0	9.2	14.6	15.0

More specific objectives on renewables are presented in Annexes in the French renewable policy section.

3.4.2 French Policy and Regulation Landscape Overview

Energy Transition

Although no official statement in France defines the exact meaning of "Energy transition", the Ministry of Environment does use the expression on its website and relevant energy publications ("Transition énergétique"). The final objective of the French energy transition is to "prepare the post-oil period and establish a new French energy model that would be more robust and sustainable and able to deal with energy supply issues, changes in prices, depletion of resources and the requirements of the protection of the environment". The French energy transition law voted in August 2015 is expected to drive France towards a more sustainable future. This law results from a multi-step process initiated in 2012 that took into account all stakeholders. Through different public initiatives, including a national debate on energy among others, the civil society had the opportunity to make its voice heard. The synthesis of this debate revealed 15 major concerns of French society about the energy transition that integrates the social, economic and technical dimensions with respect to the 2030 objective of the country, that is to say the European Union climate and energy package. The French energy transition should serve "all French" people and modernise the economy through a low-carbon energy mix financed by different economic levers. The synthesis of the debate constituted a first draft on which National Committee for the Energy Transition (CNTE) drew in creating the framework of the future law on collaboration with NGOs. The final version of the law defines 8 major axes, to drive/implement the energy transition:

- Renovating buildings
- Developing clean transport
- Fighting against waste and promoting the circular economy
- Promoting renewable energy
- Strengthening nuclear safety and informing citizens
- Simplifying and clarifying procedures
- Giving citizens, businesses, territories and the State the power/means/capabilities to act

Involving citizens, communities and companies, the French energy transition law has established economic tools like tax credit and free eco-loan to facilitate its application. Different blueprints at the national and territorial level have been set up under the direction of the CNTE. So far, it would appear that the energy transition finds all its meaning through the regulation, which meets the challenge – at least in theory – to engage all categories of stakeholders.

The French energy transition, embedded in the regulation voted in 2015, encompasses to some extent a socio-economic perspective. It relies on economic tools like tax credit or eco-loan while developing a more sustainable lifestyle around the circular and green economy. The French Court of Audit (Les Echos, 2014) highlights the weaknesses of the technical measures that should effectively support the application of the law.

Urgency and pressure on the energy transition

A national policy to tackle climate change was initiated in 1989 by the Prime Minister Michel Rocard who decided to create an interministerial working group, named "Interministerial Mission on Global Warming". The objective was to coordinate the actions of France in its fight against GHG emissions, both nationally and with international bodies. Originally centred on the energy topic, this small entity developed measures on energy savings, fuel taxes, energy efficiency, and the development of a nuclear capacity to maintain 2000 GHG emissions to their 1990 level.

The debate on the climate question was introduced in 1999 through a first parliamentary report, previous to the signing of the Kyoto Protocol in 2000. In 2005, with the fight against the intensification of the GHG effects and the prevention of risks related to global warming were recognised as national priorities, the POPE Act (Legifrance, 2005) was adopted to complete the measures of the new National Programme to tackle Climate Change.
The National Observatory on Climate Change was created in 2001 and works collaboratively with Meteo France, and the Institute for Research and Development (IRD) to measure the effects of climate change in France. Among others, its main missions consist of making recommendations on prevention and adaptation measures, collecting information, as well as research on the risks of global warming and climate extremes. Its report, Climate Change Impacts in France (Changement Climatique Impacts en France), documents the main consequences of climate change for agriculture, economy and ecosystems in France. Despite obvious climate change consequences, the French population does not consider climate change as a major issue. Indeed, a recent survey undertaken by Ifop (Le Figaro, 2015) reflected that only 21% of interviewed consider the fight against global warming a priority. In 2007, under the influence of Nicolas Hulot, a transversal approach of environment was adopted between ministries to coordinate effectively the different policies. The first Grenelle for environment in 2007 symbolised this change of direction, which led to the reorganisation of state services on the climate issue.

France, driven by its position as COP21 host, has made many national and European commitments to tackle climate change. Through the application of the energy transition law voted in 2015, France targets the objective of reducing its greenhouses emissions by 40% by 2030 compared to 1990. To reach this objective, the country builds its strategy on achieving a renewable energy share equivalent to 32% of final energy consumption in 2030 and halving energy consumption by 2050.
Despite a scenario of a potential 100% renewable energy mix by 2050 (ADEME, 2015) described in the Agency for Environment and the Energy Management's (ADEME) report, France like it will fail to achieve the first milestone of its energy transition pathway, that is a renewable energy share equivalent to 23% of the final energy consumption in 2020. Indeed, according to Jean-Louis Bal, President of the Renewable Energy Union, the share of renewable energies could not exceed 17% in 2020 because of the colossal delay of wind farm projects (Le Monde, 2015). Only 9000 MW has been installed so far on the 19000 MW planned 2020 objective.

The French Minister of Environment, Ségolène Royal, presented recently the low-carbon national strategy to implement orientations guaranteeing the transition in all sectors towards a low-carbon economy for the period 2015-2028. The action plan is embedded in the French energy transition law with ambitious targets: France has pledged to reduce emissions of greenhouse gas by 40% between 1990 and 2030 and to reduce emissions of greenhouse gases by 75% of 1990 levels by 2050 (French Ministry of Ecology, Sustainable development and Energy, 2015).

To complete this national policy framework, the law has set up a multiannual programming of energy which defines until 2023, the objective for energy efficiency and the share of renewable energy. It is associated with a national plan to reduce air pollutant emissions that aims to increase air quality and limit the consequences of pollution on health and the economy.

At a local level, communities are endowed with new tools like the regional plan for energy efficiency or new competence in the distribution of heat and renewable energy production.

Policy Integration

Being part of the same bill, the different policies and tools mentioned above are consistent with each other. Consequently, the law refers effectively to other policies like the heating building regulation RT2012 or the objectives of the platform for circular economy in France. These topics are also in the purview of the French Ministry of Environment, which is in charge of the energy transition law. However, the energy transition incentives go beyond the scope of the Ministry of Environment since others Ministries such as the French Ministry of Economy also covers the topic. Indeed, "sustainability and energy transition" has been identified as a major axis of economic growth that should benefit from special investments. Similarly, different poles of competitiveness set up by the Ministry of Economy like Axelera[5]or Alsace Energivie[6] coordinate the activity of professionals involved in the energy and ecology sector. Furthermore, numerous technologies among the 85 innovation topics identified across different sectors like building, transport and industries as sources of economic growth by the Ministry of economy, deal with the energy transition.

The French energy transition law plans for investments and tenders to develop green energy, whether it is solar, wind, biomass or heat energy. All sectors that consume a lot of energy or emit greenhouse gases are engaged in an impact reduction process.

If policies generally pull in the same direction, some laws raise concerns regarding energy transition. For instance the law for economic growth, activity and the equality of economic opportunity, known as the "Loi Macron" does not really integrate the perspectives of energy transition. Article 28 allows the French government to reform the environmental law by orders in four areas: the issuance of building permits, impact assessment, the public inquiry and dispute resolution. The deputies successfully maintained a right of inspection and information while the Ministry engaged publically to associate the CNTE with the decisions. Moreover, an amendment to the "Loi Macron", voted at the last minute concerning the article that liberalises the supply of bus transportation, fosters less polluting vehicles. The fact remains that this liberalisation of the bus sector appears as a direct competition to the train sector, which emits less pollution. ADEME should conduct an impact study to measure the pollution related to this activity.
On the positive side, the Macron law provides that the Government should submit to Parliament a feasibility study on the creation of a French ship dismantling industry.

The funding to support the Pubic Contribution for Electricity (CSPE) that finances, among others, renewable energy has suffered from incoherence. So far, only the electricity consumers have funded this contribution although electricity is the least polluting source of energy in France; oil and gas consumers have been outside of the scope. The new CSPE should change the situation by expanding the tax base to all consumers.

Institutional structure

Historically, the French energy system has been dominated by two national companies, namely Electricité de France EDF and Gaz de France (GDF), established after World War II and replacing a myriad of local companies to operate the complete value chain of electricity and gas. Initially operating large utilities like nuclear power plants and gas power plants, these state-owned companies had begun a process of energy diversification integrating more and more renewable energy capacities.

[5] For more information see their website: http://www.axelera.org/index.php/fr/
[6] For more information see their website: http://www.pole.energivie.eu/

In accordance with the European directive (96/92/CE), which introduced a gradual opening of the electricity market, the activities of energy production and energy transportation were separated. Successively, Réseau de Transport Electrique (RTE) and Electricité Réseau Distribution France (ERDF) were created to guarantee a non-discriminatory access to competitors. The same deregulation was instituted in the gas sector with the creation of Gaz Réseau Distribution France (GRDF). Both electricity and gas energy markets are supervised by the Comission de Regulation de l'Energie (CRE), an independent administrative authority which has powers of decision, information and consultation to defend and represent final consumers.
This structural change in the energy sector is also accompanied since 2007 by a progressive commercial deregulation, which ensures that all consumers public and private the right to choose their supplier of electricity and gas. Competitors like ENI, E.ON, and Lampiris among others have been able to provide energy contracts that fit consumers. If this deregulation seems effective for the gas market, 23% of the gas consumption of non-residential sites continues to be provided by the historical operator EDF, which still plays a major role with both private and public consumers.
La Cour des Comptes, a French financial jurisdiction of the administrative order, underlines in its last report that "the market opening appears as very partial and the weight of the incumbent EDF remains largely predominant"(Les Echos, 2015). The institution blamed the lack of information available to final consumers from both private and public actors.

Different institutions have been involved in the shaping of the French energy framework. Among others, the General Direction for Energy and Climate (DGEC) is a French central administration which defines and implements the energy policy of France and supply of mineral raw materials. Divided into two entities "Energy Direction" and "Climate Direction", this central institution carries out 6 kinds of missions:

- The opening of energy markets, including electricity and gas
- The monitoring of key sectors of energy and raw materials
- The guardianship of businesses and public institutions
- The sovereign missions
- The work at international and EU level
- The economic expertise

At a more local level, the message of energy transition is relayed by regional ADEME implantations.

Until recently, the population was not involved in energy decisions given that the energy lobby and politicians have dominated the dialogue. The debate about nuclear energy in France is almost taboo and a referendum on the topic is unimaginable today. Nonetheless, despite the lack of information, civil society is more and more concerned with the question on energy. Enercoop is the first energy cooperative owned by civil actors to provide renewable energy contracts. Moreover, personalities like Pierre Rabhi, Nicolas Hulot, think-tanks like IFRI, Institut Montagine or associations like négaWatt, CoalitionClimat 21 attempt to represent population in the debate. At a very local level, numerous sustainable initiatives, relayed by social media like Facebook or Twitter, exist but are not coordinated.

Initiatives on new sustainable technologies

The programme "Investissement d'avenir" initiated by the commission Juppé-Rocard in 2010 allocated 47 billion euros though tenders to develop and ease access to promising and sustainable technologies among others.
Moreover, to enable the implementation of the French energy transition law, significant financial resources have been released for the action plans accompanying the legislation:

- At individual level, a tax credit for the energy transition is accessible to all, occupants, tenants, and owners. It can reimburse up to 30% of the amount of an energy retrofit. This action plan is also accompanied by the revival of an eco-loan for free that aims to extend 100 000 loans and lead to 2 billion euros worth of work per year.
- At community level: The savings fund of the Caisse des Dépots that accompanies structural projects of the local public sector is increased by 5 billion euros. The loans are used to finance the following initiatives in the territories: energy renovation and positive energy buildings, clean transport, renewable energy.
- At company level: BPIFrance, which is a bank for innovation and assisting economic growth, provides loans to finance corporate investments producing renewable energy. The loans will be doubled by 2017 to reach 800 million euros annually. Moreover, BPIFrance has committed itself to finance partially responsible investments through:
    - Green loan: this mechanism grants a loan up to €300,000 to small and medium companies that desire to acquire less polluting equipment or develop eco-efficient products.
    - Environmental Technologies Fund: part of the "Programme d'Invetissements d'Avenir" it aims to assist small and medium companies to finance up to €10 million, sustainable projects coping with renewable energy, green chemistry, circular economy, smart grids and vehicle of future.
    - "Sociétés de Projets Industriels" (SPI) funds: as part of the 34 Plans of New Industrial France, it takes minority participations up to €85 million in project companies created in partnership with industry. The first project funded via this mechanism was the industrialisation of CNIM that develops solution in thermos-solar energy.

3.5 Italy

3.5.1 National energy system and regulation review

The Italian energy system has historically been highly dependent on fossil fuel sources and extremely vulnerable to external energy shocks due to the dependency from energy imports. The Italian energy system is still based on a carbon intensive mix, with about 85% of energy demand fuelled by fossil fuels, basically oil and natural gas.

The large dependency from Middle East with respect to oil imports and the great concentration in natural gas exporting partners make Italy a fragile country due to energy insecurity. Nonetheless, during last decades, several changes occurred in national energy policies, bringing the Italy system to a radical improvement in energy efficiency performance and to a growing interest in developing alternative energy sources. While traditional hydropower has constituted a large quota in the energy mix strategy from the beginning of the industrialisation process after the Second World War, the increasing interest in new clean energy sources as wind and solar ones has emerged only during the last decade, due to fast liberalisation process of the electricity market at the European level and the increasing attention toward climate change issues.

During the last years, international energy markets have complicated the energy strategy for the vast majority of developed economies, including Italy (oil lost half of its value and the prices of natural gas decreased on many markets). Despite of this negative context, Italian energy transition toward a more efficient system continued. The principal aims of such medium term strategy were to reduce the energy dependence from foreign countries and to improve the role of renewable resources in our economic landscape. In particular, the second objective has been achieved: renewable resources represent today one

fifth of the primary energy demanded and they result to be the first source for electricity production (43% of Gross National Production).

In Italy, the influence of taxation on energy products is higher than in the greatest part of European countries. This brings from one side to a relatively higher cost for energy consumption and production, which is sometimes compensated by public subsidies, mainly provided to strategic industries. The same attention does not occur (or in a quite reduced way) for private consumers. This brings to a potential regressive distribution effect due to energy taxation that has been partly counterbalanced during last decade thanks to the liberalisation process of the energy markets and entry into the markets of several additional operators, achieving a substantial increase in market competition.

In order to reduce the weight of the energy cost on the overall economic system, according to the EU Directives, Italy started during the '90s a long liberalisation process. Subsequently, the role of the government in the Italian energy sector has been reduced by this privatisation programme. Until 1995, ENI, the most important oil and gas Italian company, was fully state-owned; by 2001, the state's share of the company had been reduced to just 30%. The company held a dominant position in the Italian upstream oil and gas sector, even if many Italian and foreign private firms established a significant presence. ENI remains the leading refining and marketing company, with 30% of the market. The Italian oil market is fully liberalised. The government intervenes just to protect competition and to avoid abuse of dominant position.

Italy liberalised its electricity and gas sectors in order to comply with EU directives. Transmission and distribution of natural gas and electricity have been regulated by "Authority for electricity and gas", established to control access to networks and to regulate tariffs.

The electricity stock market has been established in 2004 by legislative decree n°79/1999 about electric market liberalisation. The "Electricity Market Supervisor" (Gestore del Mercato Elettrico) is the authority that handles the electric stock. Retails occur each day for the next day, through a mechanism of negotiation every hour, in which the meeting between demand and supply happens by a marginal price system.

The Italian energy trade bill is in deficit. Energy imports (143.79 Mtoe) overlook exports (21.255). The only export significant aspect is related to oil (20.118 Mtoe). On the other hand, the largest part of imports depends by oil (71.77 Mtoe) and gas (45.65 Mtoe). Electricity import is equal to 10.279 Mtoe and represents 7.14% of overall energy imports into Italy.

With respect to the final energy commercialisation system, the organisation is rather complex. The total cost of commercialisation for the electricity sector is included in the energy bill for the final consumer as a portion of energy selling services that companies transfer to final consumers. The amount of this transfer is centrally decided by the Authority, the "Authority for electricity, gas and hydric system" an independent organism, established by law 14/11/1991 n°481, with the commitment of defending energy consumers' interests and of promoting competition, efficiency and services diffusion, through regulation and control activities.

The amount of electricity commercialisation costs is clearly expressed in the electric bill received by the consumer, in order to be compliant with transparency laws and consumers' protection rules.

In the case of the other energy sources, the commercialisation process depends on the level of market liberalisation. All producing firms have specific contact points or the commercialize contracts and special offers with telephonic interviews and or door to door information campaigns.

As a general remark, the commercialisation system is highly diffused over the territory, and there is a large communication potential with final consumers.

On the other side, in Italy there is not a specific consumer-focused organisation while there are several generic associations protecting consumers from company behaviours endangering the welfare level of the final consumers. The legal protection for consumers is ensured by the Authority for electricity, gas and hydric system and by the Antitrust authority. There is also an increasing trend of domestic renewable energy production with the increasing exploitation of micro plants, especially in the countryside, both for the agricultural sector but also for residential purposes. Civil society is considered as a crucial driver of the introduction of RES in the national energy system, and for the agriculture sector, is also considered as a source of income diversification.

With respect to a multilevel policy implementation, according to the administrative organisation of the Italian territory, together with the centralised role played by the national Authorities, the practical implementation of some policy lines is assigned to Regions and Municipalities. According to "Fifth Title" reform of Italian Constitution, the administrative competence on the energy system is divided between State and Regions. The functions exclusively assigned to the regions are:

- Statement of the regional energy policies objectives;
- Location and realisation of the district heating plants;
- Development and valorisation of the endogenous resources and the renewables sources;
- Release of the hydroelectric concessions;
- Building energy certification;
- Guarantee of security and environmental compatibility conditions;
- Security, reliability and continuity of the regionals provisions;
- Achievement of objectives of GHG emissions limitation that were established by Kyoto Protocol;

Furthermore, in accordance with municipalities, Regions have competence on authorisation and functioning procedures of energy production plants. Regions have also the task of establishing the "Regional Energy Plans" to manage the subsidies system in order to reduce the energy consumptions and to support the development of renewable resources respecting the constraints and the potential advantages reflecting the specificities of territorial features.

With respect to the recent energy transition policies toward a sustainable society as envisaged by latest EU Directives and strategy, the most recent energy strategic plan is represented by the 2013 National Energy Strategy (NES), responding to the European compulsory documentation that each member country must produce for the medium term energy and climate strategy. The temporal horizon used in the 2013 NES document is mainly 2030, with precise targets established by year 2020 and future pathways designed by 2030. In addition to this official and compulsory document, the national energy agency (ENEA) has also produced in 2013 a Roadmap to 2050 scenario, in order to facilitate policy makers in designing future energy strategy according to the challenging EU emission reduction targets, while considering the most feasible technological options for Italy.

An overview of the Italian energy system and landscape is presented here. This mapping outlines the energy sources; infrastructure; demand; market structure; and policies of Italy, and further outlines substantial changes that have occurred since the late 20th Century. An overview of energy policies indicates the future of the Italian energy landscape over the next couple of decades. The Italian main objectives regarding energy strategy, its main problems, targets and roadmaps, main discourses at public level and

main events that have driven the change to a more sustainable energy system are summarised in the following figure.

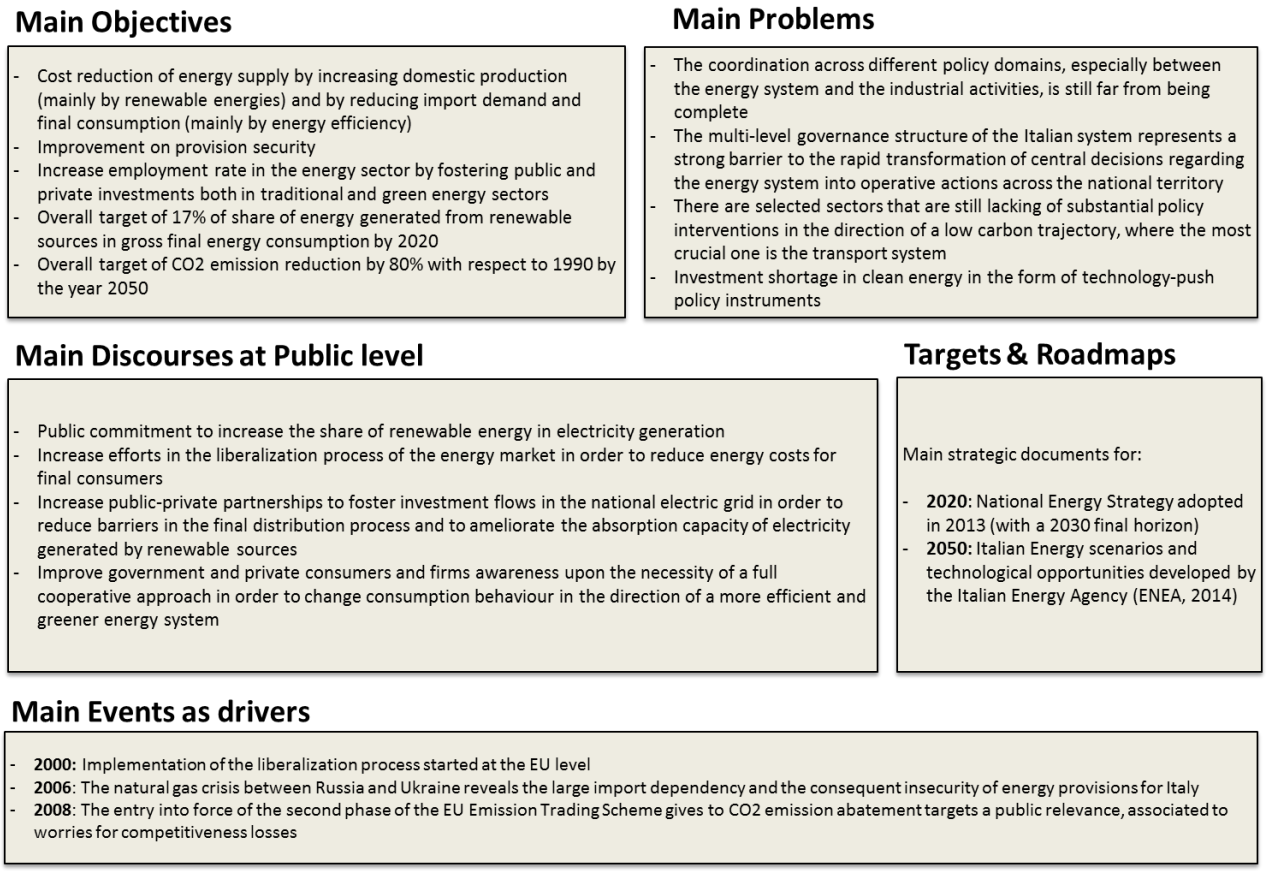

Figure 21: Italian strategy in energy policy making

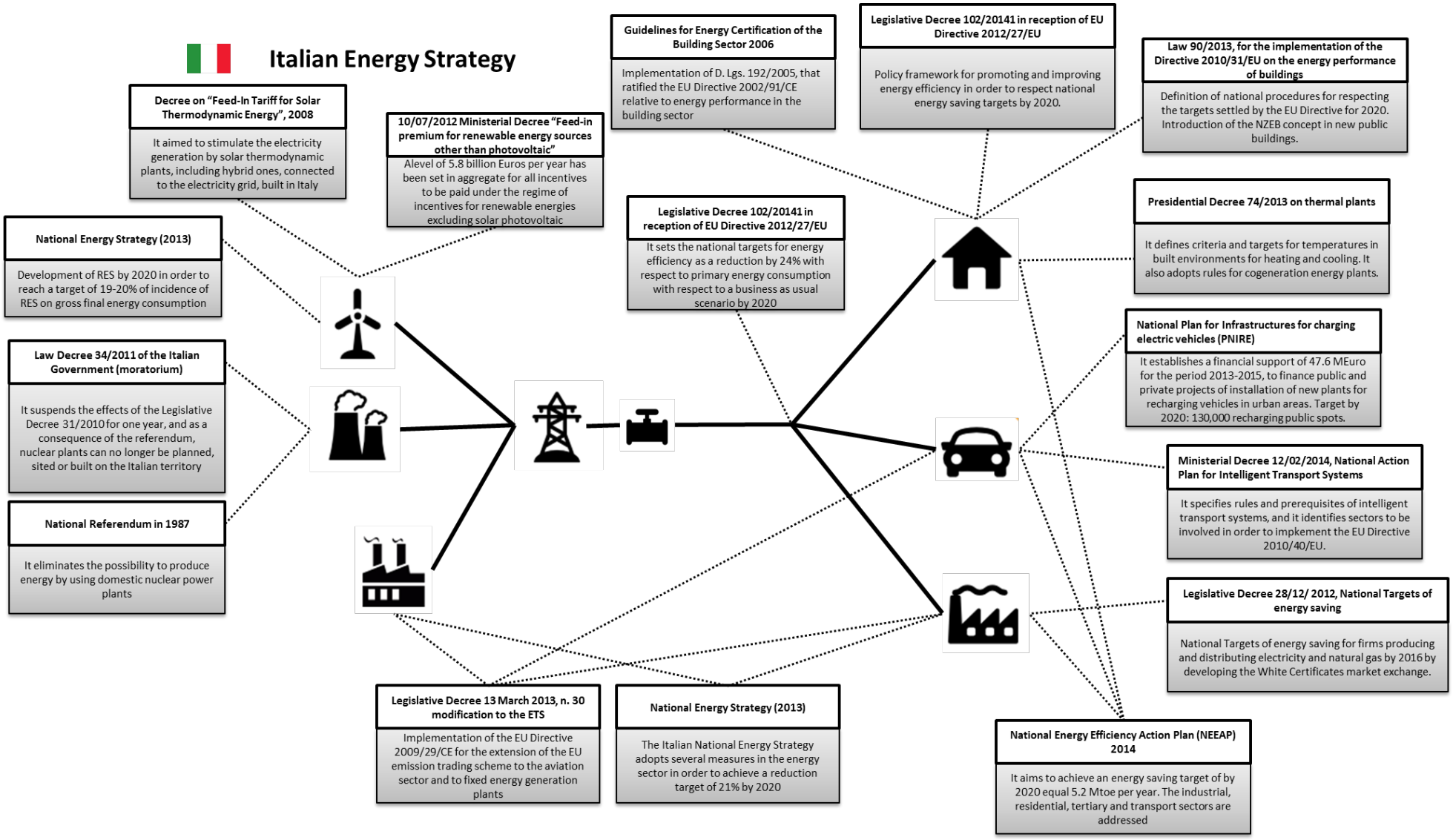

Figure 22: National energy policy strategy in Italy

3.5.1.1 *Energy political orientation & social, environmental and economic objectives and barriers*

Political & societal orientations with regards to the energy topic

The main implementation methods for energy efficiency policies in Italy are White Certificates (WhCs), introduced in 2005, and a 55% tax rebate scheme introduced in 2007. WhCs has been established with the adoption of the first European directive on the liberalisation of the electricity and natural gas market. Both these methods aim at reducing GHG emissions and energy import dependence, and at developing the market for energy efficiency products and services. WhCs are an example of a trading incentive scheme, promoting energy efficiency measures in the industry sector, both in the production process and in end use products. The 55% tax rebate programme provides tax credits to households for comprehensive or single retrofit energy efficiency measures. The total deductible amount is then distributed over a period of ten years.

Italian government identified gas price reduction as a cornerstone to improve Italian industry's competitiveness. To achieve this objective, they decided to improve market mechanism and infrastructures. Government set up the day-ahead market in 2010, the balancing market in 2011 and a gas exchange market in 2013.

Another policy regards a research fund for the national electricity system. It aims to innovate and improve the performance of the system in terms of economics, safety and the environment. The Italian government established that research activities at a system level can be included in the system costs that are paid for by end users through the creation of the Research Fund for the National Electricity System.

Objectives for 2020 and beyond for a sustainable and low-carbon energy

The 2020 targets are easily reachable by Italy thanks to the economy crisis, the industrial activities reduction and the development of the renewable resources. For this reason, In Italy has been approved the National Energy Strategy (SEN), which has objectives more ambitious to 2020 than the European strategy for Climate-Energy issues.

The main objective of SEN is the improvement of the energy system competitiveness and the pursuing of the environmental sustainability. SEN has promoted this competitiveness relaunch through four objectives:

- - Energy cost reduction
- - Overrun the European target for 2020
- - Improvement on provision security
- - Push to the growth and the occupation thanks to the investments both in traditional and green sectors.

Even if the activities promoted by SEN can contribute to the reduction emissions among 2030-2050, they are not sufficient to allow Italy an emissions reduction up to 80%, as supposed by Energy Roadmap to 2050. To achieve this objective will be necessary many efforts to change the energy system structure and many researches on low-carbon new technologies.

The target to reduce by 80% the CO_2 emissions vs. 1990, it is achievable just if a decarbonisation of electricity generation processes will happen. The electricity production can contribute for 34% to reduce emissions at 2050. This contribution can be possible thanks to the use of renewables and the technology

efficiency improvements. The transport sector also can support the reduction for 26%, introducing in the market electric cars and bio-fuels. The civil sector can contribute for 22% and the industrial sector for 18%.

To this purpose the renewable energy production is particularly stressed. The Italian National Renewable Action Plan (NREAP), outlining pathway which will allow meeting the 2020 renewable energy, energy efficiency and GHG cuts targets, has been published in 2010. In particular, Italian 2020 renewable energy targets are:

- 1) Overall target: 17% of share of energy generated from renewable sources in gross final energy consumption
- 2) Heating and cooling: 17% of heat consumption met by renewable sources
- 3) Electricity: 26% of electricity demand met by electricity generated from renewable energy sources
- 4) Transport: 10% of energy demand met by renewable energy sources.

Objectives for 2050 for a sustainable and low-carbon energy

The long run 2050 objectives for Italy are not part of an official policy strategy but they are described by the Report published in 2013 by the Italian Energy Agency (ENEA). The EU Roadmap to 2050 has been projected for the Italian case in order to be compliant with a reduction target by 2050 of cutting emissions by 80% with respect to the 1990 level, with an intermediate objective of cutting emissions by 40% and 60% by 2030 and 2040 respectively. By considering the current technological framework of the Italian energy system, the scenario analysis envisages selected technological opportunities to be developed and exploited in order to reach such challenging goals without harming the economic growth performance of the Italian system.

In particular, the following elements are highlighted as the crucial driver of a decarbonisation pathway for Italy:

- reduction in energy consumption for heating and cooling in the building sector
- promoting biofuels in the transport sector
- more stringent regulatory and control measures for emissions levels for private transport
- investments in public transport infrastructure both at the national and urban level in order to change transport behaviours for the private agents and promoting public transportation and railway use
- promoting energy efficiency in all sectors with actions oriented toward both the technology innovation and diffusion improvement, and the increasing awareness by public and private consumers through information and education campaigns as well as through the adoption of compulsory regulation and control systems.

3.5.2 Italian Policy and Regulation Landscape Overview

Energy Transition

The Italian energy system faced huge changes over last decades. The first impulse to a radical shift in the energy paradigm was the oil shock occurred in the early '70s, when the energy shortage and the increase in energy prices forced the Italian government to adopt severe efficiency measures in order to reduce the energy consumption level, both for the industrial and the domestic sectors. During the '80s and '90s the Italian energy system became rather efficient in consumption, respecting the challenging technological and behavioural changes required by the international community as the IEA and EU rules adopted.

The second impulse was mainly driven by the energy mix changes required by this changed international environment and by the energy security objectives settled by the EU. Accordingly, a general reduction in oil consumption was obtained by shifting power generation on natural gas fuelled power plants.

The third impulse was the recent efforts required by the EU to respect GHG emission reduction targets by developing renewable energy generation. Accordingly, thanks to the liberalisation process of the EU and Italian energy markets, an increasing share of energy production is obtained today by mean of renewable sources developed by a number of public and private operators.

Although these three impulses work in the direction of a greening process of the Italian energy system, a systematic and official definition of energy transition does not exist in Italy. Despite this fact, there is a general consideration across policy makers and other agents to work in the direction of improving this on-going shift of the energy paradigm towards a low carbon economy also in Italy, mainly by improving energy efficiency and by exploiting new technological opportunities in the renewable energy sector (ENEA, 2013).

Even if for the largest part of the population the real meaning of energy transition is unclear, a relevant change supports the spread of this concept that is the birth of a “green awareness”. Indeed, opposite to what happened in the past, the first step towards energy transition is done, since today citizens are aware of environmental problems, and more importantly there is a growing consciousness of how single agent behaviour might influence environmental pressure.

The second step expected to take is more difficult. Practical solutions for reducing environmental pressures linked to the energy system are still spare, and most of the work has still to be done.

There are two major causes behind this delay in officially designing and adopting a concrete energy transition process.

The first one is the lack of coordination between government’s decisions and society’s response. As an example, on the one hand, the Italian government keeps investing in energy projects based on fossil fuels, like the transformation in coal plants of some obsolete but still working plants, or by investing in new LNG sources (and regasification plants). On the other hand, citizens try to oppose to these plants creating association with the aim of requiring clean energy, or more realistically to apply a not in my backyard approach. This contrast between government decisions and citizens reactions is explained by two features: first, the Italian governance system is rather stratified, with centralised and local decisions often not well coordinated; second, there is not enough works and investments at the local government level in fostering information and education oriented towards a greater participation of the local communities to such strategic decisions (IEA, 2009).

Urgency and pressure on the energy transition

Climate and energy policies are driven by the European Union. This pre-condition cannot be an excuse for the lack of effort showed by the Italian government on these topics. There is a strong gap between the commitments that Italy took internationally and the effective energy measures applied nationally. The coordination among several departments (economic development, transport, environment, energy, infrastructure, etc.) is deficient. It compromises the achievement, for instance, of the 20-20-20 objectives or the reduction of GHG emissions thanks to the increase of renewable resources use. Furthermore, the economic crisis and the strong energy dependency of the Italian system have not supported a rapid change to a cleaner energy system. Essentially, in Italy environmental problems are considered not as a core

problem to solve as soon as possible, but as secondary issues that could be faced in the future. Consequently, excluding isolated policies, Italian government is not dealing with the energy transition with the right urgency. Climate change issues are consciously considered in several technical documents produced by the Italian Energy Agency (ENEA, 2013), but they have not been transformed into long run official strategies.

The recent policy strategy, the National Energy Strategy, adopted in 2013 by the Italian government seems to be a promising step beyond in the direction of more sustainable energy paradigm. Economic Development Ministry has set the Italian Energy Strategy for the 2030, in order to significantly reduce the energy cost gap, achieve and exceed the environmental and decarbonisation target, continue to improve the security of supply, and foster sustainable economic growth. In order to attain these results the strategy has been broken down into seven priorities, each with its specific supporting measures that have already been set in motion or are currently being defined.

While the National Energy Strategy constitutes a general long term framework with general objectives temporal horizon up to 2030, there are recent examples of single policies addressing specific issues related to the decarbonisation of the Italian energy system.

One example is given by the energy certification system in the building sector. After several years of delay with respect to the EU legislation, from 2012 also the Italian government has worked in the direction of a structured and coordinated legislation of the certification procedures. The most recent policy instrument is the Ministerial Decree adopted in June 2015, where there is an update version of the guidelines for the energy certification in the building sector, with specific rules related to calculation of energy consumption, but more importantly there are specific rules for the monitoring system at the single building level.

Another important policy tools is represented by the “Conto energia” revised in 2014 by the “Legge di stabilità 2014”, that allows investors to have a secure medium term horizon in order to decide whether to invest in renewable energies (GSE, 2014).

Policy Integration

The National Energy Strategy (NES) is the most important policy tool available in the Italian energy system. It is the first example of a coordinated policy strategy between different policy objectives and different themes in the field of the energy system. The objectives of the NES are the following:

1) A reduction of 24% in primary consumption is foreseen compared to the inertial performance by 2020 (i.e. 4% compared to 2010), exceeding the European targets of 20%, mainly thanks to energy efficiency measures.

2) In terms of the energy mix, it is expected a 19-20% share of renewable energy in gross final consumption (compared to about 10% in 2010). The share of renewables on primary energy consumption will be equivalent to 23%, while there will be a reduction from 86% to 76% of fossil fuels. In addition, it is expected that renewables will reach or exceed the share of natural gas as a primary source in the electricity sector, accounting for approximately 34-38% of consumption (compared to 23% in 2010).

As regards the long and very-long term horizons (2030-2050), environmental challenges, competitiveness, and security will require a more radical change of the system, which will largely involve not only the energy sector, but the entire functioning of society.

3) The need to strengthen efforts in energy efficiency. Primary consumption will have to fall in the range of 17-26% by 2050 compared to 2010, by decoupling economic growth from energy consumption. In particular, efforts in building and transport sectors will be critical.

4) The high penetration of renewable energy, that in any of the scenarios envisaged at the time is expected to reach levels of at least 60% of gross final consumption by 2050 (ENEA, 2014), with much higher levels in the electricity sector. In addition to the need of research and development for the reduction of costs, it will be fundamental to rethink the market and network infrastructure.

5) A substantial increase in the degree of electrification, which will almost double by 2050, reaching at least 38%, particularly in electricity and transport.

6) The key role of natural gas for the energy transition, despite a reduction of its weight both in percentage and in absolute value in the span of the scenario.

Although this structured official document constitutes an import step in the direction of policy coordination in Italy, there are still several issues to be considered carefully.

The first one is the existence of several subsidies and supporting measures to the use of fossil fuels that are still working in the Italian system, especially for some key industrial sectors (Martini, 2012). This means that from one side there is a general effort in reducing GHG emissions, but from the other side there are several forces working in the opposite direction, subsidising the use of carbon intensive industries by reducing the cost of fossil fuels.

The second one refers to the characteristics of the Italian transport sector, that is still strongly unbalanced in the direction of a large share of private (fossil-based) transport and a systematic lack of public infrastructures both for the urban systems as well as for the rail way system, that is mainly developed in the North-South direction, but rather underdeveloped for the East-West connection (Authority of Transport, 2014).

The fourth one is the absence of a coherent industrial policy in Italy, that explicitly includes new clean technologies for a decarbonisation pathway. Italy faces a historical lack of investments in R&D activates, both at the public and private level. In addition, the most recent policy framework addressing incentives to innovation was the document “Industria 2015” promoted by the Ministry of Development Economics in 2006.

Institutional structure

A programme of privatisation, which started in 1990s, has reduced the role of the government in the Italian energy sector. Until 1995, ENI, the most important oil and gas Italian company, was fully state-owned; by 2001, the state’s share of the company had been reduced to just 30%. The company held a dominant position in the Italian upstream oil and gas sector, even if many Italian and foreign private firms established a significant presence. ENI remains the leading refining and marketing company, with 30% of the market. The Italian oil market is fully liberalised. The government intervenes just to protect competition and to avoid abuse of dominant position.

Italy liberalised its electricity and gas sectors in order to comply with EU directives. Transmission and distribution of natural gas and electricity have been regulated by “Authority for electricity and gas”, established to control access to networks and to regulate tariffs.

The electricity stock market has been established in 2004 by legislative decree n°79/1999 about electric market liberalisation. The "Electricity Market Supervisor" (Gestore del Mercato Elettrico) is the authority that handles the electric stock. Retails occur each day for the next day, through a mechanism of negotiation every hour, in which the meeting between demand and supply happens by a marginal price system.

The most important stakeholder in the Italian energy market is ENI S.P.A., the Italian oil and gas multinational company. ENI is a leader in the downstream gas market too, through its 50% ownership of the main gas group, Snam Rete Gas, which controls most of the physical gas infrastructure in Italy. This includes almost the entire transmission network (Snam Rete Gas), a liquefied natural gas import business (GNL Italia), almost all the underground gas storage capacity in Italy (Stogit), and the leading local distribution network operator (Italgas).

For what regards the energy distribution sector, Terna S.p.A. is the dominant company. It is an Italian electricity transmission system operator. With 63,500 kilometres of power lines or around 98% of the Italian high-voltage power transmission grid, Terna is the first independent electricity transmission grid operator in Europe and the sixth in the world based on the size of its electrical grid. Terna is listed on the Borsa Italiana and is a constituent of the FTSE MIB index.

Although the general functioning of the energy system is managed and monitored by a central organism (the Italian Authority for energy), and decisions are taken at the central government level, there are several additional local government levels that substantially complicate the decision process. In addition, the participation of the individuals to decisions regarding the energy system management is not systematically included in the decision process, but it is left to the single initiatives of local governments. This is particularly relevant in the case of central decisions that need administrative authorisation by local governments, as the realisation of new infrastructures (power plants for instance), or in the case of the implementation of command and control tools (as for instance the energy certification procedures) that need well-informed administrative staff at the local level (Ministry of Development Economic, 2014).

Initiatives on new sustainable technologies

The most important initiatives on new sustainable technologies in the Italian energy system are related to the supporting schemes for energy efficiency and renewable sources.

With respect to energy efficiency, the main implementation methods for energy efficiency policies in Italy are White Certificates (WhCs), introduced in 2005, and a 55% tax rebate scheme introduced in 2007.

WhCs mechanism has been established with the adoption of the first EU Directive on the liberalisation of the electricity and natural gas market. Both these methods aim at reducing GHG emissions and energy import dependence, and at developing the market for energy efficiency products and services. WhCs are an example of a trading incentive scheme, promoting energy efficiency measures in the industry sector, both in the production process and in end use products.

The 55% tax rebate programme provides tax credits to households for comprehensive or single retrofit energy efficiency measures. The total deductible amount is then distributed over a period of ten years.

With respect to renewable energies, the Conto Energia system, as already mentioned, is the most important mechanism based on a market approach to incentivize new investments in the renewable energy sector.

In both cases, these tools work as indirect mechanisms to promote innovation in new cleaner energy technologies through market profit maximisation behaviours thanks to incentives to the diffusion (and not directly to invention) of energy efficient technologies and to the increased demand for renewable energies in order to respect the targets. In both cases the policy instrument has a typical demand-pull effect, while specific technology-push instruments are not systematically adopted (Costantini *et al.*, 2015).

Two additional aspects are also relevant. The first one is that the Italian government identified gas price reduction as a cornerstone to improve Italian industry's competitiveness. To achieve this objective, government set up the day-ahead market in 2010, the balancing market in 2011 and a gas exchange market in 2013, in order to make the market mechanisms and infrastructures able to ensure market-clearing conditions in a more liberalised market. The second one regards the implementation of a research fund for the national electricity system. It aims at innovating and improving the performance of the system in terms of economics, safety and the environment. The Italian government established that research activities at a system level can be included in the system costs that are paid for by end users through the creation of the Research Fund for the National Electricity System. It is financed by the A5 component of the electricity bill (Ministerial Decree DM 8/3/2006) and it has as a general goal to finance research and development activities with the scope of improving benefits for final users of the electricity system (CCSE - Cassa Conguaglio per il Settore Elettrico, 2012).

3.6 Germany

3.6.1 National energy system and regulation review

The paradigm shift in Germany has been driven mainly by a comprehensive energy transition that is also known as Energiewende. The term was born in the 1970s in an attempt by opponents of nuclear power to show that an alternative energy supply was possible.

A key milestone in this paradigm shift has been the Integrated Energy and Climate Program (IECP) of 2007, the so-called "Meseberger Programm", which gave an overall framework for climate friendly energy supply in Germany and provides explicit sectoral emission reduction targets until 2020.

The 2010 Energy Concept

In 2010, the German government initiated a new Energy Concept, a comprehensive strategy covering both medium (2030) and long (2050) term strategies, which has driven the energy policy since then. It proposes a substantial transition of energy use to reduce carbon emissions in all these sectors simultaneously, which mixes previous strategies and climate policy packages in one national strategy. The nuclear accident in Fukushima was an additional policy push to move forward this paradigm shift. A societal and political consensus in Germany emerged against nuclear and the energy transition was accelerated (BMWI, 2015).

The Energy concept aims at ensuring "a reliable, economically viable and environmentally sound energy supply" and its main important aspects are:

- Complete nuclear phase-out by 2022.
- Significant increase of energy efficiency in all sectors resulting in pronounced energy savings.
- Substantial increase of the share of renewable energies in the provision of final energy consumption.
- Reduction of CO_2 emissions by 40% in 2020 compared to 1990.

The Energiewende is understood as a 'transformative project' for the society as a whole and not only for generation of energy. The German government has launched a permanent political dialogue on the

implementation of the concept. Since 2012, the progress made towards the targets and the status of implementation is monitored annually. Every three years an overall report on the status of implementation of the concept will be prepared, which might propose new measures and policies to be implemented if necessary. The first results reflect that the energy consumption is shrinking though power generation is up thanks to efficiency (BMWI, 2015).

The Energy and Climate Package

Germany adopted another Energy and Climate Package in December 2014 with a focus on measures for buildings, in industry and in transport which will help in closing the energy efficiency and CO_2 reduction gaps (EC, 2015f). Also in 2014, Germany issued the "Climate Action Programme 2020", including a mandate to develop a "Climate Protection Plan 2050" in 2016, which will address all sectors and GHG emissions. The package has more than 100 measures to foster the energy transition; the followings are stressed (Sach, 2011):

- Renewable energies
  - Rapid and continuous expansion
  - Cost-effective and environmentally sound
- Energy efficiency
  - Reduces energy consumption
  - Secures economic efficiency
- Future grids
  - Flexible and powerful
  - Integrate RE energy

10-points agenda

1. **Renewable energies**: supported by the recent policy on Renewable Energy Sources Act in 2014 that ensured viable funding for renewable energy sources for the future.
2. **European Climate and Energy Framework 2030/ETS** The reform of EU ETS system is strategic for a successful implementation of energy reforms.
3. **Electricity market design:** with special focus on energy efficiency of existing plants and an increasing share of renewables.
4. **Regional cooperation in the EU/internal marke**t: the integration of Europe's electricity markets is fundamental to the success of the energy transition.
5. **Transmission grids:** the upgrading and creation of new power lines is needed to supply secure and affordable electricity.
6. **Distribution grids:** distribution grids also have to be adapted to the energy transition.
7. **Efficiency strategy:** the strategy on energy efficiency is established and monitored through the National Action Plan on Energy Efficiency (NAPE).
8. **Buildings strategy**: an ambitious objective has been set for buildings; they will be virtually climate-neutral by 2050. A recent paper, "Renovation Needs in the Building Stock" sets the first step for the energy efficiency strategy for buildings.
9. **Gas supply strategy**: gas is an important source of energy for Germany (25%) and as such it is also considered in the national strategy, mostly focused on security of supply.
10. **Monitoring/energy transition platform**: the Federal Government has launched the "Energy of the future" monitoring process and has restructured the existing expert forums and platforms.

An overview of the Germany's energy system and landscape is presented here. This mapping outlines the energy sources; infrastructure; demand; market structure; and policies of Germany, and further outlines substantial changes that have occurred since the late 20th Century. The main objectives of German energy strategy, its principal problems, targets and roadmaps, the discourses at public level and events that have driven the change to a more sustainable energy system are summarised in the following figure.

Energy Strategy

Main Objectives

- **Mitigating climate change** - The national climate target of cutting carbon emissions by 40% by 2020
- **Co-generation of heat and power** - The generation of electricity from combined-heat-and-power is to be raised to 25% by 2020. Public support to conversion from coal-fired to gas-fired CHP
- **Electricity market and energy security** – with specific Act on Energy Security of Supply
- **Grid expansion** - underground cables priority
- **Financial reserves for nuclear power** – setting funding for dismantling

Main Problems

- Germany's GHG emissions in 2013 were estimated at 954.7 million tons of CO2 equivalents, the largest of all EU countries
- Highly Oil dependence
- Energiewende is often narrowly associated with a power sector transformation.
- Need of lignite power generation to ensure the energy demand

Targets & Roadmaps

- The national climate target of cutting carbon emissions by 40% by 2020
- The share of renewables used in power generation is to be raised to 80% in 2050
- Energy efficiency: a 20 per cent reduction in primary energy consumption by 2020 compared with 2008 and halve it by 2050.

Main Discourses at Public level

- Define the Energy Concept in September 2010, in which the Federal Government set out guidelines for ensuring an environmentally sound, reliable, and affordable energy supply, thus mapping the transition into the age of renewables
- Anti nuclear movement – accelerated after Fukushima
- Renewables as the answer to energy transition
- Long-term strategy definition, with targets established until 2050

Main Events as drivers

- Fukushima nuclear accident was the final driver for German nuclear phase-out
- German patent applications in the fields of renewable energies and energy efficiency are on the same level as US and Japanese applications (2011).

Figure 23: German strategy in energy policy making

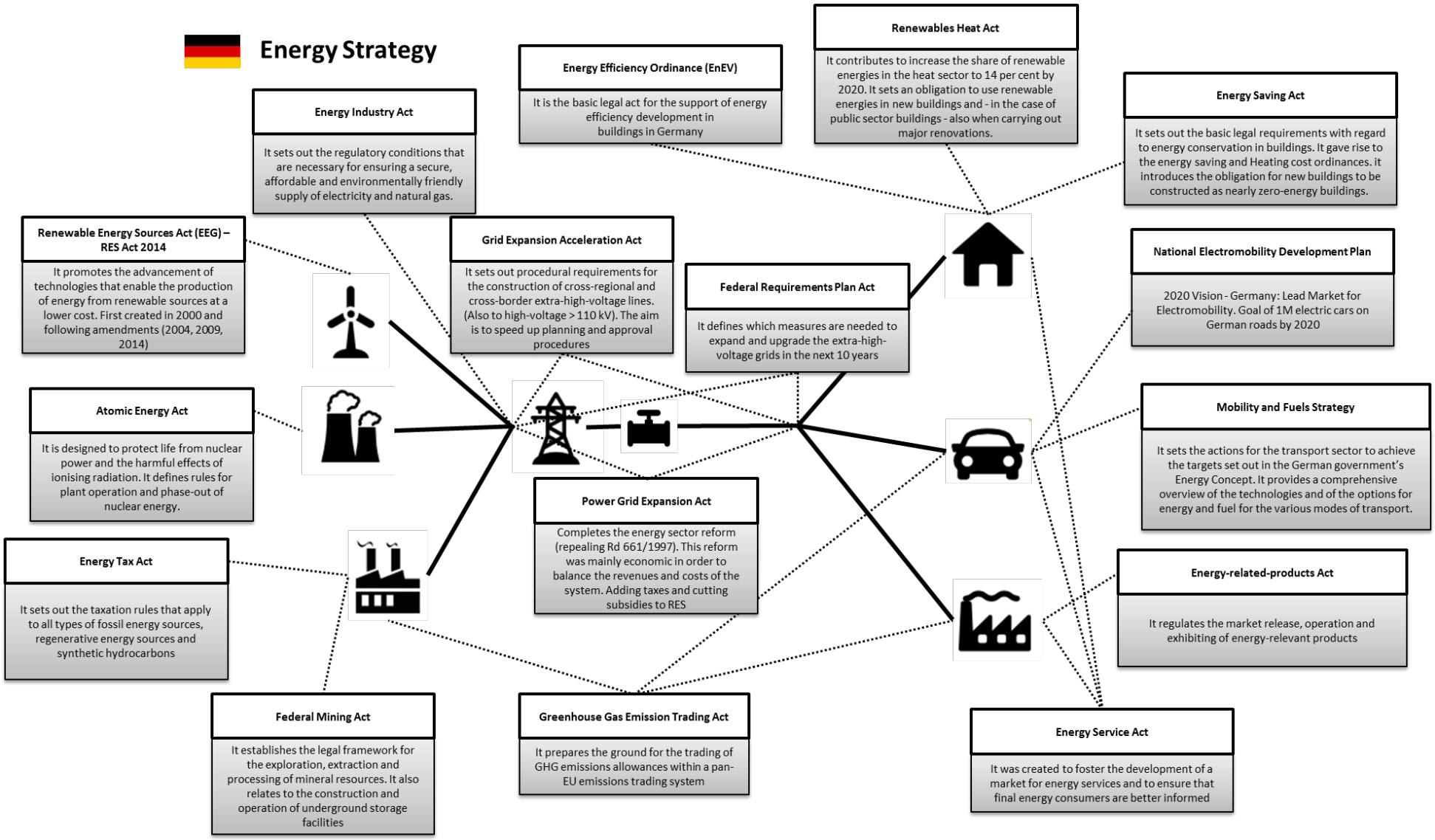

Figure 24: National energy policy overview in Germany

3.6.1.1 Energy political orientation & social, environmental and economic objectives and barriers

Political & societal orientations with regards to the energy topic

The German climate and energy policy's central pillars are (Sach, 2011):

- Long-term climate and energy policy up to 2050 aimed at fundamentally restructuring the energy system.
- Transition towards a highly efficient renewable energy system as an opportunity for the generations to come
- Climate and energy targets, cap and trade, renewable energy sources and energy efficiency
- Focus on innovation and advanced technologies, on effective and cost-efficient measures in line with market and competition principles
- Generation of strong economic opportunities and thus growth and jobs in Germany

In order to achieve this, they have established a series of policies to establish the new energy framework for the country, being the most structural ones the Energy concept or Energiewende, the Energy and Climate Package, the 10-points agenda and the Renewable Energy Sources Act. There is a strong will to achieve an energy transition in Germany: "The energy transition is our avenue into a secure, environmentally friendly, and economically successful future" (FMEAE, 2015).

One of the key success factors of the German energy transition has been the influential coalition of renewable energy supporters that have joint forces with a common goal, convince the general public and the political sector that an energy system based on decentralised renewable energy was feasible and could be beneficial for the environment and the economy. Public sentiment has been supportive of sustainable energy transition, with deeply entrenched support for notions of collective action to reach social goals as well as a higher degree of popular support for 'green' ideals and wider spread belief in the notion of anthropogenic climate change (Lockwood *et al.*, 2013).

A survey published in early 2015 shows a high level of support for Energiewende and EEG: 75% of private households, energy providers, and industrial firms still support these actions. Referring to some of the specifics of the survey, over 90% of people believe that a positive impact on the job market will be driven by the transition, Germany will become more competitive, the environment and climate will be better protected, and the consumers will be less dependent on power providers.

The considerable success of German energy transition could not have been possible without this broad political and public support. This implies that within German politics consensus exists on the general framework of energy policy. Economics Minister Rösler, one of the most conservative forces affirmed: 'Our goal now is to exit from nuclear power faster than previously planned; the pace is crucially dependent on how fast we can develop alternative sources of energy. The decision to exit from nuclear power was not satisfying in itself, we therefore initiated or changed 16 laws in order to also safeward our entrance into renewable energies and ensure a reliable energy supply' (Bosman, 2012).

Objectives for 2020 and beyond for a sustainable and low-carbon energy

Germany has set ambitious targets for 2030 and 2050:

- Germany has the long term objectives of a share of renewables in gross final energy consumption of 30% by 2030 and 60% by 2050 (EC, 2015f).
- Germany intends to reduce GHG emissions by 40% by 2020, 55% by 2030 and by 80-95% by 2050 on 1990 levels (EC, 2015f).

- In 2013, Germany notified a national target of improving its final energy intensity by 2.1% per year on average until 2020 (EC, 2015f).

3.6.2 German Energy Policy and Regulation Landscape Overview

Energy transition definition

In Germany, the energy transition is translated as the "Energiewende". This concept dates from the 70s, where it emerged from anti-nuclear movements and oil shocks (HBS, 2015). In the early 70's, plans were announced to build a nuclear plant in the village of Wyhl, however it encountered a strong resistance movement across large parts of society. The anti-nuclear movement was one cause for the creation of the Green political party in 1980 (*Ibid*.). Over time, environmental ideas and aversion to nuclear energy have become mainstream in Germany (OSW, 2013). The term "Energiewende" was actually coined for the first time in 1980 in a study by the German Institute for Applied Ecology. This study argues that economic growth was possible with lower energy consumption (HBS, 2015), which resonated with the evolution of German's energy policy in response to the oil crises. Germany suffered strongly from the oil crises which led to policymakers considering energy savings as an important part of the energy policy and a desire to get away from oil, as expressed by the watchword of the 80s 'Weg vom Öl' (Hourcade and Le Peltier, 1988). The 80s were already a decade of energy transition, for Germany already considered moving away from oil and reducing energy consumption by launching energy policies, research and development in the fields of coal, nuclear, energy efficiency, renewable energies and taxes on oil. The 90s were the launching decade for renewables. In 1991, the Feed-in Act was adopted which provided the first feed-in tariffs and stipulated that green power had a priority over conventional power (HBS, 2015). The 2000s were the decade of integration with European energy policy objectives and the launch of the Germany's first integrated Energy & Climate Program in 2007. Currently, the energy transition is seen as "[Germany's] avenue into a secure, environmentally friendly, and economically successful future" (FMEAE, 2015). On July 2015, according to the Federal Ministry for Economic Affairs and Energy (2015), "the governing coalition agreed on a comprehensive package of measures which set the course for a successful energy transition, put a structure in place, and made it possible for the stakeholders to plan ahead. In this way, the Federal Government is making systematic progress on the energy transition. The measures taken are: safeguarding innovation and competition; requiring the electricity providers to meet their obligations to supply, and furnishing them with a reliable basis for their investments; guaranteeing free price formation; ensuring that everything is anchored in the internal European market and backing up the electricity market of the future with a capacity reserve".

In a nutshell, the German's vision of an energy transition is several decades old. While it is largely grounded in anti-nuclear movements and the environmental friendliness of a large part of the population, the current energy policy appears also to rely on an economic discourse, aiming at ensuring Germany's economic competitiveness and increasing employment.

Urgency and pressure on the energy transition

As seen in the previous paragraph, the urgency to transition was already felt in the mid-70s due to a combination of anti-nuclear movements and oil shocks. However, the energy transition gained even more weight with the early recognition of the threat posed by climate change. Indeed, in 1987, the chancellor Helmut Kohl spoke of the "threat of grave climate change from the greenhouse effect" at the German Parliament (HBS, 2015). In 1989, the Federal government launched a study that informed the formative years of German climate policy. This study suggested "early action on climate change was needed in the

face of "overwhelming evidence" [of climate change] (Deutscher Bundestage, 1989). That explains why, already in the 80s/90s, unlike other countries such as the UK, climate mitigation was already part of Germany's energy policy and why the political consensus on the importance of climate change has not been seriously challenged up to today (Kuzemko, 2013; Laes *et al.*, 2014). However, while several actions existed in the 80s and 90s it's only in early 2000 that renewable energies really took off with the Renewable Energy Act voted in 2000 (Laes *et al.*, 2014).

Policy integration

If considering the energy transition from a climate perspective, it is important to note that in Germany, the climate change issue has been closely linked to energy and transport (Beck, 2009).

Germany proposed the National Climate Protection Program in 2000 which targeted 25% of CO_2 emissions reductions from 1990 to 2005. Regarding energy, this programme promoted renewable energies, energy saving, energy retrofits of old buildings, an increase of energy production from CHP and an energy savings ordinance (Beck, 2009). In 2008, Germany's adopted its Strategy for Adaptation to Climate Change. This strategy stipulated that "the Federal Government will:

- Promote cross-sectoral and comprehensive discussion about the German Adaptation Strategy
- Help to ensure that adaptation becomes an integral part of planning and decision processes in all relevant fields of action (Deutscher Bundegstage, 2008).

The first comprehensive package establishing a clear link between energy and climate is the Energy & Climate program of 2007. This package aimed to cut GHG emissions by 40% in 2020 compared with 1990's levels. It comprised 29 measures, mainly focusing on energy efficiency. The cross-areas measures taken were: support programmes for climate protection and energy efficiency; SME programme; operating costs of rental accommodations; CO2-building rehabilitation programme; energy-efficient modernisation of infrastructure; energy-efficient modernisation of government buildings; CO2 strategies for passengers cars; reform of vehicle tax on C02 basis; energy labelling for passenger cars; aviation; shipping; energy efficient public procurement; energy research and innovation; electric mobility.

In 2014, Germany adopted the "Climate Action Programme 2020". The Programme contained around 100 measures in all relevant sectors and incudes a mandate to develop a "Climate Protection Plan 2050" by 2016, which will address all sectors and GHG emissions (EC, 2015f). The 100 measures taken covered:

- Main sectors: energy industry, industry, commerce/trade/services, households, transport, agriculture, land-use and forestry.
- Key policies measures on different sectors than energy: Climate-friendly building and housing strategy; Climate change mitigation in the transport sector; Reducing non-energy- related emissions in industry, commerce, trade and services; waste and recycling management and other emissions; Research and development; Advice, public education and independent initiatives to step up climate action
- Activities undertaken by Länder, local authorities and social stakeholders
- Reporting, monitoring and implementation support for climate change action

It therefore appears that the energy policy in Germany is integrated in the policy making, how the integration results in effective energy transition remains to be answered. However, the existence of monitoring programmes, in the Climate Action Programme 2020 and in the Energy of the Future action of the Federal Government, will bring an overall vision on how Germany's progressing.

Another aspect of policy integration in Germany is how the different policy-making levels are integrated together, for Germany is a federal democracy built on 16 Länder. In energy policy, the federal government

is primarily responsible for introducing legislation and the Länder are responsible for administrative implementation of national law. The individual Länder are involved in shaping energy management and state committees (IEA, 2013). The fact that the Länder have responsibilities in terms of policy implementation was crucial in the nuclear phase-out movement. Indeed, during the nuclear programme of Germany, landers were responsible for the implementation of nuclear plants; landers which were not happy with the nuclear policy could take their time to delay the nuclear plant implementation, which played a role in weakening the development of nuclear power plants. The power of landers is also illustrated by the fact that the German federal energy agency (DENA: Deutsche Energy-Agentur GmbH) was created only in 2000 while there were energy agencies in the Länder already from the end of the 70s (Chappoz, 2012).

Lastly, the responsibilities of different ministries have sometimes caused a problem in terms of energy policy integration. Germany's energy policy spans various areas of state and business activity which fall within the remits of different ministries. Before the Energiewende was announced, this was not a problem because the competences of different ministries seldom overlapped. However, with an undertaking on the scale of the Energiewende, the unclear division of tasks between the various ministries in charge of implementing the Energiewende has created informational chaos and confusion with regard to the division of powers and competences (OSW, 2013). That was particularly true for the Ministry of Economy and the Ministry of the Environment, and the overlapping competences of ministries have triggered criticism from politicians, the media, business associations, experts and public opinion (OSW, 2013).

Institutional structure

Taking a new institutionalism viewpoint, Germany can be classified as a Co-ordinated Market Economy (CME) (such as Sweden, Finland and Denmark). CMEs are associated with social democracy, greater collective capacities and are countries where social and political institutions engage directly, on an on-going basis, in shaping the economy (Hall and Soskice 2001). The international Energy Agency classifies Germany as a Social Market Economy (IEA, 2013). The characteristics of Germany as a CME are (Lockwood, 2011):

- "Patient" finance available as banks and firms have close long-standing relationships and share private information
- Management of firms depends partly on supervisory boards which involve other stakeholders including employees
- Pervasive inter-company relations for facilitating technology transfer, which tends to encourage complementarity through product differentiation and niche production rather than direct competition

In the neo-institutionalism theory, these characteristics help explain why Germany appears as a leader for fostering energy transition. Indeed, its CME characteristics mean Germany tends to adopt a 'co-ordinated' form of discourse enabling long-term coalition building while long-term planning is part of its institutional make-up (Kuzemko, 2013). In this frame, innovations such as renewables, which are keys to Germany's energy policy, are more likely to succeed because they benefit from a coordinated support rather than facing strong competition from incumbents. These CME characteristics are reinforced by Germany's electoral system, which is based on proportional representation. According to Lockwood *et al.* (2013), there is a strong correlation between electoral systems and environmental policy, for proportional representation systems, unlike majoritarian systems do not work against smaller parties (ibid.). This has enabled the Green Party to be a strong voice in the making of current German's energy policy (Lockwood, 2014).

This decentralised, but coordinated, approach plays an important role in the energy transition. Indeed, support for municipalities is strong in Germany and both municipal and regional governments have been highly supportive of various aspects of renewable energy growth, while many municipalities still own energy supply and generation businesses that have given them a vehicle for investment (Lockwood, 2014).

The "social" aspect of Germany's institutional model makes the policy-making process more likely to ask for and take into account the public opinion, which is favourable to pro-environmental policy and the energy transition. For example, a report by the Federation of German Industry, after an unsuccessful transport project, rejected by the local population, recognises the need to achieve a "new consensus" with regard to public approval of infrastructural projects. The report claims that this is a prerequisite of the success of the Energiewende (OSW, 2013). With regard to the energy concept, the German government has launched a permanent political dialogue on the implementation of the concept.

Another consequence of Germany's CME and social economy institutional structure is the growth of energy co-operatives. For RESCOOP, an energy model relying on energy cooperatives is a democratic energy model (RESCOOP, no date).

Initiatives on new sustainable technologies

The support of new sustainable technologies is directly linked with the country's institutional structure in new institutionalism theory. CMEs are more likely to support new sustainable technologies. This is the case of Germany according to Cetkovic and Buzogany (2015) which advocate that the traditional coordinative policy-making style in conjunction with the strong foundational conditions in the research and industrial base and the decentralised federal state structure have enabled Germany to assume a pioneering role and successfully advance all three dimensions of renewable energy transition

For Lema *et al*. (2014), Germany's leading role both in terms of renewable energy deployment and industrial growth can be explained by the existence of a set of conducive factors, the most important being the comprehensive and stable government support. Since the late 1980's, a number of demand-side and supply-side policy measures have been applied and continuously refined aiming at expanding the domestic renewable energy sectors (Cetkovic and Buzogany, 2015). The stable regulatory framework facilitated a relatively easy access to loans and credit for renewable energy investors and the state played a critical role mainly through the activities of the government-owned development bank KFW (Kreditanstalt für Wiederaufbau). According to Meadowcroft (2011), the maintenance of institutions such as the KfW bank, which offers cheap finance to sustainable projects, and the adoption of command-and-control policies have helped to establish new industries around emergent technologies. Germany's policies have offered stable, technology-specific prices to renewable generators (fixed prices from 2000), and a guaranteed market. By providing attractive returns with low risk and ensuring grid connection (Mitchell *et al*. 2006), a key aspect of the feed-in tariff policy was that its benefits could be accessed by a range of groups, including farmers, households, cooperatives, schools, small businesses and municipalities, rather than large energy companies, which were in fact excluded from the policy (Lockwood, 2014). In this last example, the "social" aspect of the German's institutional structure is visible, as it supported a range of actors rather than only big energy companies.

Germany's current highest priorities in R&D are: renewable technologies (photovoltaic, wind energy), energy efficiency measures in the building sector and in industry, crafts, trade and services and measures in energy storage and smart grids respectively (EC, 2015f). These priorities are reflected in the different Energy and Climate packages ad in the 6th Energy Research Programme of the Federal Government (2011).

4 Discussion and conclusion

This deliverable presents the results of task 4.1 of the ENTRUST project. The ENTRUST project explores the human factor in the energy system in order to identify pathways that can help to increase the pace of transitioning from fossil fuels based energy systems to sustainable and low-carbon energy systems. In this project, Task 4.1 focuses on policy-making because energy transitioning is policy-driven (Kuzemko, 2013b).

This deliverable, 'mapping of policy & regulation landscape', provides an "updated picture of the current situation in terms of policies and regulations in a range of European countries". The countries chosen for this study, Ireland, Spain, UK, France, Italy and Germany in their entirety provide a rich variety of perspectives and approaches being taken by Member States and their efforts to transition to low-carbon economic models. For each country a short introduction of its energy system, its infrastructures and history, was explored in order to present their specific contexts in relation to energy policy-making. The energy system of the country is also presented in detail in Appendix 4, with key figures and facts given for the main elements of each country's energy system with their main policies and strategic orientations. Summary diagrams are also presented to allow for a quick overview of the key energy policies in each country and along with its key objectives, policy drivers and issues arising with regards to the energy transition topic.

To synthesise the work undertaken in the task and offer a comparison of these six countries, five comparison tables have been developed to sum up each country's strengths, challenges and objectives, as well as problems inherent to the design of their energy system and how they respond to controversial topics (accessible in Appendix 2).

The extensive research work carried out for this deliverable indicates that there are numerous interlacing factors influencing energy policy-making and the transition potential of one country. These factors include, while are not exhaustively presented below, are as follows:

- The economic and financial situation
- Geographical and geophysical characteristics
- Energy system design and energy demand
- Institutional structure, institutional openness to lobbying and administration efficiency
- Energy market structure
- Political orientations
- Previous policy outcomes and policy practices
- Transport and construction sectors practices and design
- Economic development
- R&D and technical development
- Public opinion and participation
- Major external events (such as external energy shocks, world economic crisis, international political events …)

Each country has responded differently to these factors and their combinations (see Appendix 2) – which helps to explain the variety of energy systems in place – of policy-making and transition potentials. **All these factors influence energy policy-making and the transition potential, but they do not do so in the same way and with the same intensity**. For example, the geographical and geophysical characteristics of each country can highly influence the nature of the energy system in place there and can often either improve or reduce the energy supply options available to them. Very often public opinion does not have the same influencing potential when compared to geographic and geophysical characteristics, but public

opinion can change the structural processes on an energy system and, *ceteris paribus*, can potentially offer new options to transitioning.

For the purpose of T4.1 we set out to determine how policy making can support best practice in terms of energy transitioning, and **it was important to find which influencing factors' can be changed by policy-making and among these, which ones offer the most potential to deliver energy transitioning.** To determine this, are approach was largely informed by new institutional theory.

New institutional theory proposes that the key factors that can be changed by policy-making, and that are the most likely to quicken the delivery of a low-carbon and sustainable energy systems, are the institutional structures and political orientations already in place. Following from this, new institutionalism theory prioritises the **influencing potential of ideas, with institutional systems being key to explaining the outcomes of policies**. It advocates that governance and political choices are related to **interpretive frameworks and concepts that then result in various institutional contexts that deliver specific associated outcomes** (Kuzemko, 2013b). For Lockwood *et al*. (2013) the speed of transition is directly determined by these dominant policy orientations (or paradigms) and the path of transition can be often determined by inertia in specific institutions of the energy system. The challenge of interpretative frameworks is that very often they can be so strong that they can be taken for granted and thus difficult to change (Kuzemko, 2013b).

New institutionalism theory has also determined which elements (termed Success Factors (SF) hereafter) are necessary for a successful transition (Lockwood *et al.*, 2013):

- New practices for a sustainable/low carbon energy system are less costly or more profitable than incumbent
- The risks of such practices and outcomes are sufficiently mitigated
- Institutional arrangements are inclusive
- New practices and outcomes are seen as opportunities for investors and are not too costly for the different energy user groups
- New policies for transition are self-reinforcing (economically and politically)
- Climate change is perceived by policy-makers as a major crisis
- Policy paradigm is consistent and gives strong values to sustainability

While new institutionalism theory advocates that interpretative frameworks at political and policy level directly influence the speed of transitioning and the path of transition, it must be remembered that their influence is also dependent on, and limited by the other factors identified above (i.e. a country's geographic and geophysical characteristics or certain external events).

Taking into account the above success factors, along with the success factors from the climate and environmental policy integration conceptual frameworks, we had developed KPIs to compare each country's institutional and political frameworks and their policy potential to deliver a sustainable and low-carbon energy system. A comparison table is provided in Appendix 3.

Overall, it shall be noted that all six countries have entered an energy transition. Indeed, each country is diversifying its energy mix towards reducing their dependence on fossil fuels, increasing the spread of renewable energy technologies and identifying alternative energy supplies sources. While not all countries have developed a long-term and comprehensive energy roadmap for a low-carbon and sustainable energy system, they do have national plans on either energy efficiency or on renewables, or indeed both, and on the role taken by most notably the construction and transport sectors. **However, the degree of real engagement in this transition, farmed in terms of sustainability and speed, are very different for each**

country. This is due to the differences on how each factor is expressed in one country, resulting in different strengths and challenges, and likeliness to support a comprehensive low-carbon and sustainable energy transition. The objectives set by each country are often in relation with their main weaknesses. For example, in the UK and Ireland there is a strong emphasis on energy efficiency in the building sector because their current building stocks are among the least energy efficient in Europe. The stated objectives also depend on the political orientations and interpretative frameworks of each country. These political orientations influence whether the overall energy policy is consistent, comprehensive, open to public scrutiny/debate and visions on the long-term the benefits of the energy transition. **In this respect, Germany seems to have the most promising political orientations, while Spain appears to lag behind. The UK and France present some strong elements in favour of energy transitioning but this is mitigated somewhat in UK, given that the Conservationist Party is currently in power there and have a different viewpoint on energy transitioning, one which is less favourable. Also, in light of the Brexit vote the UK's transition towards a low-carbon economy has been thrown further into doubt. Ireland has developed an interesting energy policy that shows that its political orientations are largely favourable to an energy transition. Italy's institutional political orientations have led to the development of an energy policy that should deliver an energy transition, but it appears a little less consistent when compared to other countries in the study.**

Results from studies using new institutionalism theory on low-carbon energy transition have found that the current policy paradigms and institutional formations have indeed influenced the current state of energy systems towards a neoliberal economic paradigm (Kuzemko, 2013a; and 2013b). This has been proven true across Europe, which showed how the latest development in the EU common energy policy**, the Energy Union package, affirms and completes the EU energy market liberalisation process started in the 1990s**. According to Ranci (2003), liberalising the whole EU energy sector was the only way to achieve an integrated market, which is one of the central ideals in EU policy-making. However, the liberalisation process took long a long time to be realised. The liberal stance from the Commission was not always compatible with Member States' national interests and in the first decades of European integration, European institutions' ability to act was somewhat limited. Jegen (2014) shows that **the EU managed to establish a European energy policy by referring to areas of key competences other than energy, and inscribed its power in new treaties and by encapsulating its liberal views and objectives under the "Competitive, Sustainable and Secure (CSS)" energy market framework** (Jegen, 2014). Jegen estimates, along with others, that the CSS frame has been successful because it has been taken over and incorporated into the everyday discourses of national policy makers (Jegen, 2014; Jacquot and Woll, 2008). A counterpart to this strategy is that the ambiguity of this framework has allowed national actors to emphasise the specific elements that were congruent to their own national interests (Chester 2010), **resulting in different degrees of institutionalisation of the CSS framework within the various Member States**.

This is actually well-related to the results of this deliverable. For example, Ireland's overall strategy on energy is closely related to the CSS framework of the EU, having stated that "the three key pillars of Ireland's energy policy are security, sustainability and competitiveness". The five other countries do not make such an explicit reference to the CSS framework but their national plans on energy more or less emphasise the link between energy and competitiveness and do comply with EU directives.

Whether the (neo)liberal economic paradigm is the most efficient interpretative framework for energy transitioning remains an open question. In many ways it has proved somewhat counterproductive.

Proponents of the (neo)liberal economic paradigm, including Deloitte (2015), have praised the 3rd EU energy and climate package, referring to it as being based on strong liberal principles that produced unexpected and unintended outputs. Other commentators are not so sure. According to Kuzemko (2013a; 2013b), the (neo)liberal economic paradigm has also created strong relationships between policy-makers and companies, which have been seen in this deliverable to work against an efficient energy transition.

The "models of capitalism" approach, while not answering this question, proposes a differentiated view on how institutions are subject to the neoliberal economic paradigm with regard to the energy topic. This approach stipulates that relationships exist between different energy governance institutions and the wider economic governance structures (Schmidt, 2002). For Lockwood (2011) models of capitalism are deeply embedded in institutions, while Hall and Soskice (2001) differentiate two models of capitalism along:

- Liberal Market Economies such as the UK, Ireland (LME): that rely on market competition and an emphasise individual action; or
- Coordinated Market Economies such as Germany (CME): where the State plays a greater role in shaping the economy emphasising collective over individual goals, and non-market modes of coordination are important, including more extensive collaborative relationships.

Institutions shaped by these two different capitalism models have different approaches to governing energy towards low carbon transitions (Lockwood, 2011) with the following consequences:

- CMEs are better at incremental innovation while LMEs are better at radical innovation. Following this, it comes that CMEs are better at strengthening niche innovation, and therefore are better able to support innovative low-carbon technologies (*Ibid*.).
- CMEs are better than LMEs at innovation aimed at sustainability because industry and government are able to reach consensus on goals through deliberation while LMEs have to rely on arms-length regulation that industry will seek to game and erode (Mikler and Harrison, 2012).

This approach is interesting for it is at least consistent with the findings in this deliverable that show Germany to be leading the way, by a good margin, in realising a sustainable energy transition. In addition, Germany's current Energiewende programme is less related to the EU CSS framework than say the UK and Ireland's current energy strategies. This suggests that Germany appears to be less reliant on neoliberal policy frameworks, as espoused in countries like the UK and Ireland, and also less influenced by the (neo)liberal views of the EC.

The insights and finding in this deliverable offer a suite of interesting perspectives to take forward to task T4.2, which will develop an assessment of Europeanisation in national policy dialogues and will seek to replicate successful policies from the national and EU level. Task T4.2 will investigate whether a compromise is possible, or even desirable, by facilitating Europeanisation through an alignment of countries' political frameworks to the (neo)liberal economic approaches and see whether stronger energy transitions practices in fact weakens market coordination. Other Europeanisation strategies will also be sought and compared. The differences in political orientations, institutional structures and models of capitalism among the various countries will be taken into account establish whether replication of national policies to the EU level is indeed possible.

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6 Appendix 1: Extracts from actions of the Commission, Council and Parliament.

1975:

Council resolution of 17 September 1975 concerning a new energy policy strategy for the Community (EUR-Lex):

"The Council, having taken note of the communication from the Commission of 5 June 1974, "Towards a new energy policy strategy for the Community",

- Recognises that this communication is part of the process of formulating a Community energy policy designed to guarantee safe and lasting supplies under satisfactory economic conditions
- Emphasises that there is an urgent need for a Community energy policy due to the new factors obtaining on the world energy market
- Affirms its political will to draw up and implement a Community energy policy
- Emphasises that this Community energy policies implies close coordination of the positions of the Member States of the Community which will enable it progressively to express a common viewpoint on energy problems vis-à-vis the outside world
- Adopts the following guidelines: (a) as regards energy demand: reduction of the rate of growth of internal consumption by measures for using energy rationally and economically without jeopardising social and economic growth objectives; (b) as regards energy supply: improving security, under the most satisfactory economic conditions possible, by means of the following:
  - Development of nuclear power production
  - The hydrocarbon and solid fuel resources in the Community
  - Diversified and reliable external supplies
  - A research and technological development effort ensuring the required development of the various energy sources".

1983:

Resolution of the European Parliament on the preconditions for an effective policy in the Community in Minutes of Proceedings of the sitting of Friday, 11 March 1983 (EUR-Lex):

Key extracts:

- "Believing that the first precondition for an effective energy policy in the Community is a determination by the Governments of all Member States to ensure that energy supplies are available at economic prices, with minimal risk of interruption, in order to enable social and economic growth"
- "Noting the importance of the Community's coal reserves and the technological skills of its peoples, a third precondition must be recognition of the essential contribution which exploitation of these resources can make to the Community's indigenous energy production capability"
- "Asks that, the Community and each of its Member States take cognizance of the fact that they are faced with a challenge unprecedented since the birth of Europe, the challenge of safeguarding its energy supply, that they commit themselves to taking the necessary measures demanded by such a situation"
- "Asks the Member States of the European Community to work out a common energy strategy to achieve jointly agreed objectives"
- " Considers that the definition and adaptation of a Community energy strategy must necessarily involve for the Community the recognition of a new priority, energy, requiring substantially increased and better coordinated financial resources, that is to say:
  - a substantial increase in the energy and research sector's share of the budget"

1985:

Communication from the Commission to the Council, new community objectives (AEI):

Key extracts:

- "Energy problem"
- "Common energy objectives and the Commission's monitoring role"
- "Objectives: greater integration of the community energy market to improve supply security, reduce overall costs and enhance economic efficiency through increased competition"
- "Reduction of security risks through indigenous energy production, diversification of supply sources, greater system flexibility and effective contingency measures"
- "The balanced pursuit of both energy and environmental aims, particularly through the use of the best available and cost-effective control technologies and through improvements in energy efficiency"
- "Continued promotion of innovative energy technologies through research, development and demonstration"
- "Further improvement of energy efficiency in all sectors to achieve at least a 25% reduction in the overall intensity of final energy demand by 1995".
- "To maintain and if possible increase the present market share for solid fuels. Continued restructuring of the Community's solid fuels production industries".
- "To increase the efforts already underway to develop and commercialise new and renewable energies with a view to tripling their displacement of conventional fuels by the end of the century, enabling them thereby to make a significant contribution to the Community's energy requirements".

1988

Council's recommendation of 9 June 1988 on developing the exploitation of renewable energy sources in the Community (EUR-Lex):

Key extracts:

- "The Council of the European Communities hereby recommends Member States:
- To introduce, where appropriate and necessary, legislation and/or administrative procedures which would help to overcome, on a non-discriminatory basis, obstacles to the exploitation of renewable energy sources
- To pay particular attention to the development of renewable energy sources and to energy savings"

1993:

Council decision of 13 September 1993 concerning the promotion of renewable energy sources in the Community (Altener programme) (EUR-Lex):

Key extracts:

- "Member States shall endeavour to contribute in their energy policies to the limitation of carbon dioxide emissions by taking account of the Community's indicative objectives relating to the renewable energy sources
- The Community shall support a series of actions to promote renewable energy sources within the context of the Altener programme (specific actions for greater penetration of renewable energy sources), hereinafter referred to as the 'programme'.
- The Programme shall last five years
- The amount of Community funds estimated as necessary for implementation of the programme shall be ECU 40 million for the period 1993-1997"

White paper. Growth, competitiveness, employment The challenges and ways forward into the 21st century. Commission of the European communities (EC, 1993):

Key extracts:

"In other words, we are faced with the immense responsibility, while remaining faithful to the ideals which have come to characterise and represent Europe, of finding a new synthesis of the aims pursued by society (work as a factor of social integration, equality of opportunity) and the requirements of the economy (competitiveness and job creation)".

Themes addressed:

- Decentralisation
- Growth
- Competitiveness
- Globalisation
- Unemployment
- Key sector: information, heal
- Information networks
- Trans-European transport
- Energy network
- Telecomunication
- Environment
- Knowledge base economy
- Sustainable development of the industry

1995:

White paper: An energy policy for the European Union (EC, 1995):

Themes addressed:

- Market integration and opening of the internal market
- Competitiveness and environmental protection
- Security of supply
- Community institutional responsibilities
- Sustainable development and environmental protection
- Energy efficiency
- Renewables with Alterner II.
- The role of regions, urban and rural areas.

Key extracts:

- "There is considerable flexibility as to the final shape of the future fuel-mix. The weight given to climate change concerns, the effects of technology and the liberalisation of markets and the fact that some renewables are on the threshold of economic viability will be the major determining factors"
- "The changes implemented by the Community's solid fuels sector have enabled an important part of production to improve its overall competitive position. If this progress is sustained, there is a real possibility that in the next decade, an important share of the domestic production of solid fuels will be fully competitive at world market prices. But in parallel, action has to be pursued to develop and implement even more efficient combustion technologies if solid fuels are to maintain or even increase their share in the long-term".

- "Improving competitiveness and protecting the environment are not necessarily in conflict. Internalisation of external costs and benefits could offer the best and most efficient way of integrating environmental concerns".

2012:

Consolidated version of the Treaty on the Functioning of the European Union. Article 194 (EUR-Lex):

Key extracts:

- "Establishment and functioning of the internal market and with regard for the need to preserve and improve the environment, union policy on energy shall aim, in a spirit of solidarity between MS to:
  - Ensure the functioning of the energy market
  - Ensure security of energy supply in the union
  - Promote energy efficiency and energy saving and the development of new and renewable forms of energy
  - Promote the interconnection of energy networks"

Appendix 2: Comparison tables of energy system problems, main challenges, objectives and strengths and controversies in the six countries

To synthesise the information gathered and offer a comparison of these six countries, five comparison tables have been developed. Respectively these tables compare:

- Problems inherent to each country's energy system: that is, structural problems of the energy system, not specifically linked with energy sustainability issues
- Challenges countries will have to overcome if they are to decarbonise their energy system and make it sustainable
- Countries' main energy policy objectives that have been already adopted
- Countries' main strengths that will ease the transitioning process to a low-carbon and sustainable energy system
- Controversial elements, which cannot yet be classified as being part of a low-carbon and sustainable energy system due to the controversies they trigger

This comparison table gives a score on each of the success factors from the new institutionalism theory and on each of the KPIs developed in this deliverable to assess whether the country has the elements deemed essential for energy transition. The scoring system is presented in Appendix 3.

It imports to not mix up strengths, challenges and scores on success factors and KPIs.

Strengths and challenges presented in Appendix 2 relate to the country's whole potential to energy transition based on an assessment on the whole set of factors presented above. Scores on success factors and KPIs in Appendix 3 assess how the country is performing with regards to the potential of its institutional structure and political orientations and political ideas to deliver an energy transition.

All tables presented in Appendix 2 have been developed based on the content of this deliverable. As a result we present outcomes of these comparisons at general level without entering into a detailed comparison for each score, for the tables cannot be taken for exhaustive.

Table 4: Country comparison: problems inherent to the energy system

Problems inherent to the energy system itself	IE	ES	UK	FR	IT	DE
Electricity public debt		x				
Energy dependency	x	x	x	x	x	x
Electricity overcapacity		x				
High peak periods in cold winter days				x		x
Scarce national energy supplies	x					

Table 5: Country comparison: main challenges to an effective and efficient energy transition

Country's main challenges against an effective and efficient energy transition	IE	ES	UK	FR	IT	DE
Overcoming a unstable/ unfavourable to energy transition and/or non-coordinated/unbalanced policy and unfavourable institutional structure	x	x	x	x	x	x
Reducing very high GHG emissions/very high fossil fuels dependency	x	x				x
Improving public transportations	x					

Improving drastically the efficiency of the building stock	x		x			
Better integration of RES within current system	x			x	x	x
Limiting the influence of certain actors (big energy companies, retired policy-makers …).		x		x	x	x
Developing a long term energy transition strategy		x	x		x	
Overcoming changing ideological orientations			x			
Increasing inclusion in energy debates	x	x	x		x	
Further liberalising energy markets		x		x		
Overcoming low nuclear electricity prices competing with RES electricity prices				x		
Overcoming long administrative procedures for wind and biomass				x		
Ensuring nuclear safety and cleanliness				x		
Overcoming vagueness in energy policy		x				
Country's economic and financial situation		x				
Stabilising the economy of electric and gas systems		x				
Reducing energy costs for end-users		x				
Better supporting RES development		x	x			
Overcoming slow transposition of EU directives		x		x	x	
Overcoming the fact that the energy transition is secondary nowadays		x			x	
Overcoming little will to adopt EE standards in the construction sector	x				x	

Table 6: Country comparison: main objectives adopted for energy system & energy related activities

Country's main objectives already adopted for the energy system and energy dependent activities	**IE**	**ES**	**UK**	**FR**	**IT**	**DE**
Balancing energy debt		x	x	x	x	
Energy independency and security	x	x	x	x	x	x
Reducing energy consumption		x				x
RES objectives >= 20% of primary energy share for 2020	x	x		x		x
Reducing RES development costs			x			x
Green economy growth			x		x	
Sustainable and EE buildings	x	x	x	x		
Reducing GHG emissions	x		x	x	x	x
Mitigating climate change			x			x
Nuclear phase-out						x
Grid expansion	x					x
Energy system transition	x		x	x		x
Energy efficiency	x	x	x	x	x	x
Decarbonised transport sector	x	x	x	x	x	x
Increasing inclusion in energy debates	x			x		x

Markets optimisation	x					
Further development of energy infrastructures	x					

Table 7: Country comparison: main strengths for an effective and efficient energy transition

Country's main strengths for an effective and efficient energy transition	IE	ES	UK	FR	IT	DE
Legally binding documents	x	x	x	x	x	x
Coal phase-out			x			x
Higher subsidies for off-shore wind power			x			x
Gas development			x			x
Low carbon emission				x		
Increasing inclusion in energy debates				x		x
Policy instruments for RES	x			x	x	x
RES investment support	x			x	x	x
Large share of RES in electricity production		x			x	x
Electricity increase and electricity interconnection development	x				x	x
Long term energy policies	x			x		x
Economic growth and energy decoupled						x
Public buy-in of renewables encouraged					x	x
Green energies linked with competitiveness, innovation & jobs						x

Table 8: Country comparison: controversial topics

Controversial topics	IE	ES	UK	FR	IT	DE
Nimbyism linked to major energy developments	x		x		x	
Regulation against major energy developments in protected areas			x			
Shale gas controversies	x		x			
Nuclear development			x	x		
No shale gas				x		
Nuclear dislike	x				x	x

Crosses have been given to most important topics, an empty cell does not necessarily mean that the country does not work or support the topic. In a nutshell, the tables present the most important items for each of the six countries.

Appendix 3: Comparison table on success factors and key performance indicators

All tables presented in Appendix 3 have been developed based on the content of this deliverable. As a result, we present outcomes of these comparisons at general level without entering into a detailed comparison for each country, for the tables cannot be taken for exhaustive.

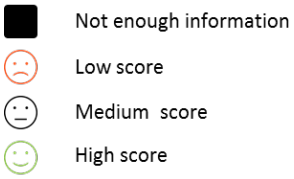
Table 9: Country comparison: success factors and KPIs to assess political and institutional potential for energy transitioning

Success factors (SF) and KPIs	IE	ES	UK	FR	IT	DE
Success factors[7]						
New practices for a sustainable/low carbon energy system are less costly or more profitable than incumbent ones	😐	☹	🙂	😐	😐	😐
The risks of such new practices and outcomes are sufficiently mitigated	■	☹	■	😐	😐	😐
Institutional arrangements and structure are inclusive	■	☹	☹	😐	☹	🙂
New practices & outcomes are seen as opportunities for investors and are not too costly for the different energy users groups	■	☹	■	■	😐	😐
New policies for transition are self-reinforcing	😐	😐	🙂	😐	■	🙂
Climate change is perceived by policy-makers as a major crisis	■	☹	😐	😐	☹	🙂
Policy paradigm is consistent and gives strong values to sustainability	😐	☹	😐	😐	😐	🙂
KPIs[8]						
Comprehensive and consistent energy transition definition	😐	☹	😐	😐	😐	🙂
Urgency of transitioning acknowledged at policy-making level	😐	☹	😐	🙂	☹	🙂
Energy policy is integrated and consistent	😐	😐	😐	😐	😐	😐
The institutional structure is favourable to energy	■	■	■	■	■	■

[7] From new institutionalism theory
[8] Elaborated by LGI, from new institutionalism theory, climate and environmental policy integration frameworks

transitioning	
New sustainable energy technologies and social innovations are supported or have a potential to grow	

This table has served to assess whether countries' institutional framework and political orientations have the potential to deliver efficiently a transition to a low-carbon and sustainable energy system.



Low score: SF or KPI, as described in the left column, is far from being reached, or policy is unsupportive

Medium score: policy developments and current energy system is on track to achieve the KPI/SF as described in the left column but there remains barriers

High score: policy developments and current energy system are on line with the SF/KPI as described in the left column

Not enough information: we judged that the information provided is insufficient to give a score

7 Appendix 4: Country overviews

7.1 Ireland

7.1.1 Energy supply and its related regulation

Fossil Fuels

Ireland has a heavy reliance on fossil fuels. Demand for fossil fuel in 1990 stood at 98.2% share of Total Primary Energy (TPER). Demand for fossil fuels increased during the years 2000 to 2005, correlating to a period of strong economic growth, but demand has since reduced during the intervening period. Fossil fuels accounted for 91.4% of all energy used in Ireland in 2013, excluding the embodied fossil fuel content of imported electricity. Demand for fossil fuels fell by 3% in 2013 to 12,181 ktoe, and has fallen 20% overall since 2005 (SEAI 2014a) The most significant change in the type of fossil fuel used is the marked reduction in the use of [high carbon] coal and peat, and the increase in the use of [low carbon] natural gas over the 1990 — 2013 period, although it should be noted that while the use of natural gas dramatically increased over the period, its use declined in the 2010 — 2013 period. The use of coal decreased — from a 22.0% share of TPER to 9.9%; the use of peat decreased — from a 14.5% share of TPER to 5.4%; and the use of natural gas increased — from 15.2% to 29.0%. (SEAI 2014a)

The following series of pie charts provide a breakdown of the various fossil fuels contributing to Ireland's energy mix. Figure 25 shows the energy demand according to sector for the years 1990 and 2013 respectively.

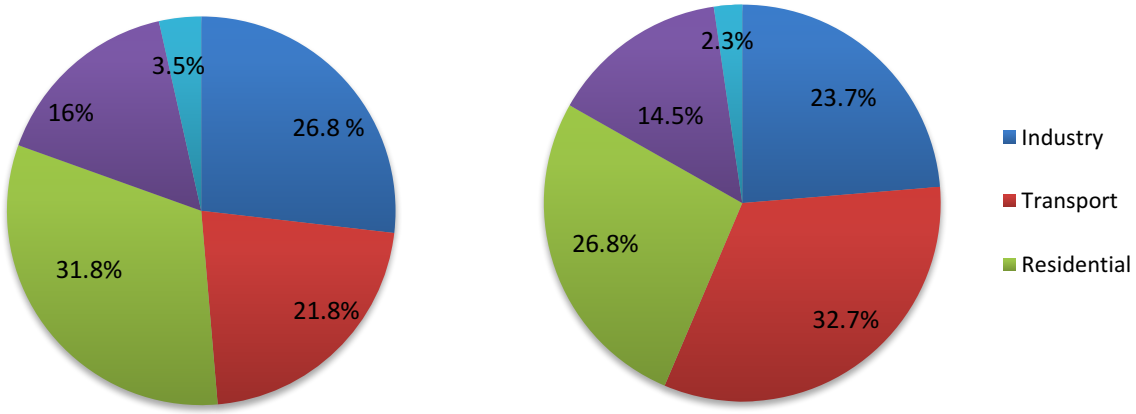


Figure 25: Ireland's primary energy requirement by sector, 1990-2013 (Howley *et al.*, 2014: 11)

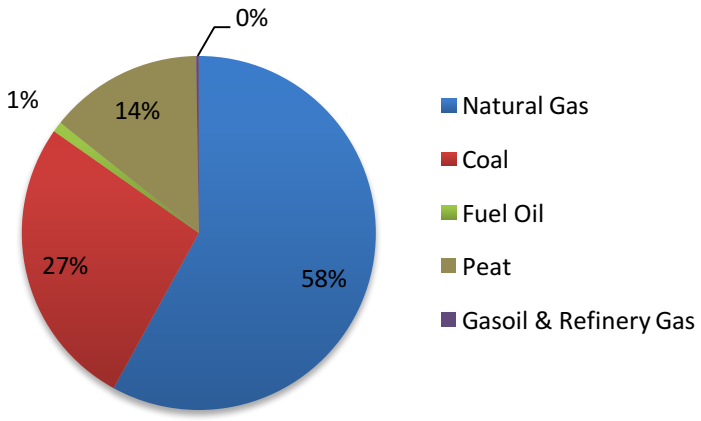


Figure 26: Electricity Generation in Ireland by fossil fuel type, 2013. (Howley *et al.*, 2014: 11)

Coal

Ireland has a single coal-fired power plant that is operated by the ESB — Moneypoint — which is approaching its end of life in 2025 (DCENR 2014) The use of coal in industry has decreased in recent years; and residential coal use has decreased also. While there were some fluctuations, year on year, from 1990 to 2013, the rate of the use of coal has reduced by 36.5%, moving from a 22% share of Total Primary Energy (TPER) to a share of 9.9%. Ireland has three Coal Acts, The Coal Mines Regulation Act 1887, The Coal Mines Check Weigher Act 1894, and The Coal Mines Weighing of Minerals Act of 1905 (All three pre-date independence from British rule, and are from a time when coal was mined in Ireland.) Ireland imports most of its coal today from Columbia (58%), South Africa (16%) and Poland (11%), as well as smaller amounts from Asia, Germany and the UK (SEAI, 2011, p55).

In large urban areas, the widespread use of 'smoky coal' (bituminous fuel) for domestic heating, was responsible for producing significant episodes of severe winter smog. A ban on the marketing, sale and distribution of smoky coal was first introduced in Dublin in 1990 in an effort to tackle winter smog. The ban was effective in reducing both smoke and sulphur dioxide levels. The ban was subsequently extended to other areas, and now applies to over 30 towns and cities. More recently (September 2015), it was announced that the bituminous (smoky) coal ban is to be extended nationwide, with the ban on marketing, sale and distribution of bituminous coal being extended to the burning of bituminous coal.

The following figure represents the coal-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the coal sector in Ireland are presented.

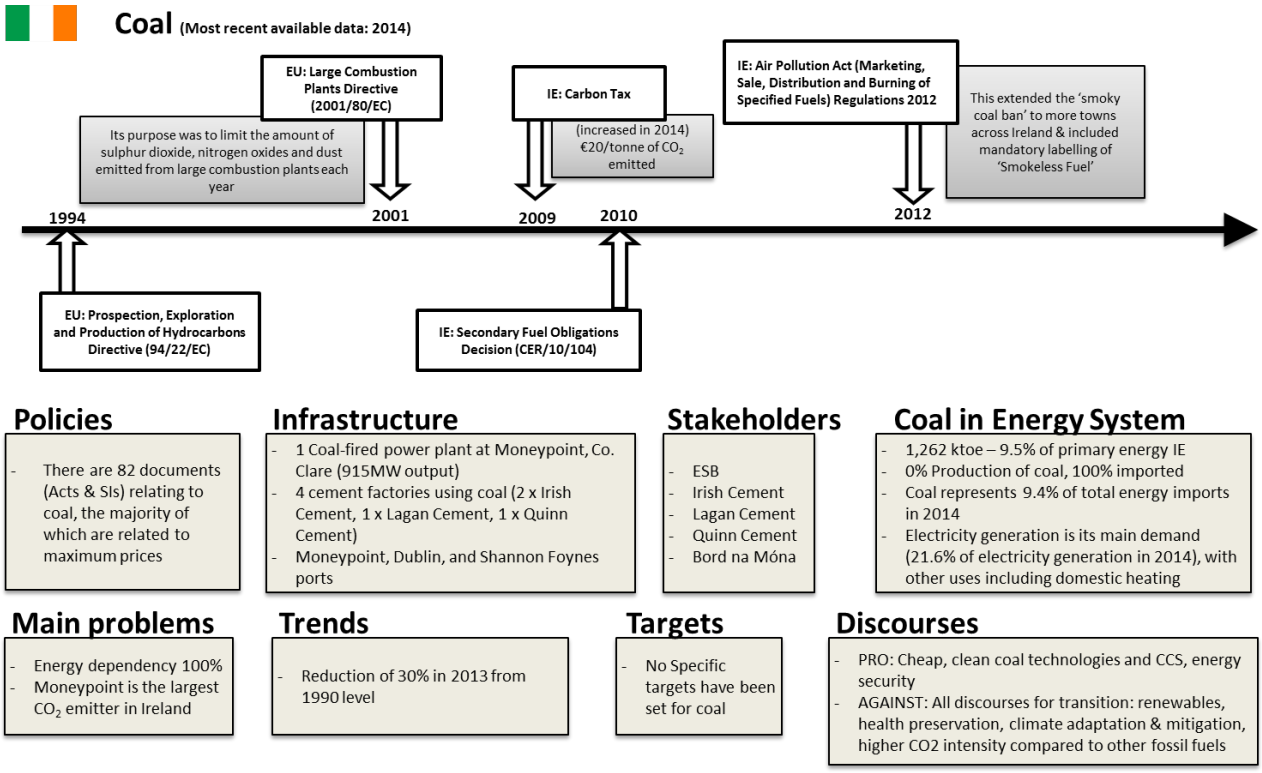


Figure 27: Irish policy & regulation overview on coal

Oil

Ireland has a single oil refinery, at Whitegate in County Cork. Imports of oil consist of the refined product (that which has been processed elsewhere) or shipments of crude oil that are housed in storage terminals at Bantry, County Cork, before being refined at this facility. The Whitegate Refinery supplies 25% – 30% of the Irish market, with approximately a third of the final product exported abroad. Efforts to purchase this facility in 2014 by a private entity ultimately failed given its importance as a strategic national asset.

Ireland is not an oil producing country – however it relies very heavily on oil in its overall energy mix, and oil remains the dominant energy source, increasing from a share of 47% in 1990 to a peak of 60% in 1999; however it has subsequently fallen back to 47% in 2013. Consumption of oil, in absolute terms, increased by 0.3% in 2013 to 6,262 ktoe, although it is still 28% lower than it had been during the boom era. Over the eight years 2005 – 2013, oil demand fell by 31% (4.6% per annum). Two thirds of the oil used was in transport, with the final third being used for thermal energy (SEAI, 2014a). The increase in the consumption of oil during a period in which the overall consumption of fossil fuels has decreased can be linked to increased economic activity, and in particular increased transport energy use. It is estimated that 630 million litres of biofuels — 283 million litres of bioethanol and 346 million litres of biodiesel — are required to achieve the 10% renewable energy in transport target (DCENR, 2014 GP).

The following figure represents the oil-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the oil sector in Ireland are presented.

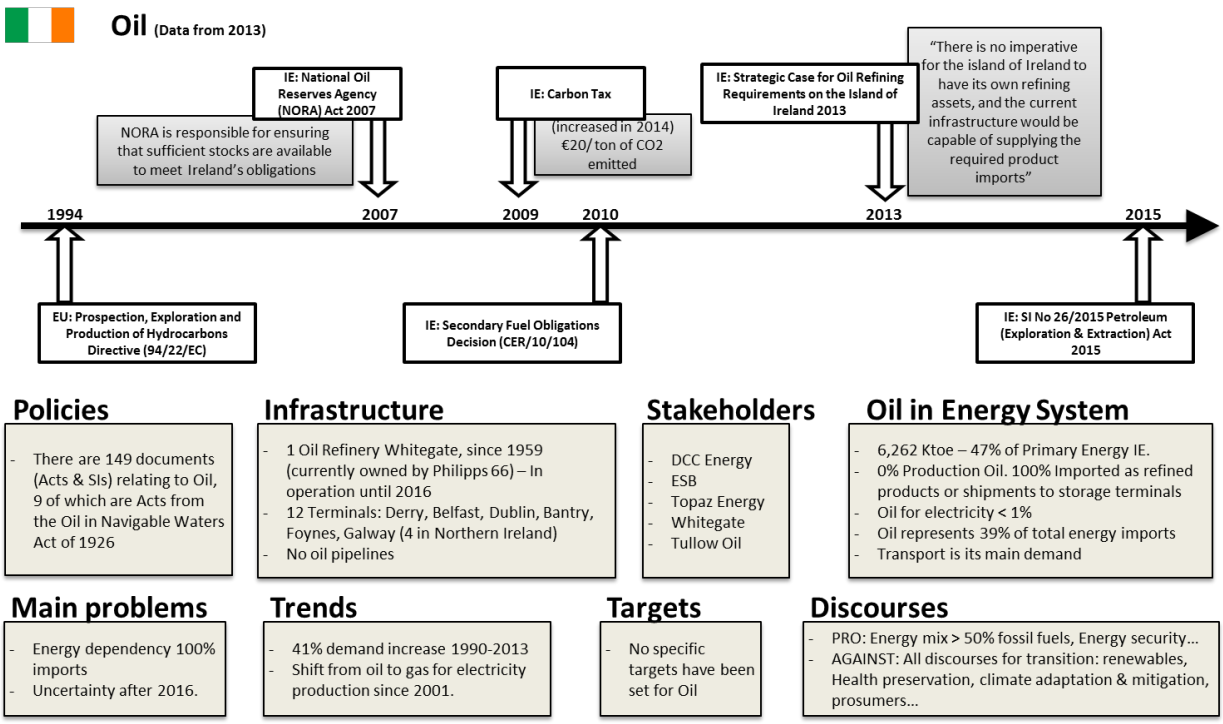


Figure 28: Irish policy & regulation overview on oil

Gas

The most significant gas pipeline in the state is at Bellanaboy in County Mayo, which brings natural gas from Ireland's only operational gas field The Corrib Gas Field located some 83 kilometres offshore. As mentioned earlier, it has generated significant local and national opposition during its construction and is set to become operational in late 2015. The Corrib Gas Field is estimated to be about 70% of the now exhausted Kinsale Gas Field and will have an estimated 15-year lifespan.

Over the period 2005 – 2013, natural gas use has increased by 11% (1.4% per annum). In 2013, the consumption of all fossil fuels, with the exception of oil, decreased. However, natural gas use fell in 2013 by 3.7% to 3,872 ktoe and its share of TPER was 29%. This decrease may be attributed to several reasons. For example, space-heating requirements were lower due to the mild winters. In addition, high gas prices during the period may have led to a switch to an alternative fuel source (SEAI, 2014a).

The following figure represents the gas-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the gas sector in Ireland are presented in Figure 29.

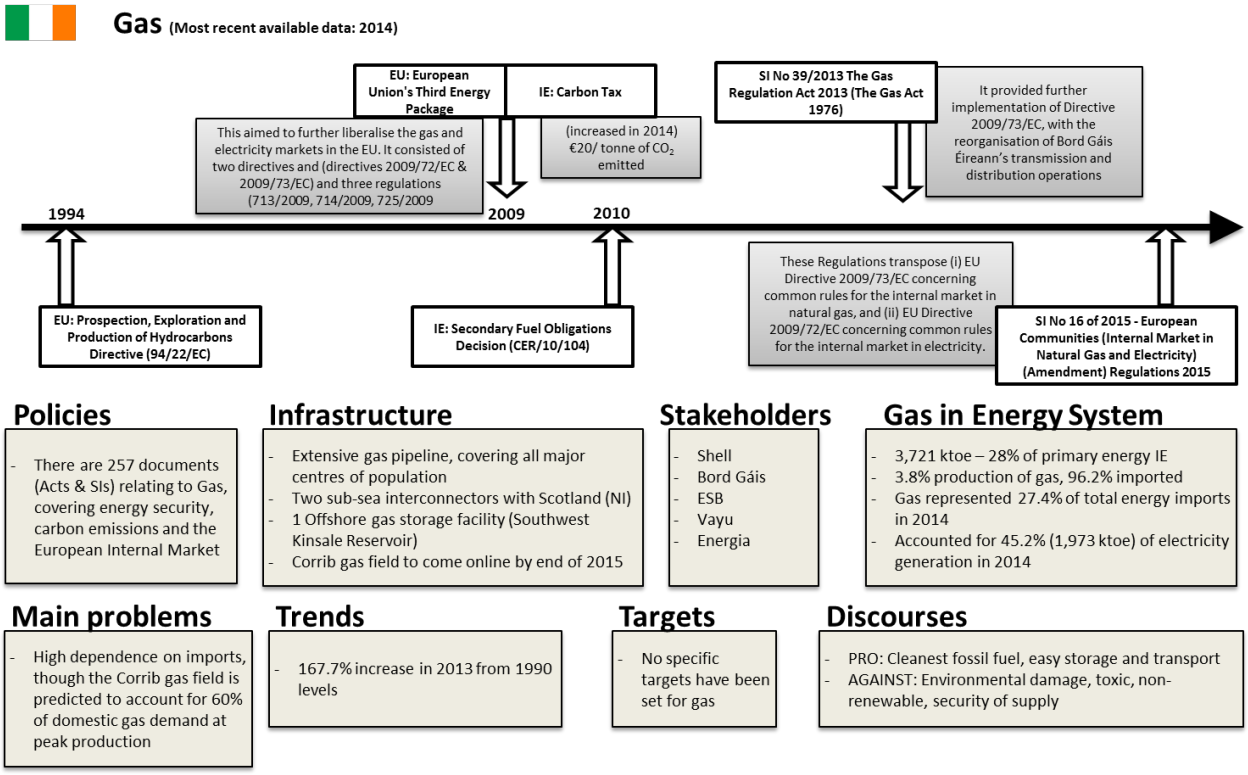


Figure 29: Irish policy & regulation overview on gas

Peat & Biomass

Peatlands cover 1.03 million hectares of the Republic of Ireland, with 7.5% of those peatlands in the ownership of the State-owned Bord na Móna. Peat as fuel for energy consumption comes in three forms: milled peat; sod turf; and peat briquettes. Residential consumption of peat includes both sod turf (sometimes 'hand cut'), and peat briquettes (made from compressed peat) — both sod turf and peat briquettes are classified as smokeless fuel. There are three peat-fired power stations in Ireland that burn milled peat, although these are being phased out. It is Irish Government policy to replace peat with biomass in electricity generation with the ambition of co-firing 30% biomass with peat by 2015 as set out in the Government's White Paper on Energy (2007). Bord na Móna announced that it will fully cease harvesting peat commercially for energy use by 2030, instead the company will develop a range of sustainable businesses and activities including the development of biomass, renewable energy (including wind and solar), resource recovery, and horticulture, amongst other new sustainable businesses (Bord na Móna 2015). The consumption of peat was substantially reduced over the 1990 — 2013 period with an overall reduction of 47.5% in its share of TPER from 14.5% to 5.4%, with a 9.8% reduction in consumption in 2013 alone (SEAI 2014a).

The following figure represents the biomass and peat-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the biomass and peat sectors in Ireland are presented.

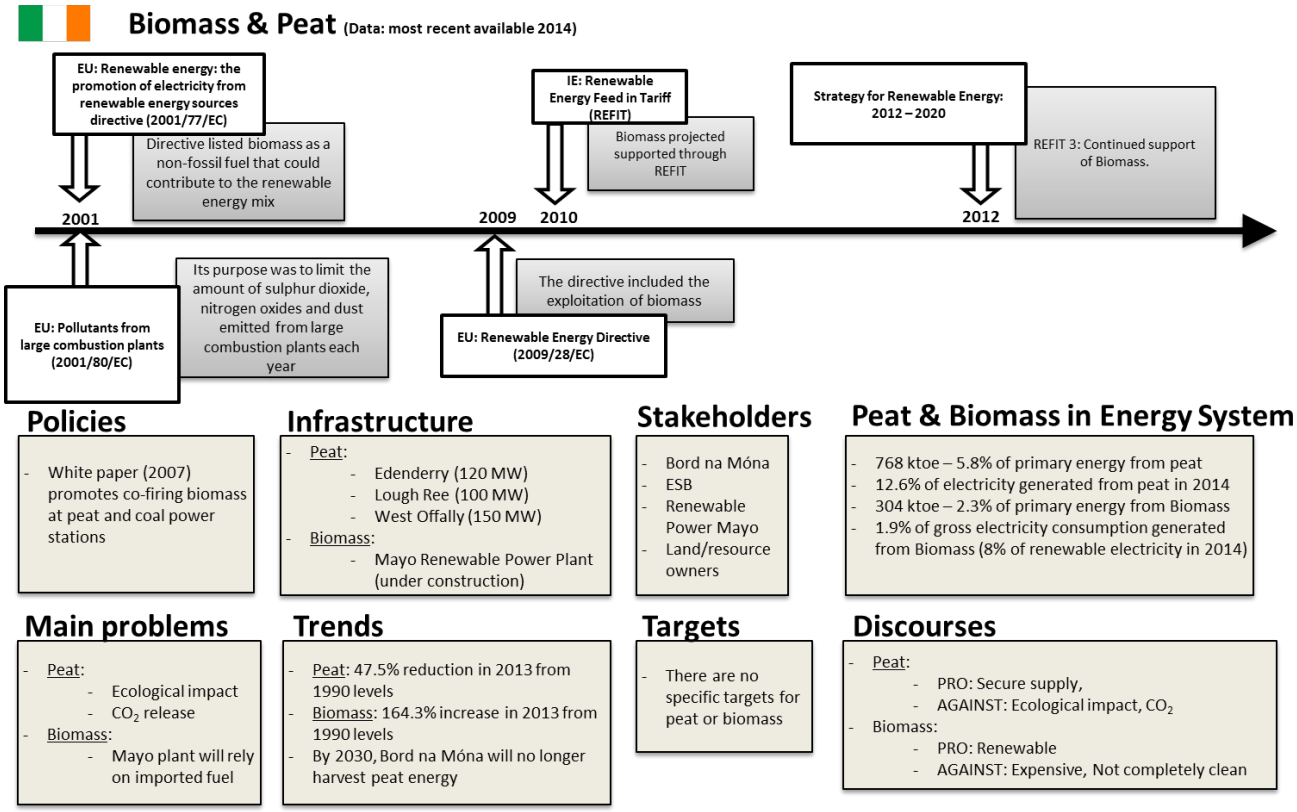


Figure 30: Irish policy & regulation overview on biomass & peat

There is a lot of potential for biomass in Ireland due to the extremely favourable growing conditions and climate. Bioenergy, in general, is encouraged in the Government White Paper on Energy. The dominant form in Ireland is wood biomass, in both the residential and industrial sectors. Since the Irish Government published its 2007 Energy White Paper, it has set targets for co-firing wood biomass at the three existing state-owned peat power stations (Dept. of Agriculture, 2015). The ReHeat Programme provides support to commercial, public and industrial sectors for the installation of wood chip and wood pellet boilers. The Governments Bioenergy Plan is currently in Draft Stage, and was drawn up in 2014 (DCENR, 2014).

Nuclear energy

Despite receiving broad political approval from the main political parties this development was met with almost immediate opposition from non-establishment groups and from the general public largely informed by nuclear accidents such as the 1957 Windscale (now Sellafield) fire disaster in the UK. Hostility to nuclear power was galvanised by a number of anti-nuclear action groups culminating in a series of protest marches and concerts at the Carnsore Point site between 1978 and 1981 titled "Get to the Point" and "Back to the Point". The partial nuclear meltdown at Three Mile Island, USA, during this period contributed to taking nuclear power off the political agenda entirely as politicians saw popular public support evaporate for the project. After the NEB failed to develop a nuclear power plant at Carnsore Point its role changed from a nuclear advocate to that of an environment-focused nuclear watchdog. It sponsored a number of reports on nuclear power plants in the United Kingdom, most notably the Sellafield Power Station in Cumbria. In 1992 it was succeeded by the Radiological Protection Institute of Ireland (RPII), which was itself subsequently merged with the Environmental Protection Agency in 2014.

As a consequence, Ireland does not have a nuclear energy sector, and there are no nuclear power stations in Ireland. The generation of electricity by nuclear fission is prohibited in the Republic of Ireland under the Electricity Regulation Act, 1999 (Section 18). However, a portion of the electricity that Ireland imports through the East-West Inter-connector is generated by the Wylfa nuclear power station in Wales, as well as other British nuclear power stations.

During the 1970s there were proposals for a nuclear power station to be built by the ESB at Carnsore Point. However, following protests and intensive lobbying from anti-nuclear and environmental groups, and strong public opposition, plans to build the nuclear power station were shelved. However, in the intervening years nuclear energy has, somewhat, come back onto the agenda in Ireland. A Government commissioned report from Forfás (the national policy advisory board for enterprise, trade, science, technology and innovation in Ireland) recommended the building of a nuclear power station in order to lessen Ireland's oil dependence and to provide energy security. (Forfás 2006) Nuclear Energy is discussed in the Green Paper on Energy Policy in Ireland (DCENR 2014) where the possibility of building a 'fourth generation' nuclear reactor in Ireland is mooted. However, there remains strong public opposition to nuclear energy in Ireland, and given the potential public backlash against such a proposal, it is not likely that such a proposal will find political support in the near future.

Renewable Sources

Renewable energy technologies in Ireland have seen steady growth in recent years. For the purposes of this section the discussion of the renewable energy contribution to the Irish energy mix is divided into thermal energy (RES-H) and electricity generation (RES-E).

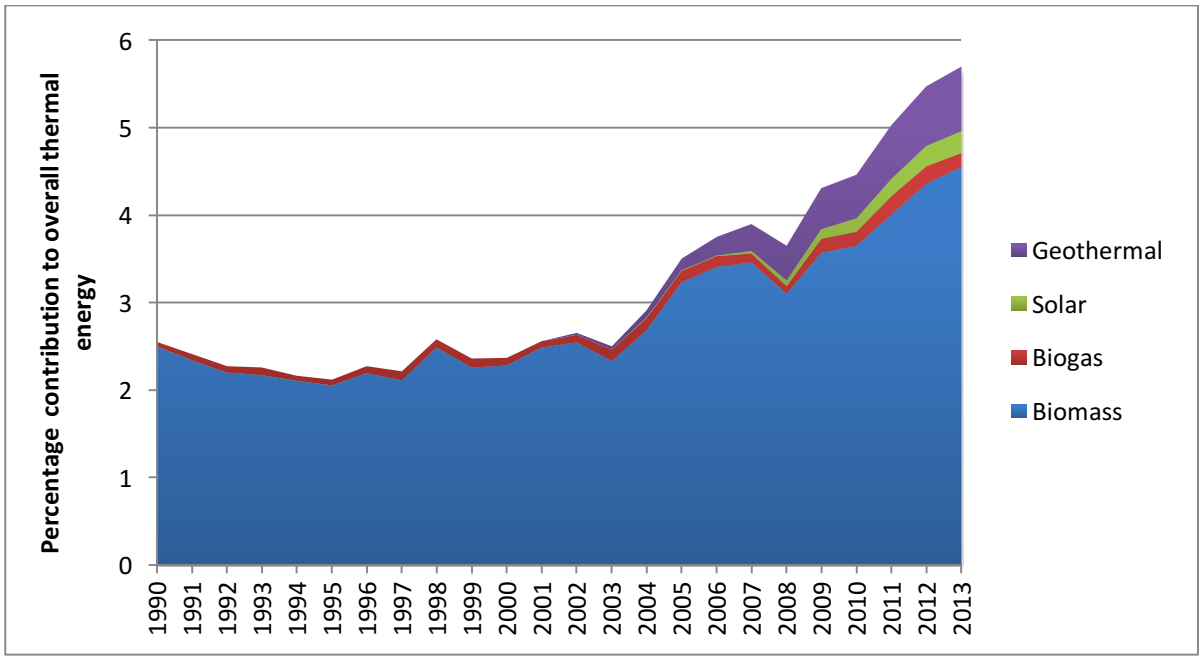


Figure 31: Renewable Energy Contribution to Thermal Energy RES-H (SEAI, no date)

Figure 25 illustrates the contribution renewable energy technologies have been making to Ireland heat/thermal energy portfolio. The rise in activity from specific sub-sectors of industry, along with a number of SEAI operated incentives for residential biomass heat systems, has meant that renewable energy use has more than doubled in the period 1990 to 2013, from 108 ktoe to 255 ktoe, which represents a growth of 134%. The share made by renewable energy to the overall thermal energy portfolio stood at

5.7% in 2013, while the national target outlined in the government's Energy White Paper is 5% of all heat to come from RES by 2010 and 12% by 2020.

As one can see from Figure 31 above, the trend was not always upwards, but rather follows a series of dips and spikes. In the early 1990s, there was a decline in RES use in thermal energy from 2.6% in 1990 to 2.1% in 1995. However, the period 2000 to 2013 saw RES-H grow from 2.4 % to 5.7%, and was dominated by biomass (mostly as a result of increased use of wood waste as an energy source in the wood products and food industries). The more recent uptake in renewable energy use in both the residential and services sectors is as a direct result from supports and grant schemes made available by government, along with revisions to the building regulations that required a share of the energy demand to be derived from renewable sources.

When one see the significant contribution made by biomass in the above graph, one should note that it comprises primarily of wood, wood wastes (firewood, wood chips, barks, sawdust, and shavings), as well as other solid wastes (including straw, oat hulls, nut shells, tallow, meat waste and bone meal), and the renewable wastes from industrial and municipal activities. Much of the biomass is subsequently burned directly for heat, or is used in combined heat and power (CHP) units, by industry while the rest is used in the residential and commercial units (SEAI, 2015c).

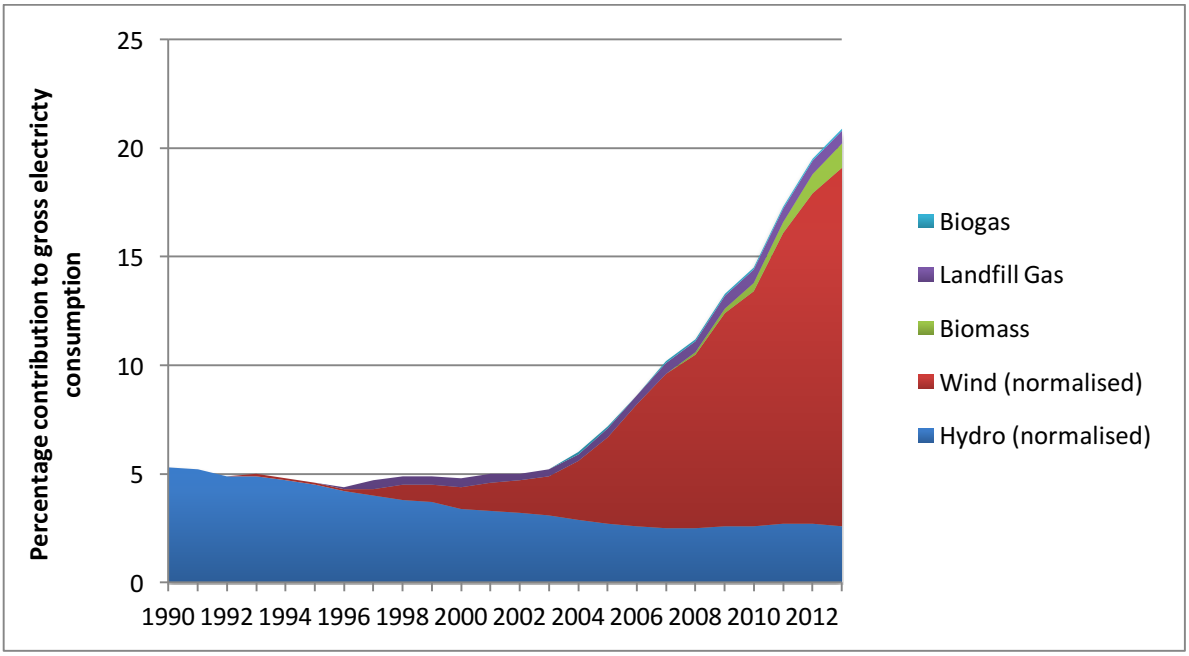


Figure 32: The contribution of renewable energy to gross electricity consumption (SEAI, no date)

The 2007 government White Paper set the national target for electricity generation from renewable sources (RES-E) at 15% by 2010 and 33% by 2020. In the 2008 Carbon Budget, the 2020 target was further revised and extended to 40% of gross electricity consumption to come from renewable energy. This decision was taken on the back on SEAI estimates that 40% RES-E will be required if Ireland is to meet the EU Renewable Directive (2009/28/EC) target of 16% renewables in gross final energy consumption. The contribution that renewable energy has made to gross electricity consumption from 1990 - 2013 is illustrated in the graph above. Historically, hydro was the largest contributor to renewable electricity in Ireland, one that we alluded to earlier citing the case of Ardnacrusha during founding years of the Irish state. However, this contribution has declined in percentage terms post-1940s. Since 1990 it has seen further decline, as the graph above shows. One should also note that electricity produced from wind energy

has increased since 1990 to reach the point where it accounted for 81% of the total renewable electricity generated in 2013, while electricity generated from biomass (the next most significant RES-E contributor) accounted for 9% of renewable electricity in that same year. Wind, hydro and biomass-generated electricity accounted for 16.3%, 2.1% and 1.7%, respectively, of Ireland's gross electricity consumption, making the total contribution from RES to gross electricity consumption in 2013 reach 20.1% (compared to 4.9% in 1990). Figure 33 below shows the transformation of RES contributions with data from 1990 and 2013 respectively.

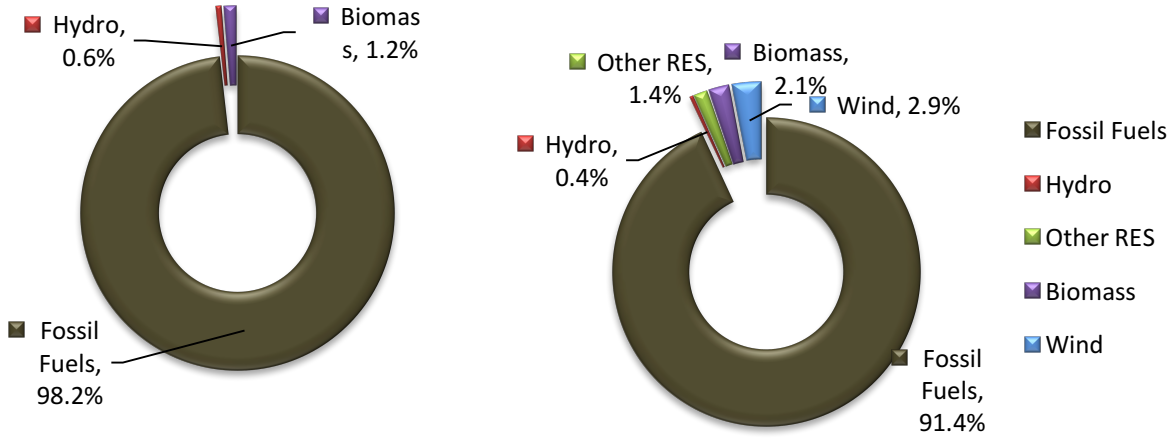


Figure 33: The share of RES contributing to Ireland's primary energy mix, 1990[9] and 2013[10]. (adapted from Dineen *et al.*, 2015: 17)

It is interesting to note that, according to SEAI (2015b) statistics, the majority of RES consumed by industry comes from biomass and renewable wastes generated in the manufacturing of wood products, with the residential, commercial services and food & beverages sectors accounting for the rest. The total amount of wind energy generated is transformed into electricity and fed straight into the national grid.

Renewables related regulation

As required by Article 4 of the Renewable Energy Directive 2009/28/EC, each Member State is required to adopt a national renewable energy action plan (NREAP) to be submitted to the European Commission. European Commission Decision EC(2009)5174 of 30 June 2009 established the template for the NREAP. Ireland submitted this plan in July 2010. Progress reports are also required, and Ireland has submitted two such reports, the first in January 2012 and the second in February 2014 (DCENR, 2015). This plan set out the government's strategic approach and measures to deliver on Irelands 16% target under the directive and following on from the policy set out in the governments White Paper on energy 2007.

The Strategy for Renewable Energy 2012–2020 was published by the Department of Communications, Energy & Natural Resources in 2012. This strategy affirms the Government's view that "the development of Ireland's abundant indigenous renewable energy resources, both onshore and offshore, clearly stands on its own merits in terms of contribution to the economy, to the jobs and growth agenda, to environmental sustainability and to diversity of energy supply." (DCENR 2014: 11a) It sets out the Government's over-

[9] Note the absence of wind energy
[10] Note the remaining 1.8% (unaccounted for here) consists of electricity imports and energy generated from non-renewable wastes

arching policy goals, and the key actions required to support the development of the various renewable energy sectors in the short to medium term, thus providing the strategic framework for the NREAP.

The Electricity Regulation Act of 1999 (and subsequent amendments) sets out the function for the Commission for Energy Regulation (CER), which includes granting of authorisation, and licensing to companies or persons wishing to construct power stations or other means of electricity generation. This includes both large and small-scale operations, and renewable energy technologies. Integrated Pollution Control Licencing, Impact Assessment, and/or Waste Licensing might also be required for such facilities as provided for under the EPA (Environmental Protection Authority) Acts of 1992-2007 and the Waste Management Act of 1996. The Habitats Directive 92/43/EEC (together with the Birds Directive 2009/147/EC), particularly where the development is within, or adjacent to, a Special Area of Conservation / Natura 2000 network site, may also be relevant. All facilities will fall under the remit of the Planning and Development Act of 2000 and subsequent amendments, but, depending on the size the facility, there may also be requirements to comply with the Planning and Development (Strategic Infrastructure) Act 2006. This will also determine if the facilities will require planning permission from the relevant Local Authority, or whether the applicant will need to apply directly to the national planning board — An Bord Pleanála. An Bord Pleanála is an independent, statutory body that decides on appeals on planning decisions made by local authorities in Ireland. Since 2007, An Bord Pleanála directly decides on major strategic infrastructural projects, such as roads, railways, and large-scale wind farms, for example, under the provisions of the Planning and Development (Strategic Infrastructure) Act 2006 bypassing the local authorities. The Board also hears applications from local authorities for projects that would have a significant environmental impact. Very small projects, such as solar panels on the roof of a dwelling no longer need planning permission, as they are now essentially a requirement under the Building Regulations (1997-2014) in order to comply with Part L of the regulations with regards conservation of Fuel and Energy.

In July 2015 the Minister for the Environment, Community, and Local Government announced an organisational review of An Bord Pleanála. This is due, in part, to the expanding remit of An Bord Pleanála, including that of foreshore licensing under the proposed Maritime Area and Foreshore Bill, and co-ordination of “projects of common interest” such as cross-border energy infrastructure projects, as well as the anticipated increase in construction activity — including strategic infrastructure projects and Strategic Development Zones (SDZs).

Wind

Ireland’s first modern commercial onshore Wind Farm comprising 21 wind turbines was installed in 1992 at Bellacorrick in Co. Mayo. There are now 195 wind farms in operation in the Republic of Ireland, (IWEA, 2015) with an installed wind energy capacity of 2395MW. Ireland has excellent potential in the form of wind energy due to the geography, topography, climate and the location of the island of Ireland. However, local opposition to large-scale wind development can be significant at times. Many developments are stalled, refused, or at the very least strenuously objected to in the planning and development stages through the various local authorities or at An Bord Pleanála if the project is significant enough to warrant a Strategic Infrastructure application in accordance with the SEA Directive 2001/42/EC. Small to Mid-Size community level or co-operative wind-energy schemes are extremely uncommon in Ireland. The Government White Paper on Energy (DoCMNR, 2007) places a strong emphasis on wind energy (as opposed to solar, or other renewables) and pledged to invest over 7bn through the semi-state bodies (which were at the time, BGE, ESB, Bord na Móna and EirGrid) mainly in electricity and gas transmission and in wind energy projects as per the *Wind Energy Development Guidelines for Planning Authorities 2006.* The White Paper

describes wind energy as being the "pivotal" (DoCMNR, 2015: 26) contribution to Ireland's renewable targets for 2020. Figure 34 illustrates the rapid deployment in wind energy technologies from 1995 to 2013. After a small dip from the middle of 2010 to late 2011, electricity production from wind energy is on the increase again.

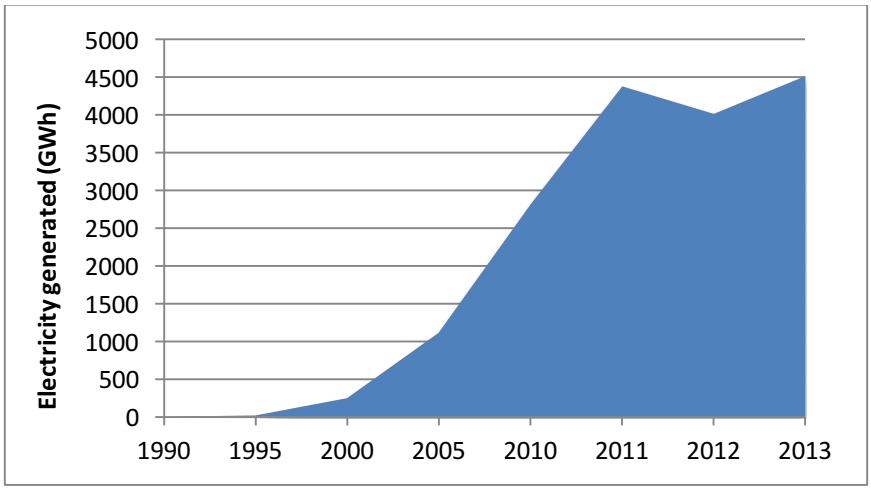


Figure 34: Growth of renewable electricity generated from wind (GWh), 1990 – 2013 (adapted from Dineen *et al.*, 2015: 25)

While the focus in Ireland has been on the development of onshore wind generation, the Strategy for Renewable Energy (2012) gives specific consideration to the offshore wind and ocean energy sectors in the context of energy policy to 2020. The REFIT 2 scheme [discussed below] includes onshore wind only — based on the assumption that Ireland's 2020 renewable targets will be met by onshore wind generation primarily — however, it is envisaged that the primary development opportunity for offshore wind to 2020, and beyond, is the potential to export energy generated offshore to the UK, as well as potentially to the North West European energy market in the longer-term.

The following figure represents the wind energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the wind energy sector in Ireland are presented.

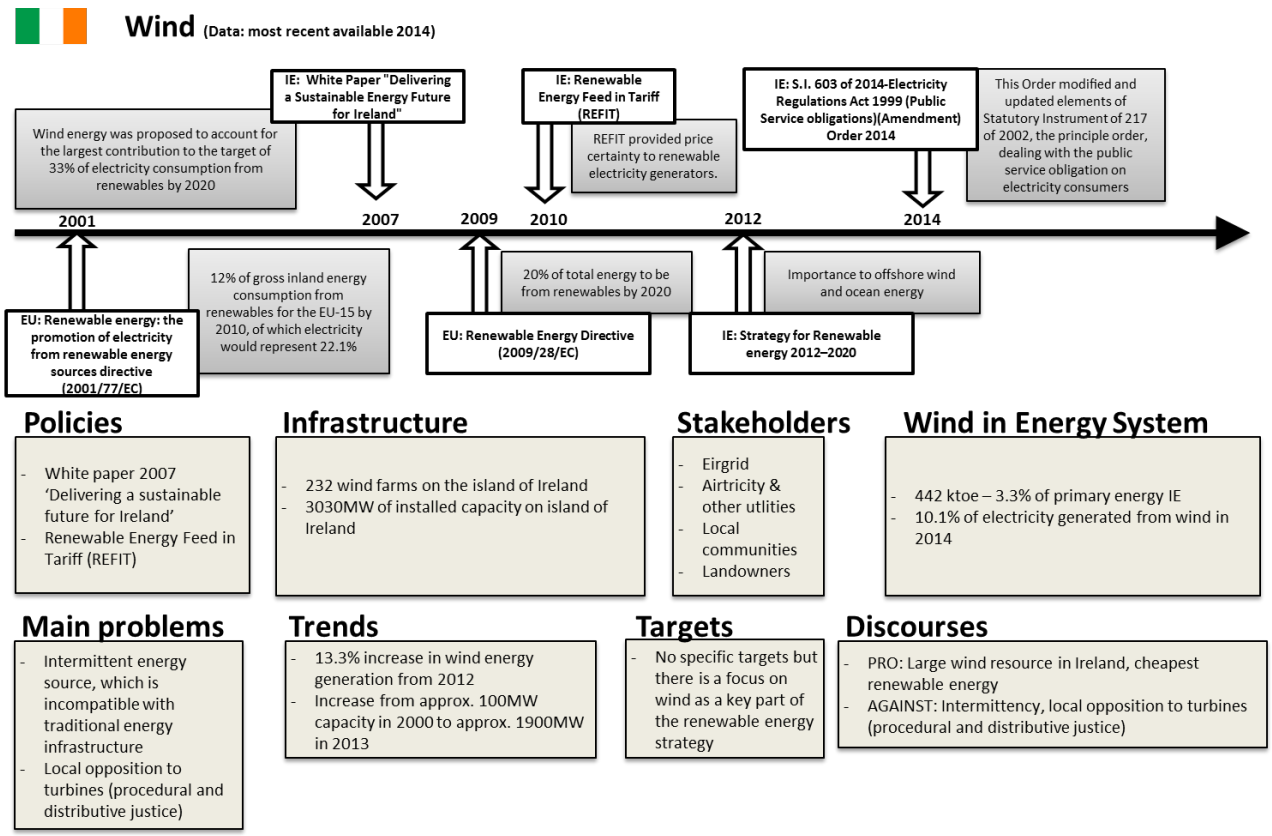


Figure 35: Irish policy & regulation overview on wind energy

Solar

Ireland does not have any large scale or commercial solar arrays, or solar farms as yet — however, international companies such as Lightsource and Amerenco Solar have expressed an interest in developing this market in Ireland (McCabe, 2015). State-owned Bord na Móna has also expressed its intention to develop solar farms as part of its move from commercial peat production to develop sustainable businesses. (Bord na Móna, 2015). Solar thermal power (mainly for water heating) has become much more common in recent years – mainly on a small scale, in the residential sector. The Government White Paper on Energy discusses solar power in these terms also, i.e. installation at the individual household level. (DCENR, 2007). With the updating of the Irish building regulations 1997-2014, in line with the Energy Performance of Buildings (EPBD) Directive 2002/91/EC, which was originally transposed into Irish Law in 2006, and the subsequent EPBD Directive Recast 2010/31/EU, solar panels for thermal heating are now seen as a basic essential for compliance with the renewables requirements of the directive and national regulations. They are also a popular choice for retrofitting of existing dwellings due to the financial incentives available such as The Better Energy Homes Scheme, where homeowners can apply for up to €1200 grand aid towards a solar thermal system, or the Accelerated Capital Allowance Scheme (ACA) which is a tax incentive for companies to invest in energy efficient equipment such as solar heating or electricity technologies. Solar Photo-Voltaic (PV) panels, for the production of electricity on the small scale are generally much less common than solar thermal panels.

The following figure represents the solar energy-related policies and regulations in the last years. Below the timeline, an overview of the different elements that have driven the solar energy sector in Ireland are presented.

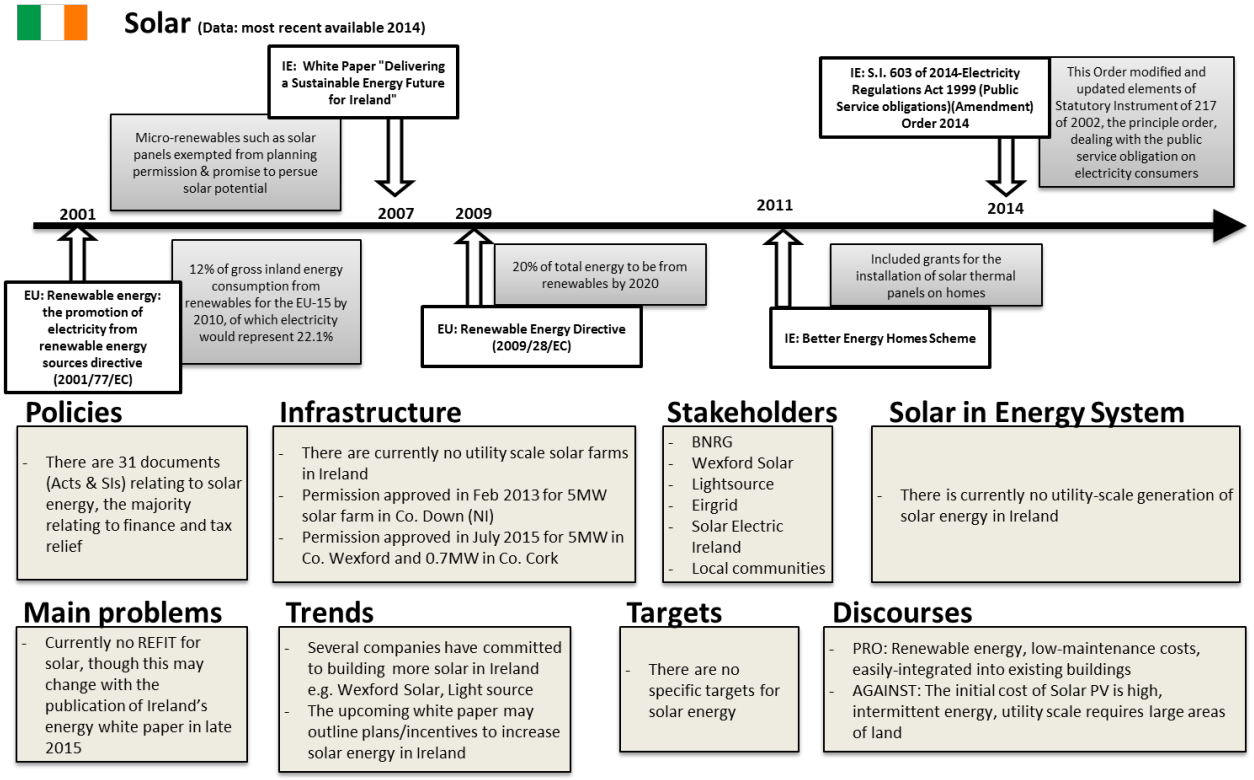


Figure 36: Irish policy & regulation overview on solar energy

Biogas and waste

There is a lot of potential for biomass in Ireland due to the extremely favourable growing conditions and climate. Bioenergy, in general, is encouraged in the Government White Paper on Energy. The dominant form in Ireland is wood biomass, in both the residential and industrial sectors. Since the Irish Government published its 2007 Energy White Paper, it has set targets for co-firing wood biomass at the three existing state-owned peat power stations (Dept. of Agriculture, 2015). The ReHeat Programme provides support to commercial, public and industrial sectors for the installation of wood chip and wood pellet boilers. The Governments Bioenergy Plan is currently in Draft Stage, and was drawn up in 2014 (DCENR, 2014).

The government also pledged to increase the use of Biofuels in its White Paper on energy. This included setting biofuel targets of 5% of the fleet of public transport vehicles run by CIE (Coras Iompar Éireann), The Irish Transport Authority, Dublin Bus and Bus Éireann. In 2013 the weighted share of biofuels as a percentage of petrol and diesel energy use was 4.8%, up from 0.5% in 2007 and 3.9% in 2012. The un-weighted share of biofuels was 2.8% in 2013, up from 2.4% in 2012. There is now also a Biofuels Obligation Scheme (BOS) which was given effect in law by the Energy (Biofuel Obligation and Miscellaneous Provisions) Act 2010 and places an obligation on suppliers to ensure that 6.383% (by volume) of the motor fuels (generally gasoline and motor diesel) they place on the market in Ireland, is produced from renewable sources, e.g. ethanol and biodiesel. Under the terms of the National Oil Reserves Agency Act 2007 (Returns and Biofuels Levy) Regulations 2010, a Biofuel Level of 2% per litre is payable on the sales of all biofuels on the market. (NORA, 2015)

The following figure represents the biogas-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the biogas sector in Ireland are presented.

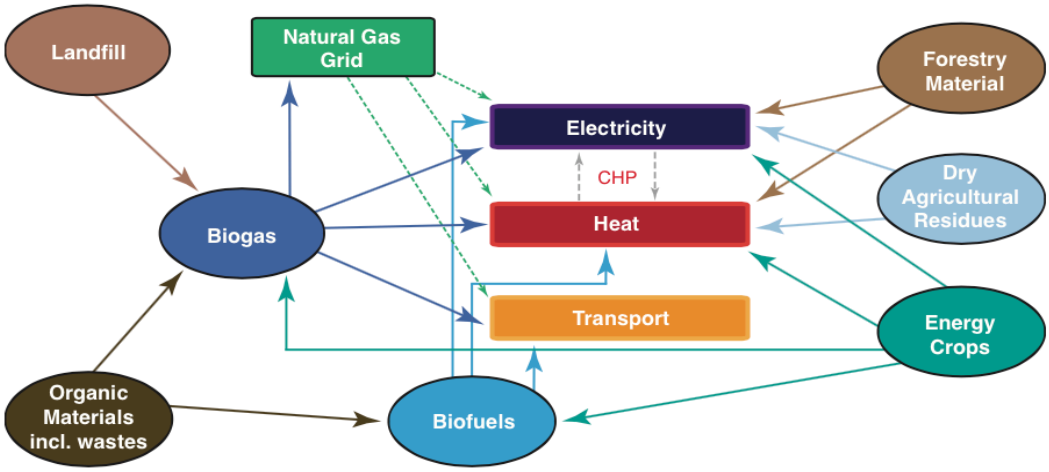


Figure 37: Potential Bioenergy pathways outlined in the Bioenergy Plan (Draft) 2014

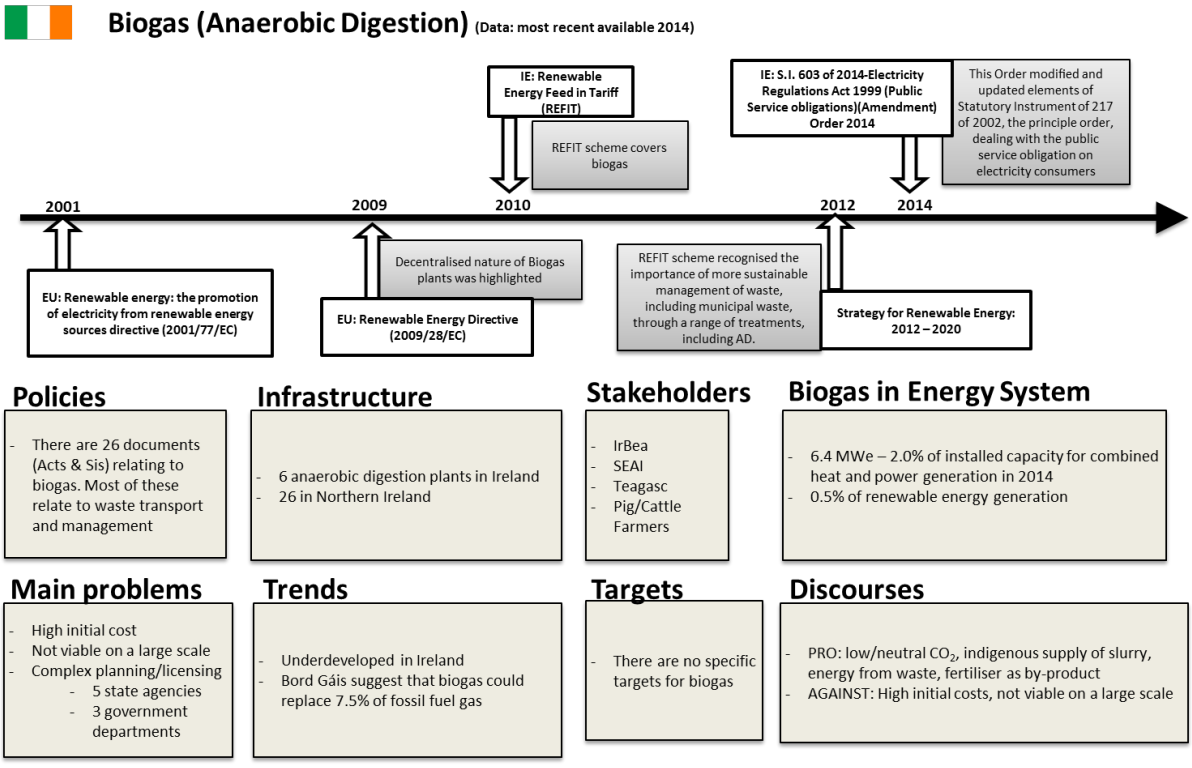


Figure 38: Irish policy & regulation overview on biogas

Hydropower and tidal

Two hundred years ago there were thousands of small water mills all over the island of Ireland, but these have all long since been abandoned. Ireland's first commercial scale hydro-powered plant for electricity generation was built in Ardnacrusha, Co. Clare in the 1920s, and is one of a handful of Irelands largest power stations, and is still in operation today. Ireland currently has over 50 hydro power stations, though many of them are very small, serving only one building, or a small collection of buildings (SEAI, 2015). The government has published guidelines on the Planning, Design, Construction and Operation of Small-Scale Hydo-Electric Schemes and Fisheries, through the Department of Communications, Energy and Natural Resources and Fisheries Ireland. Hydro power stations of any size must not breach any of the requirements

of the Water Framework Directive (2000/60/EC) WFD and national regulation transposing the WFD e.g. S.I. No 722 of 2003 European Communities (Water Policy) Regulations 2003.

There is a scheme available to small and large-scale wind, hydro, and bio-energy facilities called the REFIT scheme, i.e. Renewable Energy Feed-In-Tarrif Scheme. The original REFIT scheme now known as REFIT 1 closed in 2009, this was superseded by REFIT 2 which came into operation in 2012 for wind, hydro and biomass/landfill gas, and the closing date for this scheme is December 2015 (DCENR, 2015). The REFIT 2 scheme includes onshore wind only. A Third scheme, REFIT 3 was designed to incentivise the addition of 310MW of renewable electricity capacity to the Irish grid composed of High efficiency Combined Heat and Power (using both Anaerobic Digestion and the thermo-chemical conversion of solid biomass), biomass combustion and biomass co-firing. This will also close in December 2015. The department is currently considering new schemes to replace these as their closing date is approaching soon.

The Strategy for Renewable Energy (2012) gives specific consideration to the offshore wind and ocean energy sectors in the context of energy policy to 2020. Whereas the REFIT 2 scheme includes onshore wind only, based on the assumption that Ireland's 2020 renewable targets will be met, primarily, by onshore wind; the development opportunity for offshore wind to 2020, and beyond, is identified as the potential to export energy to the UK, as well as the North West European energy market in the longer-term. The strategy also identifies the strong potential for Ireland to become a world leader in developing and testing the next generation of offshore renewable energy equipment.

Unlike hydro-power, which is a well-established technology in Ireland, both Tidal, and Wave Energy are still in their infancy, although, as noted above, they have very strong potential to be developed as major generators of renewable energy. Ireland has a sea area of 900,000 square kilometres — ten times that of its landmass. Irish territorial waters contain some of the best offshore renewable energy (wind, wave and tidal) resources in the world, this offers enormous potential for generating carbon free renewable electricity. The Strategy for Renewable Energy 2012–2020 (DCENR 2012) is intended to provide the overarching strategic framework for the NREAP. As part of this strategy, the Irish government has given closer attention to the many potential benefits of harnessing the ocean's potential for generating sustainable energy — both for domestic use, as well as for export. Recognising the necessity for coordination across a range of policy areas, the Offshore Renewable Energy Development Plan (OREDP) outlines the framework for the sustainable development of Ireland's offshore renewable energy resources, setting out the key principles, policy actions, and enablers to develop and deliver on sustainable energy generation, and to support the offshore renewable sector to reach economic viability. The OREDP is a framework that is intended to provide a mechanism for coordinating policy, and its implementation, across three key areas — energy, environment and economy. The government established the Offshore Renewable Energy Steering Group (ORESG) to coordinate the implementation of the OREDP across the three work streams — Environment, Infrastructure and Job Creation and Growth.

The majority of the Irish foreshore belongs to the Irish State, and its management, and planning consents regarding its use, are governed by the Foreshore Act 1933, which has undergone little amendment since its enactment. In recognition of the importance of development planning, and foreshore lease licences as critical factors enabling the development of offshore renewable energy, responsibility for all foreshore functions, including energy-related developments, were assumed by the Department of Environment, Community and Local Government (DECLG) in 2010 with a view to streamlining the planning process. Foreshore licensing, as well as the co-ordination of other "projects of common interest", such as cross-border energy infrastructure projects, will be assigned to An Bord Pleanála.

Following consultation, a General Scheme of the Maritime Area and Foreshore (Amendment) Bill was published in October 2013 (DCENR 2014). The Bill newly defines a *Maritime Area* encompassing the foreshore, the exclusive economic zone (EEZ), and the continental shelf. It has three main aims: to align the foreshore consent system with the planning system; to provide for a single Environmental Impact Assessment for offshore projects; and, to provide a coherent mechanism to facilitate and manage development in the EEZ and on the continental shelf. The final version of the bill is due to be published during the Autumn/Winter 2015 session.

In order to successfully develop offshore renewable energy resources, the Irish Government recognises that significant investment in infrastructure will be required—both in Ireland's onshore electricity grid and in the infrastructure of Irish ports.

Significant resources have been established with the aim of researching and developing offshore energy in Irish waters — with a view to potentially positioning Ireland as a research, development, and innovation hub for the deployment of marine renewable energy technologies and services. The Sustainable Energy Authority of Ireland (SEAI) has supported 65 technology projects developing ocean energy in Ireland.

Receiving funding from both Irish and European sources, Marine Renewable Energy Ireland (MaREI) is a national-scale marine and energy-based research, development, and innovation hub that combines the expertise of a diverse, multi-disciplinary range of research groups and industry partners. The operational centre is based in Cork Harbour, and the research team is composed of internationally recognised experts drawn from a wide range of academic institutions, as well as from industry. MaREI supports the R&D requirements of the marine and energy industries, both in Ireland and abroad. MaREI provides innovative, tailored, technological solutions to companies through its industry-led research programme.

In October 2015 the Irish Government announced the allocation of €3.5 million to three Irish marine energy firms for the development and testing of new ocean energy technologies. The companies will receive the funding through the Sustainable Energy Authority of Ireland (SEAI). Ocean Energy has been awarded €2.3 million from the Irish Government and €4.5 million form the US Department of Energy to design and build a full-scale version of their Ocean Energy Buoy wave energy converter. Over €1 million has been allocated to SeaPower to test their wave energy converter at quarter scale in Galway Bay. And €200,000 has been allocated to GKinetic Energy to conduct towing tests of their tidal turbine system in Limerick Docks.

The following figure represents the hydropower-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the hydropower sector in Ireland are presented.

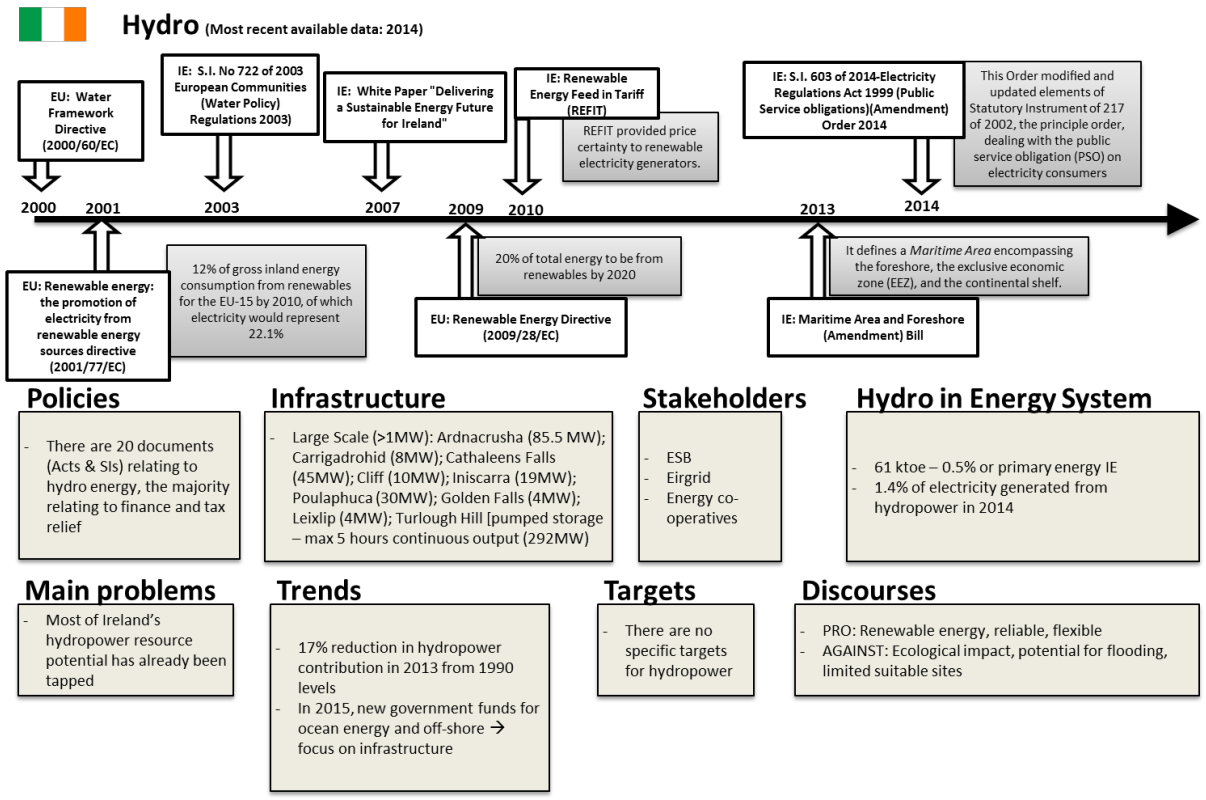


Figure 39: Irish policy & regulation overview on hydropower

Electricity

Ireland, like most developed economies since the 1980s, continues to migrate much of its energy requirements to electricity. Electricity consumption as a percentage of the overall consumption increased from 14% to 19% between 1990 and 2013. This has led the paradoxical situation where energy demand continues to increase despite steady declines in the overall energy intensity of both the energy sources and technologies needed to meet that demand. In 2013, the final consumption of electricity rose by 0.2% to 2,081 ktoe (or 24,202 GWh), accounting for 19% of final energy use. Final consumption of electricity increased in both the industry & services sectors by 1.4%, but fell in the residential sector by 2.1%.

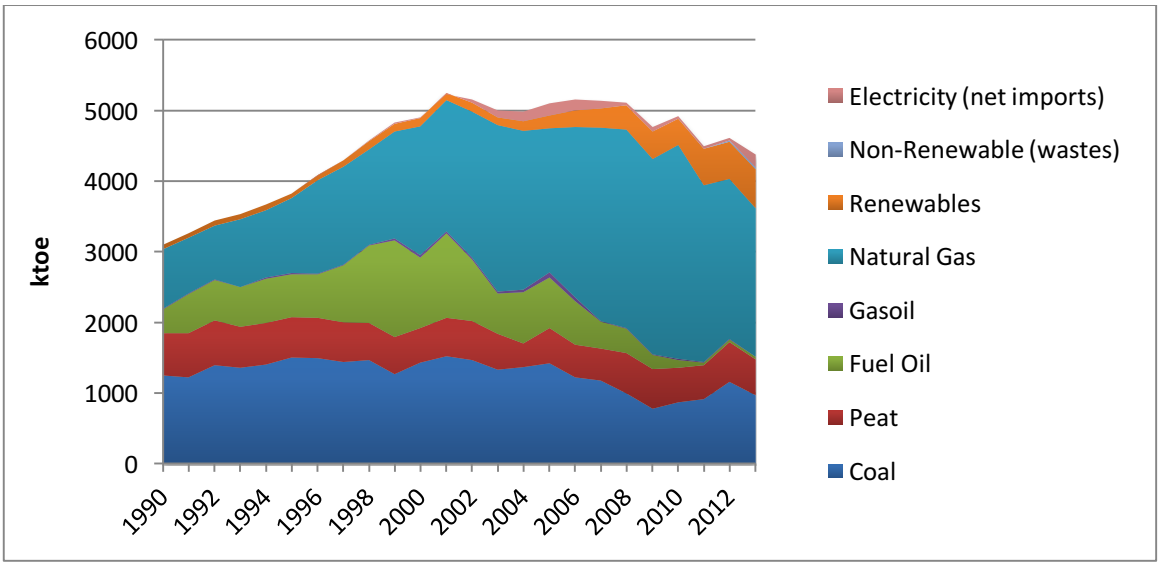


Figure 40: Primary fuel mix for electricity generation, 1990 – 2013 (SEAI, no date)

As one can see from Figure 40 above, the shift from oil to gas since 2001 is very noticeable. The decline of coal since 2005, along with a short peak 2012 is also evident. The fuel inputs to electricity generation contributed to one third (33%) of Ireland's total primary energy requirement in 2013. One can also see from the graph that the primary fuel requirement for electricity generation grew from 3,094 ktoe in 1990 to a peak of 5,237 ktoe in 2001, before declining to 4,376 ktoe in 2013. This 69% increase between 1990 and 2001 correlates to the rapid expansion of the Irish economy during this period. The period 2001 to 2004 saw the requirement fall by 4.7%, while the final consumption of electricity actually increased by 10%. In 2013, 4,376 ktoe of energy was used to generate electricity, a 16% drop from peak levels in 2001. The fuel inputs to electricity generation amounted to one third (33%) of the total primary energy requirement in 2013. Overall, between 1990 and 2013 electricity consumption, as a share of total final consumption, rose from 14% to 19% during that period. Figure 41 shows the breakdown of electricity production according to energy source used in Ireland during 2013 and a breakdown of electricity consumption by sector for 2014.

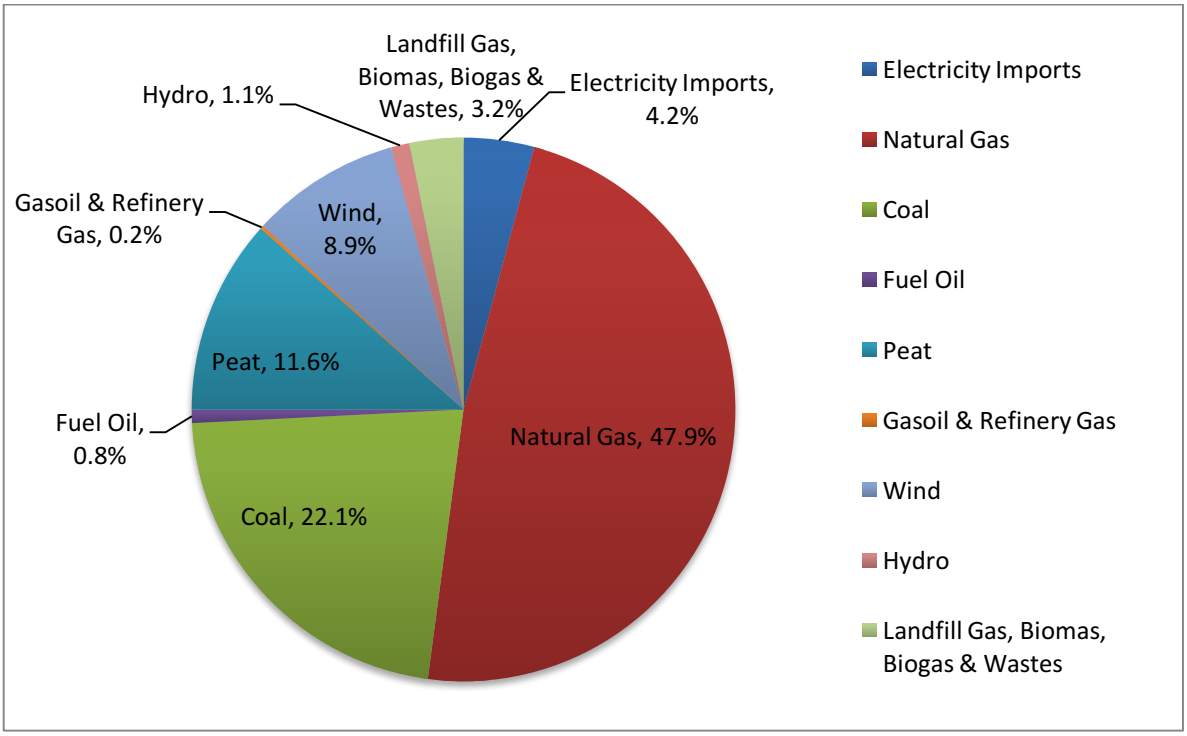


Figure 41: Breakdown of electricity production according to energy source used in Ireland, 2013 (adapted from Howley *et al.*, 2014: 11)

All electricity customers in Ireland pay a Public Service Obligation **(**PSO) Levy, which is a tax that has been used to subsidise schemes the national government deems to be supportive of its national policy objectives related to renewable energy, indigenous energy sources (primarily peat) and securing energy supply. Monies collected from the PSO Levy are used to ameliorate the costs from PSO-supported electricity generation that cannot be recouped through revenue means. The Commission for Energy Regulation (CER) is responsible for setting the PSO Levy, though it does not have any discretion over the terms of PSO schemes themselves. Its role is solely to calculate the levy and to help ensure that it is administered properly. The PSO levy generated approximately €335.4 million for the 2014/2015 year. Table 9, below, shows the different PSO levy schemes and how they are applied.

Table 10: Breakdown of PSO Levy Schemes in 2014 (CER, 2014: 12)

PSO Scheme	Technology Supported	MW of Plant Eligible	MW of Plant supported in

			2014/15 PSO Period
AER	• Onshore & offshore wind (onshore wind constitutes most of AER) • Small-scale hydropower • Combined heat and power (CHP) • Biomass (landfill gas) • Biomass-CHP • Biomass-anaerobic digestion	718	128
REFIT 1	• Onshore wind (constitutes most of REFIT 1) • Hydro • Biomass landfill gas • Other biomass	1450	1370
REFIT 2	• Onshore wind (constitutes most of REFIT 2) • Hydro • Biomass Landfill Gas	4000	499
REFIT 3	• Biomass Combustion • Biomass CHP • Anaerobic Digestion	310	5
Edenderry	• Peat, biomass (co-firing)	120	120
Lough Ree	• Peat	100	100
West Offaly	• Peat	150	150
Aughinish Alumina	• Gas – CHP	160	160
Tynagh	• Gas (Combined Cycle Gas Turbine - CCGT)	400	400

7.1.2 Energy Efficiency

Article 24 of the Energy Efficiency Directive requires each Member State to submit a National Energy Efficiency Action Plan (NEEAP) every three years. Ireland's third NEEAP was published in 2014. In the NEEAP 2014 it is stated that the Government recognises that reliable, sustainable, affordable energy is vital to Ireland's economic success; and that it remains committed to meeting its obligations under the directive, to implementing the necessary energy efficiency policies, and to continue to invest in energy research and infrastructure. The NEEAP 2014 states that by the end of 2012 Ireland had reached 39% of our 2020 target — this represents primary energy savings of 12,337 GWh; and that there is steady progress with regard to the 33% target set for the public sector (DCENR, 2014b).

The global economic downturn was particularly marked in Ireland. Between 2007 and 2012, the Irish economy contracted by 7.3%, while energy demand during the same period decreased by 18% indicating a decoupling of energy use from economic activity and emissions from energy use (DCENR, 2014b). Average energy use per home is 20% less than it was five years ago, and the average home produces 40% less emissions since the mid-nineteen nineties (Ibid.).

The International Energy Agency (IEA) in its In-depth Review (IDR) of Ireland's energy policy in 2012 concluded that Ireland has a very proactive energy efficiency policy; and it identified the ESCO market as a key focus for development, as well as improving the energy efficiency of the transport sector (DCENR, 2014b). The NEEAP 2014 highlights a number of policy developments that are informed by the IDR in order to ensure that the 2020 commitments are met. These are: the Energy Efficiency Obligations Scheme that mandates energy suppliers to deliver energy efficiency measures to commercial and residential energy end

users—delivery is assisted with a number of options including buyout and trading of energy credits; the publication of the National Energy Services Framework (2013) that sets out how energy efficiency projects, and an Energy Performance Contracting process is undertaken — providing guidance on project development, and the sources of finance and support available from the SEAI to help develop projects in the public and commercial sectors; the launch of the Energy Efficiency Fund (2014) that addresses the financing gap created by the lack of the availability of properly structured credit that is a significant barrier to economic activity in the non-domestic sector — this gap is being experienced across all sectors of the economy, including the public sector, impeding economically viable investment from taking place; the roll-out of a National Smart Metering Programme to enhance management of energy demand, deliver smart networks, and enable greater energy efficiency through the use of cutting-edge technology and consumer empowerment — the estimated cost to the consumer of €800 million – €1,000 million via network charges spread over 20 years; the publication of the *Green Paper on Energy Policy in Ireland* in 2014 to stimulate debate on, and achievement of, future energy policy priorities; and finally, the bringing forward of a comprehensive climate policy package — including legislation, the publication of national and sectoral low carbon roadmaps, and adaptation strategies over the next few years (DCENR, 2014b).

7.1.3 Sectoral analyses

Construction

Despite the recent economic and construction crisis, the industry has experienced an upsurge in activity more recently. In 2014 the Government announced a €200m stimulus for the construction sector, with the ambition to triple housing output by 2020 (Irish Government Publications, 2014).

The construction industry, represented by the Construction Federation of Ireland (CFI) has a long history of being opposed to higher standards in housing, including environmental and energy-efficiency measures. An unpublished study of 52 homes build between 1997 and 2002 by the SEAI found that none of them complied fully with building regulations (Passivhouseplus.ie). Research organised by QualiBuild ascertained that nearly a third of construction professionals did not know about the nearly-zero energy requirement for all new buildings by the year 2020, and has little experience in low-energy construction and passive house standards (qualibuild.ie). The Government introduced new Building Control (Amendment) Regulations which came into effect on 1 March 2014 to strengthen the arrangements in place for the control of building activity (Irish Government Publications, 2014).

The following figure represents the policies and regulations that have influenced the construction sector, particularly its energy efficiency in the last years. Below the timeline, an overview the different elements that have driven the energy consumption in the construction sector in Ireland are presented.

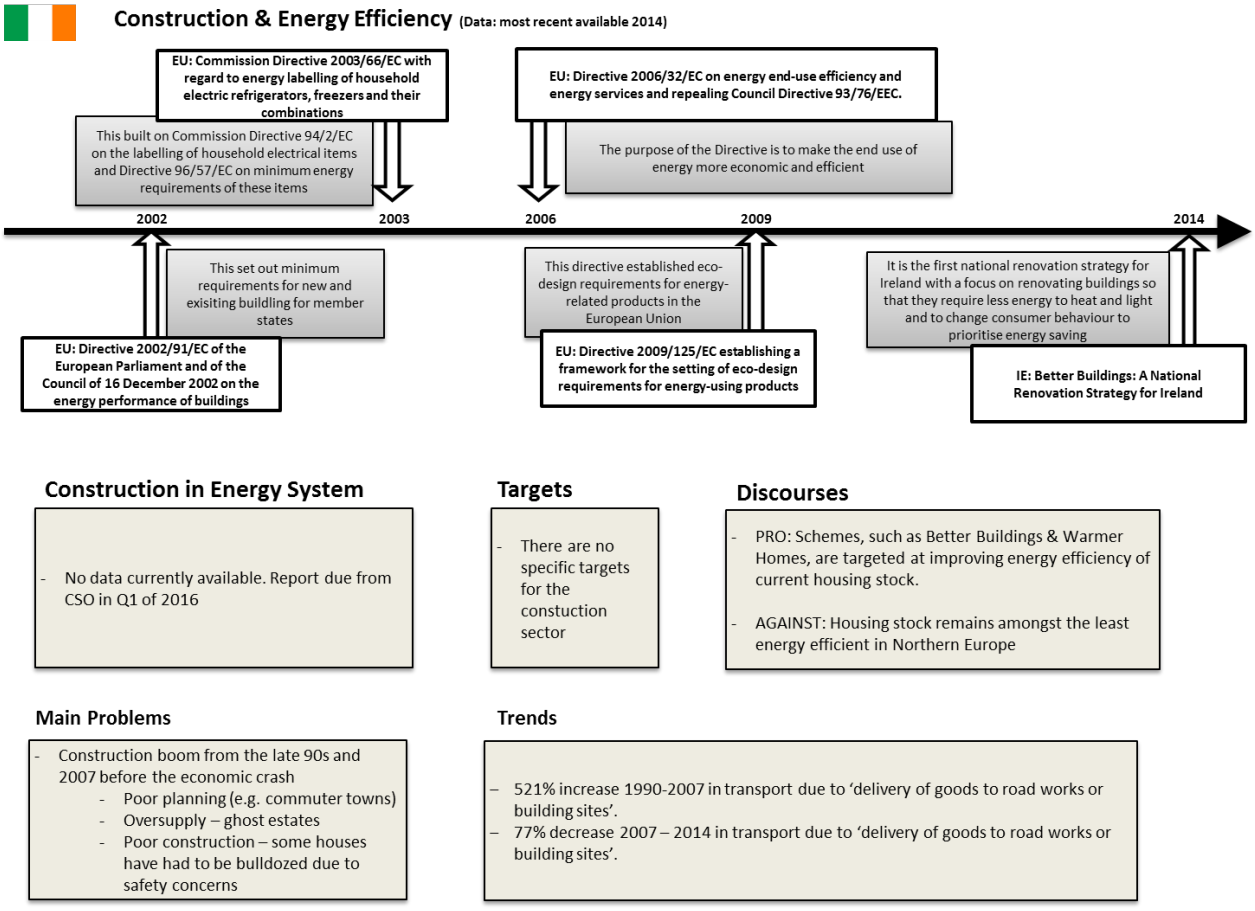


Figure 42: Overview of the construction sector in Ireland

Transport

In the most recent energy overview report produced by the Sustainable Energy Authority of Ireland it was noted that Irelands transport energy use had increase by 2.5% to 4,279 ktoe in 2013, which is 25% below the peak usage in 2007, i.e. the height of the Celtic Tiger era. In the same year, the average specific emissions from new passenger cars purchased in Ireland was 121 g CO_2 /km which is below the EU target of 130 g CO_2 / km for 2015 (SEAI, 2014). Transport was the only sector to experience and increase in primary energy use in 2013 following the reductions of the previous four years, and remains one of the largest energy consuming sectors in Ireland.

Under the EU Renewable Energy Directive all Member States, including Ireland, are obliged to achieve a minimum target of 10% renewable energy in the transport sector by 2020. In order to meet these obligations the government introduced the Biofuels Obligation Scheme (in 2009) as discussed earlier, which is administered by the National Oil Reserves Agency, and the percentage is to be incrementally increased on a regular basis until 2020 (DECENR, 2015). The second aspect of the governments "two-pronged" approach (DCENR, 2010) to meeting this target centres on Electric Vehicles, as an EU target of 10% of vehicles has also been set. The Government introduced the Electric Vehicle (EV) Grant Scheme in 2011 to incentivize and support the early deployment of electric vehicles with grants of up to €5000 available in addition to VRT reliefs, and the ESB (Electricity Supply Board) Ecars Programme, which is rolling out public accessible and domestic infrastructure to support the use of electric vehicles and electric charge points. This scheme is being administered by the Sustainable Energy Authority of Ireland (SEAI) and is

supplemented by a scheme for Commercial vehicle trials, and a separate EV scheme in conjunction with the Department of Community, Equality and Gaeltacht Affairs for the Aran Islands (SEAI, 2015).

Ireland has also developed local initiatives through the various Local Authorities, to promote greener alternatives to private car use such as bus (and taxi) lanes, car rental schemes (e.g. go-car) and the bike-to-work grant scheme which allows employees to avail of grant aid through their employer towards the purchase of a bicycle, and the bike-rental schemes. There are larger bike rental-schemes operate in Dublin and Cork, however there are also smaller schemes such as the one based on the college campus at University College Cork, UCC, which is Corks largest employer and its largest academic/educational facility, and a bike scheme which recently began operating in Clonakilty, a town in West Cork.

The following figure represents the policies and regulations that have influenced the transport sector in the last years. Below the timeline, an overview of different elements that allow a better understanding of the policy making in the transport sector in Ireland are presented.

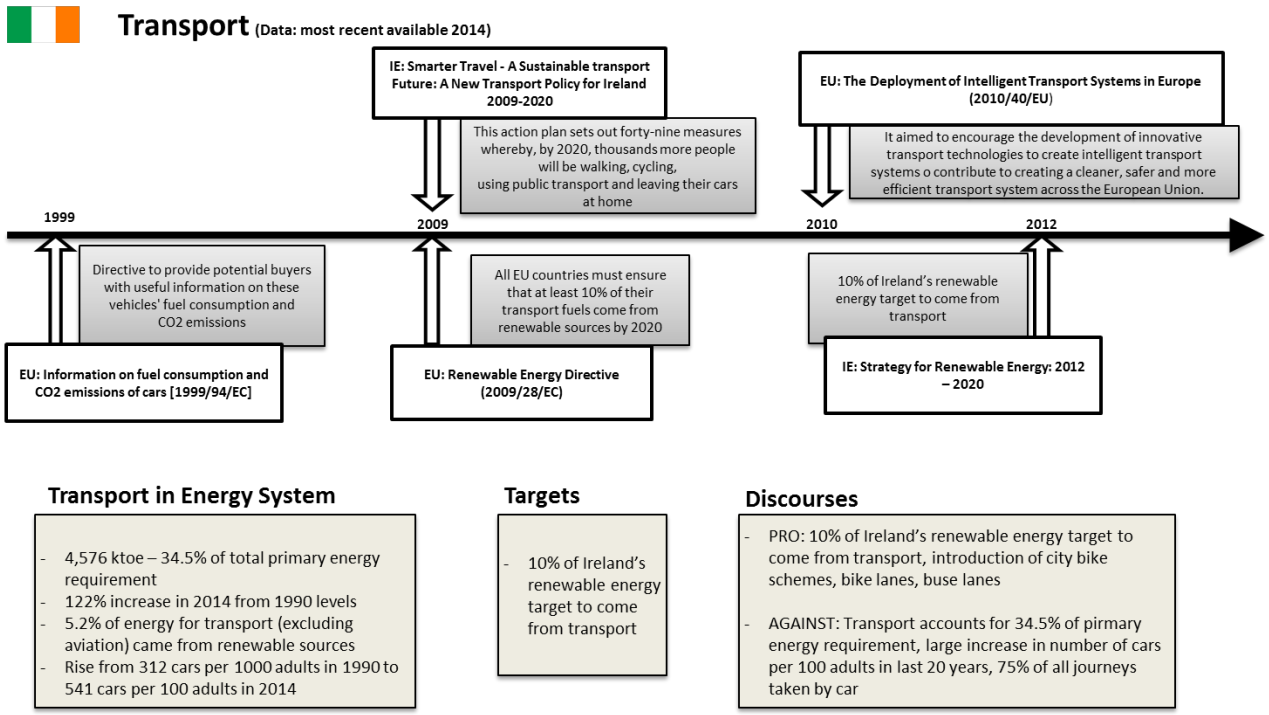


Figure 43: Overview of the transport sector in Ireland

7.2 Spain

7.2.1 Energy supply and its related regulation

National overview

Spanish energy model is still influenced by the fossil fuel sources, such as oil, gas and coal; although Spain has strong dependency on this imports as there are no local sources. For instance, only oil accounts for a bit less than the 50% of the total primary energy demand. The Spanish energy system witnessed a total primary energy demand peak on the years 2005-2008, before that, the energy demand increased progressively starting at 45Mtoes (1972), 70Mtoes (1980), 95Mtoes (1990), 120Mtoes (2000), 145Mtoes (2005-2008); after this period the primary energy decreased down to 120Mtoes in 2012 (IEA, 2015).

In terms of relative values, Figure 44 shows the total primary energy breakdown by source for year 2013 (Minetur, 2014, p. 37). Where the renewables' share has reached a 14.1%, still far from the Natural Gas and Oil demand. The natural gas (21.4%) is present in both, electricity generation by the combined cycled plants and also as a fuel for heating the buildings; while the large oil share (43.5%) is mainly due transportation.

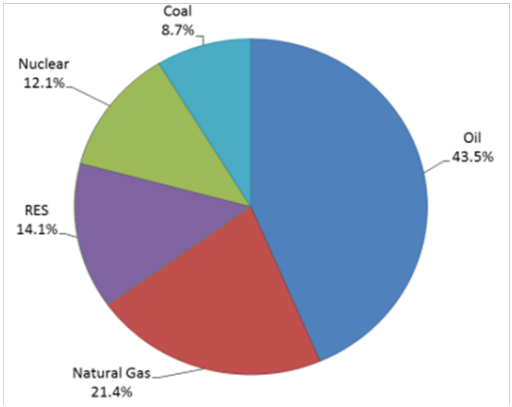


Figure 44. Primary Energy Breakdown in Spain by source in 2013. (Minetur, 2014, p. 37)

The total primary energy use in the action plan 2014-2020 target for Spain, is set to be 119.9Mtoes, representing a 26.4% reduction (saving 42.8Mtoe). From the Annual Report 2013 on the Directive 2012/27/EU by April 2013, total primary energy consumption is 121.6 Mtoe which is 25.3% less (41.2Mtoes) compared to the base scenario value of 162.8Mtoes (Minetur, 2014b, p. 31).

The primary energy intensity in Spain hasn't varied much during the last 30 years, however from a value of 160 Toe/M€ in 2003, it has decreased constantly down to 131.3toe/M€ in 2013.

Fossil Fuels

Coal

Spain has traditionally backed national coal production subsidising the sector in order to be competitive and promote it over the imports; however, currently EU Directives support renewable energies in detriment of fossil fuels; and Spain had to adapt its legislation and regulation to EU Directives.

Until January 1st, 2011, the coal industry received subsidies under the hood of the regulation 1407/2002, regarding the public subsidies to the coal industry inside the National Coal Plan of 2006-2012. Later, the Council Decision 2010/787/EU become the new European framework of the UE policy applicable to subsidised coal; this decision regards the states' subsidies to facilitate and structure the shutdown of non-competitive mines, and prolongs until 2018 the Member States' possibility to cover losses of current

production and exceptional costs (not related to coal production). Therefore, from 2018 on, the participation of national coal to electricity generation will depend, exclusively, on coal production by competitive and efficient companies (IRMC, 2013).

A different regulation framework applies to the thermal power plants that use national coal for electricity production. Directive 2010/75/EU on Industrial Emissions (European Commission, 2010), obliges companies using coal for electricity production to invest, before January 1st 2016, in order to reduce the pollutant agents (SOx and NOx). Non-investment will represent a mandatory reduction on their production, to (1) up to 1,500 hours/year and (2) a total of 17,500 residuary hours. These limits will reduce the use of national coal, affecting the viability of mining companies.

The Spanish new action framework 2013-2018 plans new public policies to restructure the mining sector, which will promote technologies that improve efficiency and reduce CO_2 emissions. Therefore, the actual subsidies to the coal sector are (IRMC, 2015):

- Subsidies for the shutdown: With the aim to cover the losses for the unit of coal produced for those mines that are not competitive. The outdoor mines received 1€ per ton (2013), 0.5€/ton (2014), and 0€/ton (2015); the indoor mines followed a decreasing trend from 30€/ton in 2013, reducing 5€/ton each year until reaching a 5€/ton by 2018. The maximum subsidies decrease from 5.8 M tones on 2013 down to 1.8 M tones on 2018. The Technical Report IET 2095/2013, establishes the regulatory bases of the subsidies for the exercises 2013-2018, related to cover the losses for coal production units.
- Exceptional costs subsidies: These subsidies are devoted to compensate the exceptional costs due to the shutdown of the coal production. There are two categories:
  - Subsidies with a social character devoted to finance the processes of employees' reduction for the coal production units that will shut down.
  - Subsidies of exceptional character to cover the costs of the shutdown and mitigation of the environmental impact of the shutdowns.

  In RD 676/2014, the subsidies regime to cover the exceptional costs for the shutdown of mines is established, and IET/5942014 approves the regulatory base for the 2013-2018 subsidies for these exceptional costs.
- Subsidies for the economic impulse to the mining regions: A number of subsidies have been released to face the new situation and find other economic activities in these areas, different to the coal production. The estimated budget is 250M€ for infrastructures and 150M€ for enterprises projects. IET/1158/2014 and IET/1157/2014 approved the regulatory bases for the subsidies of enterprises projects that generate employment. And RD 1112/2007, establishes the subsidies regime for infrastructures development on the coal mines regions.

Finally, mention that the law 15/2012, December 27th, on fiscal measures for energy sustainability; modifies the coal tax which was increased up to 0.65 €/GJ from the previous 0.15 €/GJ.

Oil

Spain had a demand of 1.29 million barrels per day (mb/d) in 2012, lower than previous years where a maximum demand was reached (1.60 mb/d in 2005). The largest import volumes came from México (15%), Nigeria (14%), Russia (14%) and Saudi Arabia (13%). Considering the oil consumption by sector, in 2012, transport was the main oil consumption sector in Spain with a 63.4% share, the industrial sector represented 17.9% of total use. Spain has a large and complex refining industry with 9 refineries and a capacity of 76,530 kton, eight of these nine refineries are placed in the coast in order to facilitate the importation. This infrastructure, combined with a weak domestic demand, implied an increase of the export of oil products; Spain become a net exporter of oil products and gasoil since July 2012.

Refineries are owned by Repsol (52%), Cepsa (38%) and BP (10%), shares represent the total capacity. Compañia Logística de Hidrocarburos (CLH) has a network over 4,000km long with a total of 67 storage plants; for a total storage capacity in 2010 of 28.3 million cubic meters (mcm). In 2009, the national production of oil was of 107,000 tons.

The juridical regime for exploration, investigation and exploitation of hydrocarbons is regulated by Law 34/1998, that was modified by the Law 8/2015, May 21st, which regulates specific tributary and non-tributary measures related to the exploration, investigation and exploitation of hydrocarbons. In detail, it adopts non-tributary measures to be adapted to the EU normative, regulates the minor markets distributors' activity of oil products and sets new tributary figures for the exploration, investigation and exploitation of hydrocarbons.

The law 15/2012, December 27th, on fiscal measures for energy sustainability; establishes a tax on fossil fuels products used to generate electricity, oil is taxed by 12€/ton and gasoil by 29.15€ per 1,000 litres, also it eliminates the former exemption of hydrocarbons taxes for electricity generation. Also, the general type taxes for oil products such as, liquid hydrocarbons were raised and a special type tax was considered, named as "green cent"). Figure 45 represents the oil-related policies and regulations in the last years. Below the timeline, an overview of the different elements that have driven the oil sector in Spain are presented.

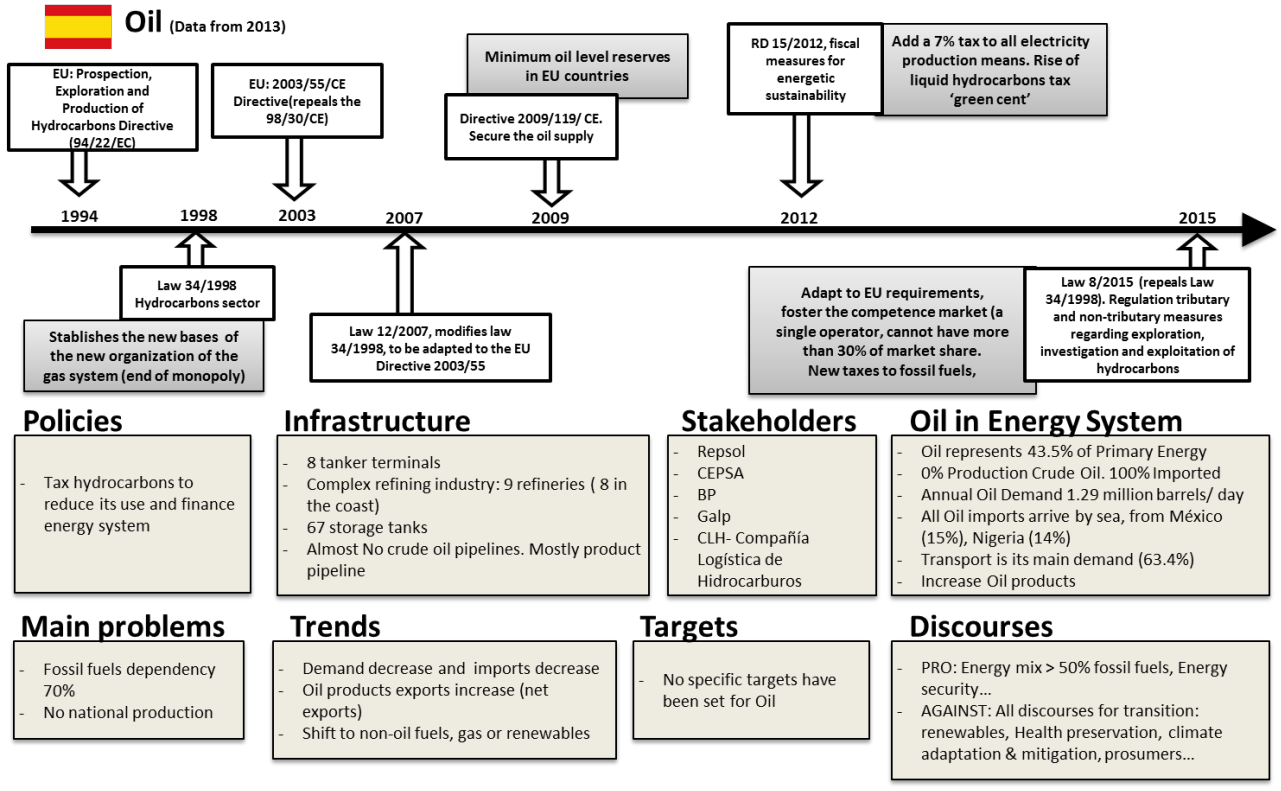


Figure 45: Oil policy overview in Spain

Gas

The domestic natural gas production is almost negligible (0.3% of the total consumption), while the total natural gas demand by 2012 was 32,500 million cubic meters (mcm), the equivalent to 365,351 GWh. Total natural gas consumption has significantly increased since the beginning of the 1990s (5,000mcm) reaching

its peak in 2008 of 40,300 mcm (450,726 GWh). By sector, in 2012, the transformation sector accounts for 39% of the total demand, closely followed by industry (31%) and far from the residential sector (12%). Spain's natural gas supplies are quite diversified, the Royal Decree 1766/2007, obliges gas retailers to diversify its portfolio so that its supplies from the country is less than the 50% of its overall supply. Overall, in 2015 the natural gas in Spain was imported from Algeria (53.9%), Nigeria (13.6%), Qatar (11.0%), Norway (10.6%), Perú (3.7%), Oman(2.8%) and others (4.2%).

The Spanish natural gas infrastructure (IEA , 2014, p. 406) accounts for two important pipelines connection with Algeria and Morocco, two with France and two with Portugal. Spain also has 6 regasification plants located at the main entry points of the natural gas system; and the LNG terminals have a total LNG storage capacity of 3.2mcm. Gas Natural Fenosa is the leading shipper in Spain, and Enagas owns and operates most of the Spanish natural gas grid.

The Spanish National Energy Plan (PEN-91) promoted natural gas as an alternative to oil and oil products, so that it improved its infrastructure and interconnections. The gas sector regulation was focused, since 1998 (Law 34/1998) on achieving the complete liberalisation of the natural gas market, and develop a stable regulatory framework to promote new gas infrastructures to face the increasing demand and foster the diversification of the gas supply sources.

The main European Directives are the 2003/55/CE (repeals the 98/30/CE), the 2004/67/CE on secure supply guarantees, and finally, the 2009/73/CE July 13th, 2009, which regulates the common norms for the national natural gas market. The Spanish national regulations are created in order to transpose the European Directives; the most remarkable ones are:

- Law 12/2007, transposed the EU Directive 2003/55/EC to create a competitive national market; restructuring the competences, separation of the functional activities, among others.
- RD Law 13/2012, defines the transportation network managers, gives more protection to the consumers and more rights to the residential consumers. It promoted the combined cycle plants by giving significant incentives for investment, for instance (1) for installations previous to 1998 will receive 23,400 €/MW/year for the first 10 years or (2) 7,875 €/MW/year for environmental investments during the first 10 years. The availability service regulated by the ITC3127/2011, was only 4,697 €/MW/year only for 1 year (2012) (Sostenibilidad y Energía, 2013).
- RD Law 8/2014, is approved to improve the economic sustainability of the gas sector. There is a deficit of tariff in the gas market, as from the 2008 the demand has been reduced and the new installations (combined cycles) that were built are currently working at a 10% of their normal capacity. It is estimated that the levels of demand of 2008, won't be achieved until 2020, hence the measure is to increase the taxes in order to reduce the accumulated deficit.
- The new law 8/2015, regulates specific tributary and no tributary measures related to the exploration, investigation and exploitation of the hydrocarbons. Establishes the creation of a secondary gas market, with the purpose of obtaining "more competitive and transparent" prices and thus, facilitating the entry of new gas retailers. A gas wholesales market is organised, with a new unique gas operator, to manage the "gas hub", the sell and purchase platform, and the prices of the products.
- The law 15/2012, regards the fiscal measures for energy sustainability and added special taxes to the natural gas. These taxes could be either:
  - General: 0.65 €/GJ (0.234 c€/kWh) for use of natural gas as a residential heating fuel or as a motor fuel for generation or cogeneration of electricity;
  - Reduced: 0.15 €/GJ (0.54 c€/kWh) applied on the natural gas for industrial use;
  - Vehicular: 1.15 €/GJ (0.414 €/kWh) as a vehicle fuel usage.

The following Figure 46 represents the gas-related policies and regulations in the last years. Below the timeline, an overview of the different elements that have driven the gas sector in Spain are presented.

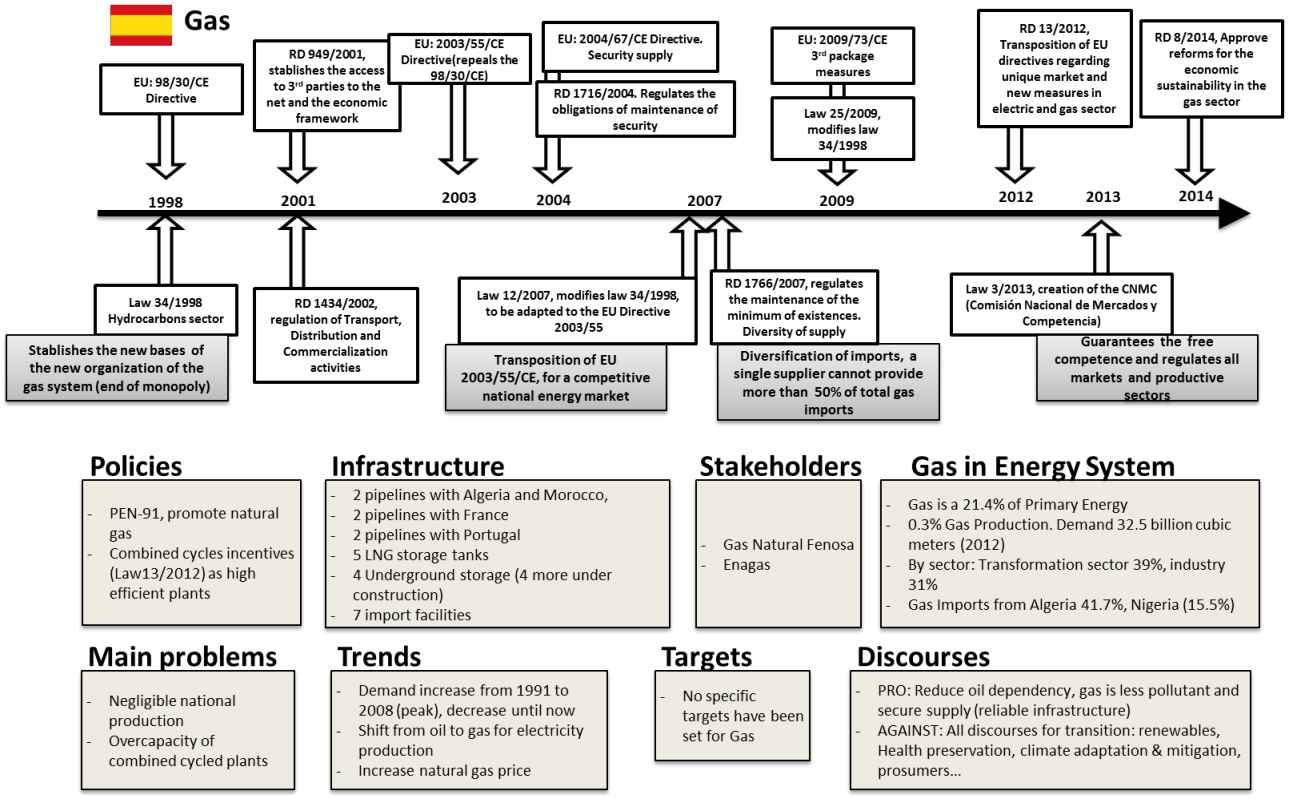


Figure 46: Gas energy policy overview in Spain

Renewable Sources

Spain, as part of the European Union, follows the guidelines of the European Directive 2009/28/EC on Renewable Energies, which aims to produce 20% of its primary energy with renewables. So, the current Spanish "PER 2011-2020" is aligned to the European Commission objectives; Table 11 presents a comparison between the estimated progress of the renewable energy percentages in the Spanish energy mix set by the Spanish's Plan Renewable Energies PER 2011-2020 and European Union targeted shares for Spain.

Table 11: Comparison of PER and EU renewables shares projection to 2020 (Energía y Sociedad, 2014).

	2011-2012	2013-2014	2015-2016	2017-2018	2020
European Union	10.96%	12.09%	13.79%	16.05%	20%
Spain PER	14.75%	15.85%	17.00%	18.50%	20.08%

In 2012 each EU Member State launched a progress report regarding its real progress on renewable energy objectives. Spain achieved a 13.5% of renewable share for the total primary energy demand. On the following Table 12 a comparison between the 2005 initial values, 2020 objectives and the 2012 real progress advance, is represented.

Table 12: Initial (2005), progress (2012) and target (2020) RE shares in Spain (Energía y Sociedad, 2014).

Renewable Energy prevision	2005		2012 progress	2020	
	%	TWh	%	%	TWh
Heating and cooling	8.9%	41,175	11.9%	17.3%	62,291
Electricity	18.4%	53,768	29.2%	39%	144,827
Transportation	0.8%	2,849	4.8 %	11.3%	37,396
Total	8.2 %	96,536	13.5%	20.8%	238,665

With the latest data on renewable energy shares, Spain achieved a 14.1% (17,06Mtoes) of primary energy demand on 2013 and a 14.6% (17.27 Mtoe) on 2014. Also in 2013, RES technologies contributed by 42.4% to total electricity production, being 119.6TWh; already higher than the objective set by 2020. The evolution of total renewable primary energy consumption in kToe from the 1990 until year 2014 divided by the type of source can be found in the annual statistical report of the Instituto para a Diversificación y Ahorro de la Energía (IDAE, 2015).

Having a closer look to renewable sources in each sector, Table 13 describes the power installed and energy produced by each source during year 2014. Analysing these figures, it should be highlighted that wind and hydropower are the two sources with largest capacity installed and therefore are the largest RES electricity producers, being Wind 46%, Hydropower 37%, followed by PV (7.2%), Solar thermoelectric (4.8%) and Biomass, Waste and Biogas (4.3%) of the total electricity produced by renewables in 2014. Regarding renewable thermal production, which includes heating and cooling, biomass and waste have the largest share accounting by 92% of total heating and cooling renewable production.

It is also worth to mention the variability of installed renewable energy power capacity, which varied over the period from 2000 to the 2014 reaching the peak of annual capacity installed in 2008. In numbers, renewable capacity installed in 2000 was 878MW, it grew constantly reaching the peak on 2008 when in that year alone 4,656 MW were installed; and from that point on, the annual new installation decreased year by year until in 2014 when only 51MW were installed.

Table 13. Power installed by source and sector in Spain by 2014 (IDAE, 2015).

Electricity Production			
RES source	**Power Installed (MW)**	**Energy Production (GWh)**	**Primary Energy Production (ktoe)**
Hydropower	19,095	42,916	3,361
Wind Power	22,974	52,262	4,493
Solar PV	4,786	8,198	705
Solar Thermoelectric	2,250	5,455	2,142
Biomass	677	3,651	949
Waste	224	585	122
Biogas	222	727	209
TOTAL	50,228	113,793	11,981
Heating and Cooling production		**Transportation**	
RES source	**Primary Energy Production (ktoe)**	**RES source**	**Primary Energy Production (ktoe)**
Biomass and waste	4,005	Biofuels	969
Biogas	43	TOTAL	969
Low Tº Thermosolar	259		
Geothermal	18		
TOTAL	4,325		

Renewables related regulation

There is a list of policies and regulations that are common and transversal to the all renewables, in this sense the Spanish Renewable Energy Plan "Plan Energías Renovables (PER) 2011-2020" was developed under those premises and in substitution of the previous "Plan Energías Renovables 2005-2010 (PER)" which at the same time substituted the "Plan Fomento de las Energías Renovables 2000-2010 (PFER)". The PER 2011-2020 incorporates an overall objective of achieving 20.8% in 2020; per sector aims to generate a by renewable energy sources a 39% of total electricity, cover a 11.3% of all the transportation consumption and a 17.3 % of the Heating and cooling demand by 2020 (IDAE, 2011, p. 74).

Regarding renewables regulation, many Royal Decree and Royal Decree Laws have been launched during the last decade which affect directly to the renewable sector. A summary is done below (Energía y Sociedad, 2014) (Suelo Solar, 2014):

- Law 54/1997, is the fundamental law for electricity production from renewables, cogeneration and waste, it creates the "special regime" for renewables, cogeneration and waste; to be differentiated from the "ordinary regime" which concerns conventional energy production (nuclear, fossil fuels). RD 2818/1998 develops the special regime, modified by RD 841/2002; and finally both repealed by RD 436/2004 that establishes the juridical and economic methodology for the "special regime" electricity production.
- RD 661/2007 regulates the production on the special regime categorising the different energy sources in groups (wind, solar, waste, biomass, biogas…), in which the owner of the installation perceives a "regulated tariff" or a quantity accounting for the electricity market price plus an incentive; this system is the called "Feed-in-Tariffs", also used in many EU countries to promote clean sources. The energy produced in the special regime is guaranteed to be purchased and with priority to the rest of ordinary regime technologies. This RD is repealed by RD 9/2013, within the frame of the energy sector reformation.
- In 2012, RD 1/2012 was adopted to guarantee the economic sustainability of the system, established the suspension of the procedures of pre-assignation to retribution and supressed economic incentives to new renewable installations (PV, wind, cogeneration and waste). The RD 6/2009 created the registration of the pre-assignation. Also, the Law 15/2012 imposed a tax of the 7% to all the electricity generated by renewables installations.
- RD 2/2013 modified the regulated activities and the incentives to "special regime" installations (repeals RD661/2007); this RD guarantees a reasonable profitability rate, but lower than the previous one; also RD 9/2013 was launched in order to adopt urgent measures to guarantee the economic stability of the electric system.
- Law 24/2013, is the new Electricity Sector Law is the final step of the electric system reformation (almost repeals all RD 54/1997), where the terms of special regime is substituted by specific retribution installations. Also this Law 24/2013 aims to embrace in one law all the changes on the Royal Decrees that modified somehow the energy sector, such as RD 14/2010, RD 1/2012, RD 13/2012, RD 20/2012, RD 29/2012, the previous mentioned Law 15/2012, and RD 2/2013 and RD 9/2013.
- RD 413/2014 changes again the regulation of the electricity production by renewables means, cogeneration and waste. Stablishes a theoretical profitability rate for renewable energy installations previous to the RD-L 9/2013 will be 7.4% and the posteriors will have 5.8%; however, it may not correspond to the real one.
- Finally, in October 2015, the Royal Decree 900/2015, which regulates the self-consumption, stipulates a tax to the producers due to its connection to the grid in order to contribute the system's cost, also it does not allow sharing the same installation among various consumers, among others.

The need to apply the European Directives on Renewable Energies, made that Spain has adopted very beneficial actions and laws to foster RES among the territory, especially RD 661/2007, aided by favourable economic conditions. The Spanish economic turmoil, caused a complete change on the approach of the policies and regulations regarding renewables. From 2009 on, incentives were unsustainable for the electricity sector. Therefore, these new laws and regulations were and are mainly devoted to reduce the electric deficit of tariff generated, by reducing the costs of the system. These laws have created controversy among renewable energy actors (plant owners, manufacturers, investors…), ending up with many legal demands against the Spanish government and created instability in the Spanish energy regulation regime.

Nowadays, the current renewables' share in the Spanish electricity mix is above the EU countries' average, however, accounting the overall energy, Spanish renewable energy shares are still under the 2020 targets.

Wind

The objective for wind power by 2020 as part of the Plan Energías Renovables (PER) 2011-2020 is to achieve an installed power capacity of 35,000 MW able to produce 70.734 GWh for on-shore wind farms and reach a capacity of 750 MW to ultimately produce 1,822 GWh. The measures to achieve those objectives account for normative simplification, public investments (90.6M€) and financing (138.2M€).

In Spain, the wind sector does not have a specific regulation framework yet, so all the incentive cuts and affectations in the wind installations are subjected to the general Royal Decree on renewables and electricity sector. From RD 661/2007, the amount of wind power capacity with access to retribution is limited to 20,155 MW, the retribution stipulated for wind systems was up to 73.2€/MWh for the first 20 years. Also RD 1614/2010 reduces the incentives to wind power production by limiting the number of hours with right to receive incentives (a reduction of around the 35% for the years 2011 and 2012); and moreover affected by the 7% tax as electricity producers (RD 15/2012).

The following Figure 47 represents the wind energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the wind energy sector in Spain are presented.

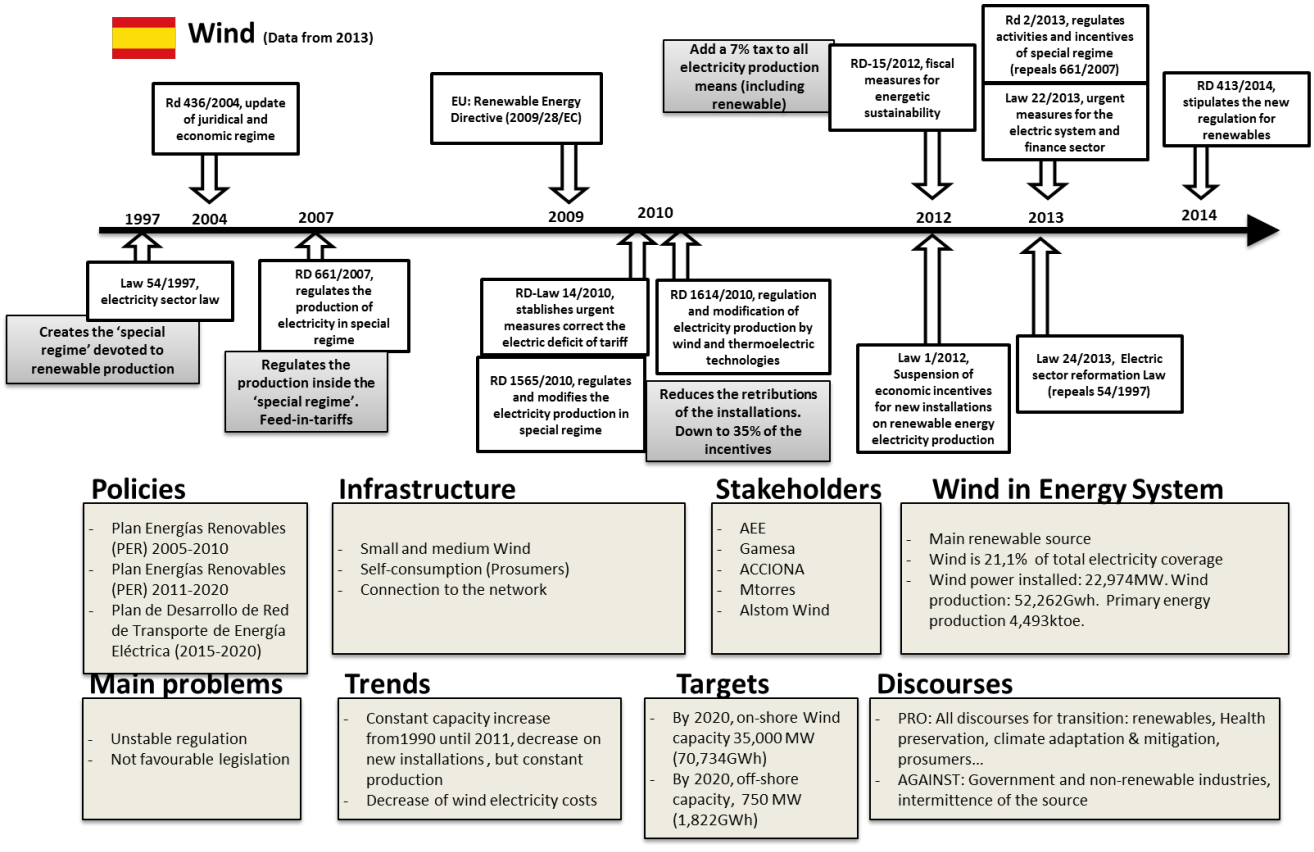


Figure 47: Wind energy policy overview in Spain

Solar

The electricity produced by solar technologies can be divided by solar photovoltaic (PV) and solar thermoelectric. Their objectives by 2020 are also included in the Plan Energías Renovables (PER) 2011-2020". The capacity objective for PV by 2020 is 7,250 MW, with an associated production of 12,356 GWh; regarding the thermoelectric the capacity aim is to be 4,800 MW and a production of 14,379 GWh. To achieve this objective the public administration facilitates investments (33.8M€ for PV, and 49.3M€ for

thermoelectric) and financing (79M€ for PV and 47.5M€ for thermoelectric) for the whole period 2011-2020.

The photovoltaic sector in Spain has suffered from many regulation changes, also it is subjected to the renewable energies and electricity sector regulations mentioned. For instance, RD 1578/2008, regards the retribution of the electricity production by solar photovoltaic technologies, modifying RD 661/2007. The PV installations' retributions are, then, categorised as building integrated installations, with 34c€/kWh (<20kW) and 31c€/kWh (>20kW); and for PV non-integrated installations an incentive of 32c€/kWh (<10MW).

RD 14/2010 creates a generation toll and a limitation on the hours with the right of retribution for the PV plants (1,250 hours/year for fix installations and 2,367 hours/year for movable), but it prolonged the years with right for retribution; once these hours' limit is achieved only the electricity market price is perceived. So, in practical terms, the income for PV installations is reduced by 30% applying this RD compared to RD 661/2007, and a 10% reduction compared to RD 1578/2008. In addition to this incentive cut, the owners should also face the 7% tax for the electricity generation, set by the RD 15/1012.

The solar thermoelectric sector has been the leader in the solar sector, especially in the south of Spain, the feed-in-tariff stipulated to this technology by RD 661/2007 was 26.94c€/kWh for the first 25 years; RD 1565/2010 establishes a specific regime for innovative thermoelectric installations and RD 1614/2010 limited the number of equivalent hours with right to be incentivised. And it was also subjected to RD 1/2012, Law 15/2012 and RD 2/2013 described above which regulates the cuts on the subsidies and adding taxes to renewable production.

The following Figure 48 represents the solar energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the solar energy sector in Spain are presented.

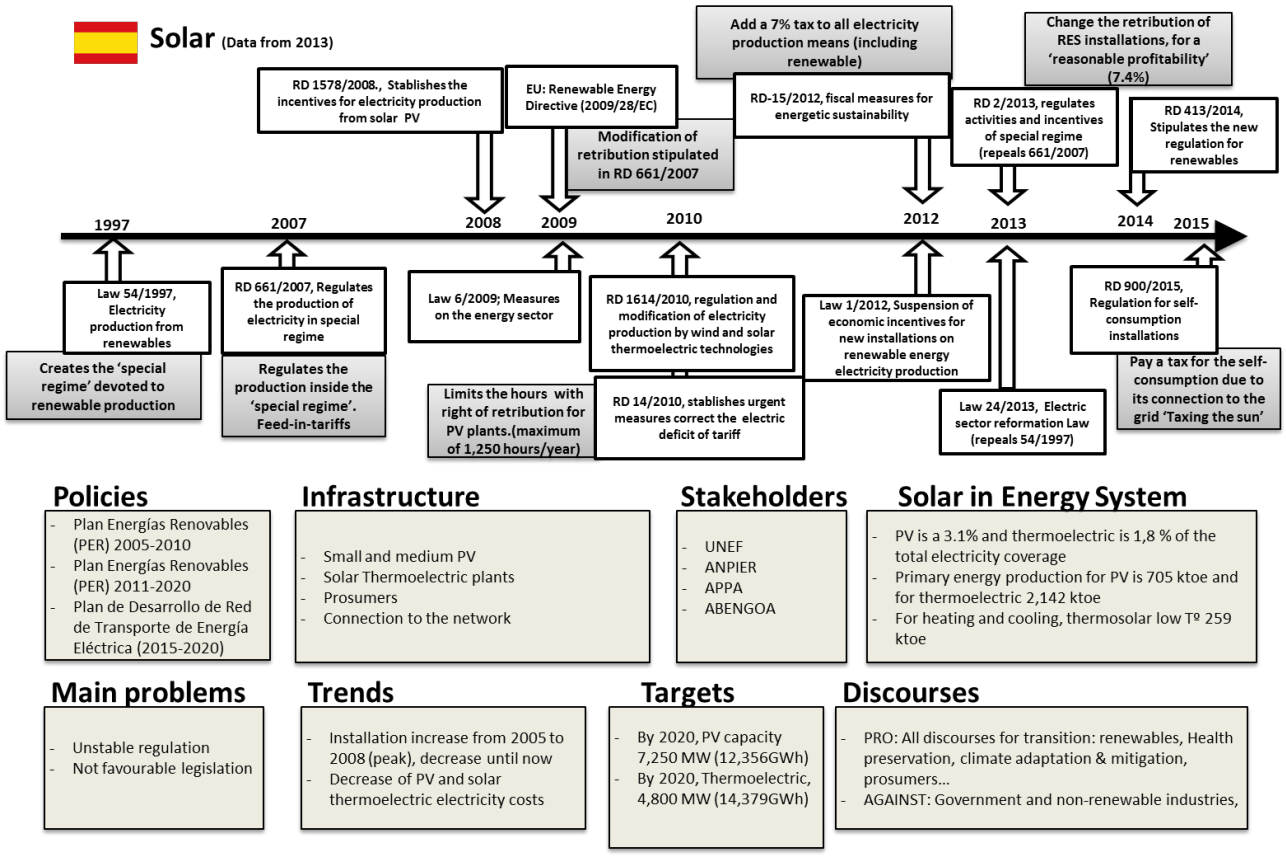


Figure 48: Solar energy policy overview in Spain

Biomass, biogas and waste

The objectives by 2020 inside the Plan Energías Renovables (PER) 2011-2020 are to achieve a capacity of 1,350 MW and a production of 12,200GWh on biomass and 400MW capacity with a production of 2,600 GWh on biogas. The objective on waste combustion is to achieve 200MW capacity with an estimated production of 1,500 GWh.

The biomass and biogas incentives set by RD 661/2007 are of 13.06 c€/kWh for the first 15 years of the plant lifetime; and the waste combustion incentives are 12.57 c€/kWh also for the first 15 years. However, they are now subjected to the modifications of RD 413/2014, which establishes the methodology to calculate the so-called "reasonable profitability".

A particular law for biomass is the Law 43/2003, Law 10/2006 and 21/2015, where in its 4th additional disposition, describes the usage of forestry biomass, where the government, in collaboration with regional governments, will develop a strategy for forestry biomass, according to the objectives of the Plan Energías Renovables (PER) 2011-2020

The Instituto Diversificación y Ahorro de Energía (IDAE) helps financing projects to incorporate biomass in houses and business. For instance, with the programs "Biomcasa II" (IDAE, 2013) and the "GIT" (IDAE, 2013) program.

Hydropower and tidal

The hydropower electricity production objectives by 2020 are shown in Table 14:

Table 14: Hydropower objectives by 2020 in Spain (Minetur, 2011, p. 26).

Size	Capacity objective	Production objective
Small (<1MW)	13,681 MW	33,140GWh
Medium (1-10MW)	268 MW	843GWh
Large (>10MW)	11,676 MW	26,548GWh

The hydroelectric production incentives are also stipulated by RD 661/2007, with 7.8 c€/kWh for the first 25 years. But RD 15/2012 created a tax for the use of continental water for energy production of a 22%, which is reduced by 90% for mini-hydroelectric installations (<50MW) and for the pump hydroelectric >50MW. The hydroelectric is affected by laws and Royal Decrees regarding the usage of continental waters, such as RD 9/2008 that repeals RD 849/1986, referred to the hydraulic public domain legislation. Electricity generation by tidal is not really developed and common in Spain, the objective is to achieve a 100MW capacity and a production of 220GWh by 2020, the incentives for tidal, geothermal, wave and sea-thermal were 6.89 c€/kWh for the first 20 years (RD 661/2007), also taxed by RD 15/2012.

The following Figure 49 represents the hydropower-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the hydropower sector in Spain are presented.

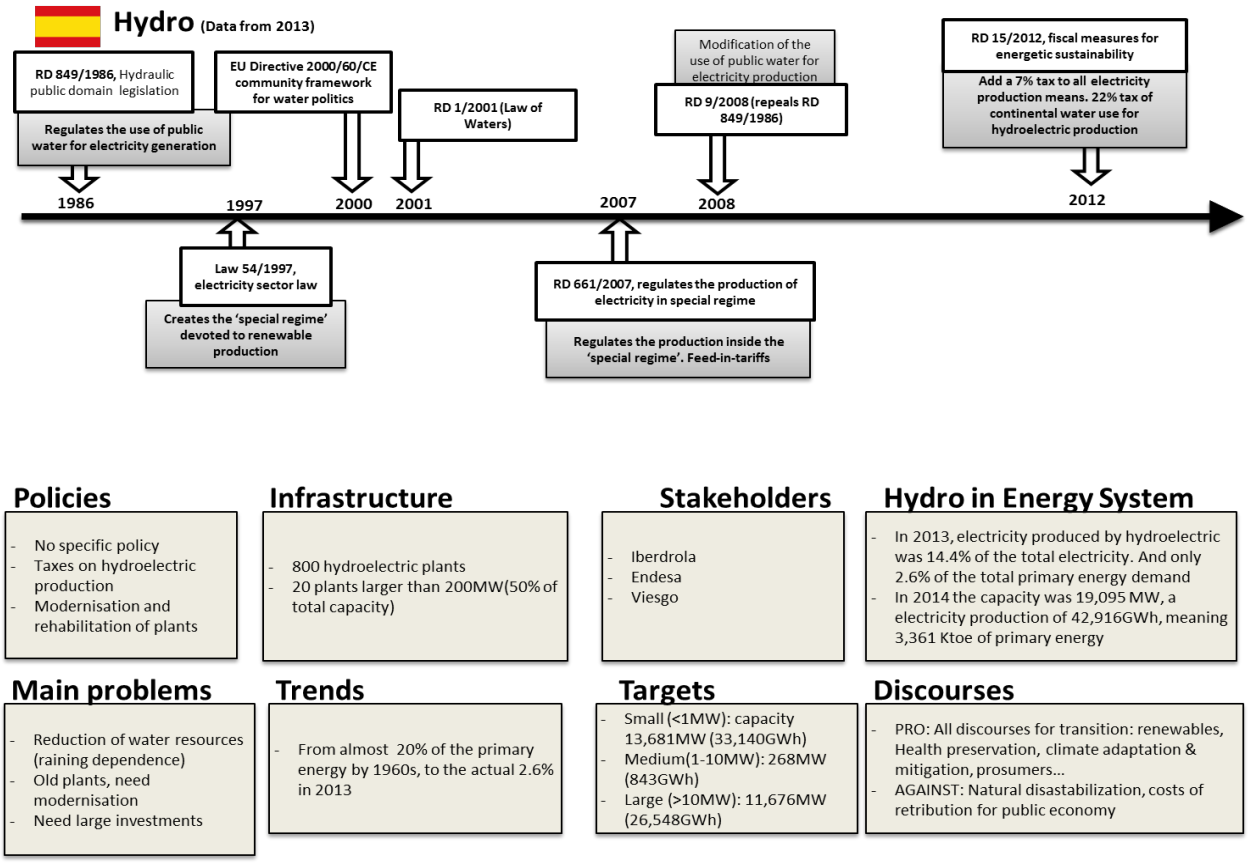


Figure 49: Hydropower policy overview in Spain

Nuclear energy

Nuclear energy was the second source for electricity production in 2013, with a 21.2% of the whole electricity production. Spain accounts for a total of 10 nuclear installations, owned in different proportions by Nuclenor, Endesa, Unión Fenosa, Iberdrola and HC Energía. Five of these nuclear plants are still in operation, with a total of 7 reactors, as shown in Table 15. The other power plants are closed or are under-closing arrangements; these are Santa María de Garoña, Vandellós I, José Cabrera; with one reactor in each.

Table 15: Operative nuclear plants in Spain, reactors, start and end years, power capacity (Minetur, 2014)

Nuclear Plant	Reactor	Start year	License expire	Power
Almaraz	Almaraz I	1983	2021	1,049 MW
	Almaraz II	1984	2023	1,044 MW
Ascó	Ascó I	1984	2023	1,033 MW
	Ascó II	1986	2025	1,035 MW
Cofrentes	Cofrentes	1984	2034	1,102 MW
Vandellós II	Vandellós II	1988	2027	1,087 MW
Trillo I	Trillo I	1988	2028	1,066 MW
TOTAL	7 reactors	-	-	7,416 MW

In 1996, the electricity generated by nuclear plants represented a 35% of the total electricity generation, having been constantly reduced until reaching the current 21.2% by 2013. Although during this period the power installed has remained constant (7,700-7,800 MW), and the electricity generated annually is around 58,000-62,000GWh.

In Spain, the nuclear plants for electricity production were planned in the 1970s and started operating by the 1980s, according to the Law 25/1964. In a plan divided into three stages, 25 nuclear plants were projected, but only 10 were finally built due to the first Energetic National Plan of the democracy in 1983 (PEN-83), which aimed to stop the ambitious plan on nuclear plants' construction empowered by the electricity utilities in Spain. The reasons to paralyse the nuclear plants were mainly, the demand reduction, technical reasons and social conditionings. The block of these plants had economic consequences for the electric companies that had invested and were already building them (Energia-Nuclear, 2013).

However, PEN-83 stipulated that a percentage of nation-wide electricity bills would be devoted to compensate the electric utilities losses as a result of the blockage of part of the constructed nuclear plants. Therefore, PEN-83 had an impact to the electric bill of the consumers; this compensation was named "Nuclear Moratorium".

The "Nuclear Moratorium" was again included in the National Energetic Plan of 1991 (PEN-91), which recognised a debt to the nuclear plants company owners of around 3,800 M€ by 1990. But, in 1990, the Spanish energy model was still dependent on nuclear energy, so the PEN-91 had the aim to diversify the energy mix, by renewables or gas.

It was the Law of Structuration of the National Electric System (LOSEN) in Spain in 1994, which established that these companies will be compensated with a billing charge from energy sales to consumers, fixing a maximum of 3.54% (average of 1.72%) and a 25 year-term (until 2020). Also, LOSEN admits the possibility to compensate third parties of the 4,278.8M€ debt, measure applied through the "Fondo de Titularización de Activos Resultantes de la Moratoria Nuclear".

In 1997 (RD Law 54/1997), with the Electric Sector Law, the market was liberalised. From this time, any new nuclear plant would be subjected to administrative authorisation. Also compensation schemes were established for those nuclear plants' proprietaries that were completely paralysed, fixing an individual quantity for each project and with 25 years for the complete payment (until 2020). In 2006 the fund was modified to reduce the charge on the electric tariff, the percentage decreased down to 0.33% and the compensation period was also shortened until the end of 2015.

The total quantity that the Spanish State should compensate to the affected companies is around 4,383 M€, that ended up having an extra-cost of around 65M€/year to consumer bills across Spain. Companies that have received most money due to this fund include: Iberdrola (3,256 M€), Endesa (1,070 M€) and Fenosa (42M€).

To finalise this section, it is worth to mention that the nuclear sector was also affected by laws that aim to stabilize the economic functioning of the energy sector in Spain, for instance, Law 2/2011, regards economic sustainability and Law 15/2012, fiscal measures for energy sustainability; in which taxes of 7% for electricity production are included also for nuclear and several measures regarding the production and storage of nuclear residues (2,190 €/kg of heavy metal produced).

The following Figure 50 represents the nuclear energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the nuclear energy sector in Spain are presented.

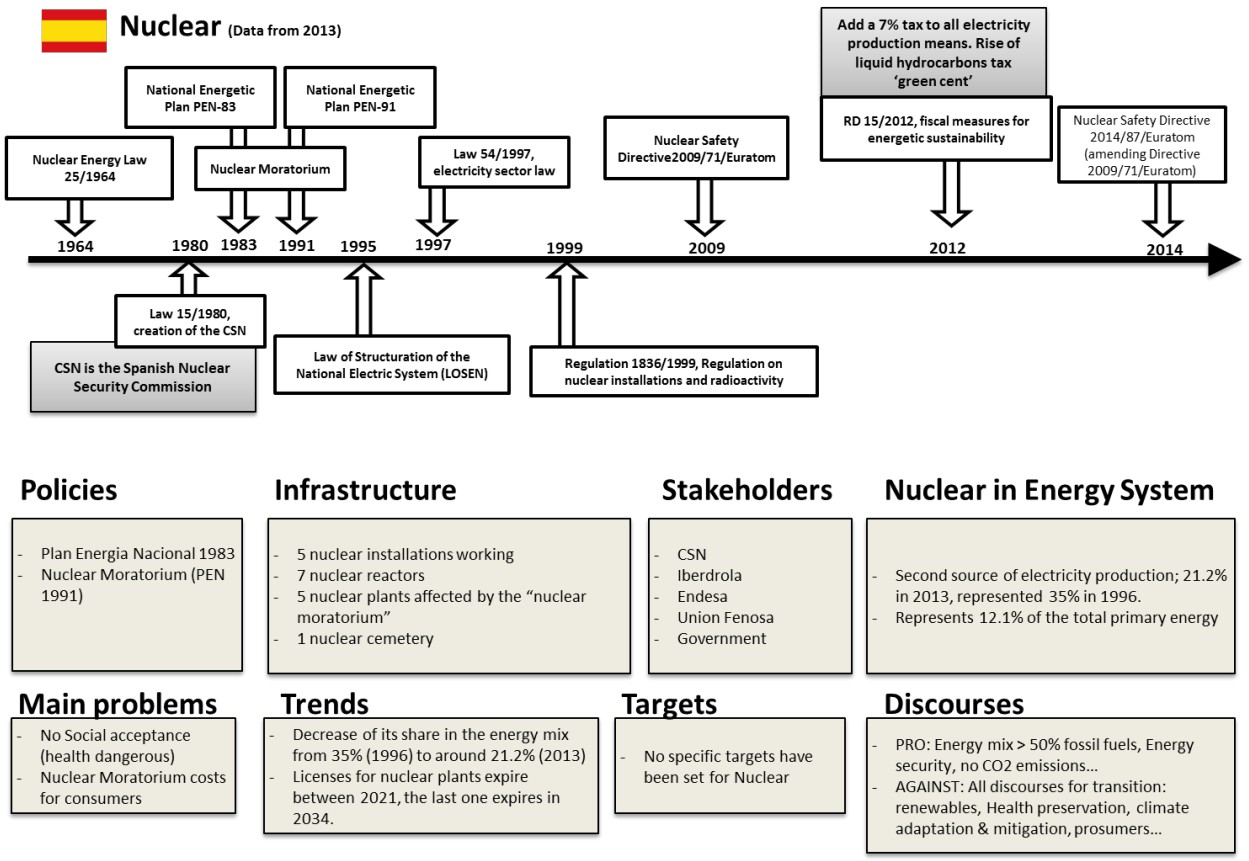


Figure 50: Nuclear policy overview in Spain

Electricity

The electricity production mix in Spain is quite variated, due to the different plans launched which each of them fostered a different source for electricity production, starting with nuclear and hydro power plants, moving to coal thermal plants and fostering the natural gas combined cycle ending with the boom of the renewables, especially with the wind power (IEA, 2015).

The percentages of the actual electricity mix in Spain can be observed in Figure 51, where wind is the main source with a share of 21.2%, followed by nuclear (21.0%), coal (14.6%), hydropower (14.4%), cogeneration (12.4%), combined cycle (9.6%) and the different kind of renewables; the data can be found in the Red Eléctrica Española site (REE, 2013, p. 11). Spain already generates almost 40% of their electricity by renewables sources, which is the targeted percentage by 2020.

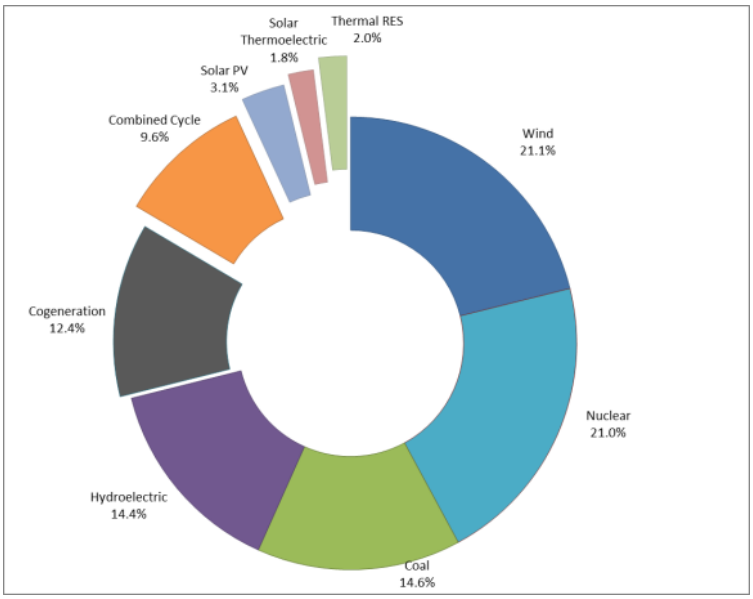


Figure 51: Electricity Production by source in Spain in 2013. (REE, 2013, p. 11)

By sector, the electricity consumption of the commercial and public services occupies 33% of the total electricity consumption, the residential sector 31% and industry represents 30%; transportation and agriculture represent less than 5% (IEA, 2015).

7.2.2 Energy Efficiency

Energy efficiency has become a hot topic in EU policies, as a reduction on the energy consumption will benefit the EU region as it imports almost all of their energy. The target by 2020 is reduce the energy consumption by 20%, and for 2030 a 27% reduction. The Energy Efficiency Directive (2012/27/EU) established measures to aim the 20% the energy consumption reduction by 2020, using the energy more efficiently in all stages of the energy chain from production to final consumption (European Commission, 2012).

All the EU members should have transposed the Directive into national legal order systems by 2014, in Spain the transposition of the Directive 2012/27/UE is still not completed and dispersed in many norms. Many articles from the Directive still don't have a national norm in Spain: for instance article 9 on net meter balances; article 2 that defines an efficient urban system for heating and cooling; article 7 development of the systems obligations for the 1.5 annual savings for energy retailers; articles 15, 18 and 19 which establish the suppression of all incentives against energy efficiency, the participation of the consumers on the demand management and the obligation of the states to supress all obstacles against the energy efficiency.

Within the Energy Efficiency Directive, EU countries should prepare National Energy Efficiency Plans every three years, Spain prepared the NEEAP 2011-2020, and also the most recent one is the Spanish National Action Plan Energy Efficiency NEEAP 2014-2020. Chapter 4 of the Spanish NEEAP describes the measures for enforcement of the Energy Efficiency Directive, in order to achieve an annual final energy consumption's saving objectives until 2020 of 571 kToes/year, divided by sector as Table 16 presents (CNMC, 2014, p. 66).

Table 16. Annual final energy consumption savings' objective until 2020 (CNMC, 2014, p. 66)

Annual final consumption savings until 2020	%	ktoe
Industry	55%	311.6 ktoe
Transportation	25%	141.1 ktoe
Buildings	15%	82.1 ktoe
Public Services	2%	12.3 ktoe
Agriculture	2%	9.5 ktoe
Communication	1%	6 ktoe
Total	100%	571 ktoe

One of the points that the Energy Efficiency Directive remarks, is the smart metering deployment and the right of the consumers to have access to their consumption data in real-time. Spain is ahead on the electricity smart meter installations, Decree IET/290/2012, regarding the substitution plan of digital meters has the aim to have 100% smart meters installed by the end of 2018, almost 60% of all electric meters were already smart by mid-2016. So far, the substitution of the smart meter has benefited the DSOs, but not the final user, as not all the consumers with smart meters are informed of their hourly consumption, cannot opt for an hourly-price tariff and cannot have easy access to their consumption data. However, consumers already pay for smart meter rental at a rate of 0.81€/month for monophasic (the traditional meter has a cost of 0.47 €/month), and the three phases smart meter has a rental cost of 1.36 €/month (the traditional has a cost of 1.53€/month).

Energy efficiency obligation schemes are created to comply with the objective of article 7, these schemas apply standardised systems of negotiable energy efficiency certificates involving public and private partners, supported by the Energy Efficiency National Fund, which was created according to article 20 of Directive 2012/27/EU. The obligation scheme structure is described in the NEEAP 2014-2020 (Minetur, 2014b, p. 63), the obligated parties in Spain shall be electricity, gas and oil product (including transportation) sales companies, their obligations will be established annually. IDAE will be the certifying body and manager of the energy savings certificate scheme. The target is to save 571kToe/year until 2020 (a total of 15,979kToe), and should be achieved by the implementation of the energy efficiency obligation scheme.

National Energy Efficiency Fund, created by RD 18/2014, to which the obligated companies might contribute annually by the quantity equivalent to the investment needed for the accomplishment of the energy savings obligations, as a way to achieving them. With this payment of the economic equivalence to the National Energy Efficiency Fund, the obligated subjects (electric, gas and oil companies) have fully accomplish its annual saving obligation. The contribution is distributed proportionally according the sales volume of each company, the list of the obligated subjects is in the annex II of the IET/289/2015.

The programs to promote and facilitate an energy efficient use by small energy consumers, the policies for communication and information are: institutional advertising and communication campaigns, IDAE website,

IDAE online newsletter, internal audio-visual productions and citizen information service on energy efficiency and renewable energies consumer information and empowering programs. And training based on e-learning and attendance-based learning.

The promotion of the Energy Services Companies (article 18), their role is incorporated into the Spanish legislation under the hood of the RD 6/2010. Some measures of economic support for the procurement of energy services were created, such as JESSICA holding fund (122M€ budget), Aid for Energy Renovation of Existing Buildings in residential sector (PAREER) had a 125M€ budget. The ESCOs in the IDAE database has been constantly increasing reaching 968 by March 2014, where 93% are large enterprises and the 7% are SME.

Moving to the policies and measure regarding the energy sector, the article 14 of the Energy Efficiency Directive, assess the potential of the application of high-efficiency cogeneration and efficient district heating and cooling systems. However, the transposition of the EDD into a RD in Spain has not progress much due to the in-depth reform of the Spanish electricity sector; the new Electricity Sector Law 24/2013 supported the electricity production by cogeneration, with a remuneration system, enough to reach the minimum income needed.

The National Markets and Competition Commission (CNMC) is the responsible body to guarantee the origin of electricity, as well as managing the entry system, enabling electricity producers which use renewable energy sources or high-efficiency cogeneration to demonstrate that the origin of the electricity.

The efficient heating and cooling networks, also called district heating and cooling networks. In Spain, the actual network only satisfies the demand of the equivalent to 65,000 homes. In 2013 the installed capacity was 608 MW for heating and 248 MW for cooling. From the total of 200 networks identified 86% produce only heat, while only a 2% produce cooling. Most of these supply to the tertiary sector (68.71%), followed by residential (22.66%) and industry only 9%. Still, no clear measures have to date been launched in Spain.

Finally, Energy Efficiency in the transformation, transmission and distribution of the energy system and also ease the consumer decision are described. In the last years, the Spanish energy sector and the electricity sector in particular has experienced many reforms. In 2013 alone, RD Law 9/2013, Law 24/2013 on the electricity sector, RD 1047/2013 that calculates the remuneration for electricity transmission, RD 1048/2013 that calculates the remuneration for electricity transmission, RD/2014 that establishes the methodology for the calculating voluntary prices for small electricity consumers and its legal framework for procurement.

7.2.3 Sectoral analyses

Construction

In 2012, the final energy consumption in the building sector in Spain was 25,534 kToe, representing a 30.8% of the total national consumption, 82,991 kToe. 15,466 kToe of this consumption derived from the domestic building sector, being 18.6% of the national energy consumption, while 10,068 kToe derived from the services building sector, representing 12.1% of the total national energy consumption. There is a need to improve the energy efficiency in the building sector, the Spanish NEEAP 2014-2020 sets as a target that the building and equipment segment should save annually 87.1 kToe, representing a 15% of the total annual savings target on energy in Spain (571 kToe/year).

The total dwellings' stock in 2012 was 25,382,415 dwellings, comprising 10 million buildings, occupying 2,500 million m^2 of usable surface, from which 2,100 million m^2 have domestic use and 400 million m^2 are

for tertiary or service use. That makes a total stock of 9,720,304 buildings users as main dwellings or for domestic use and 393,956 buildings for use in the tertiary or services sectors. The renovation market is very small compared to the new buildings market, after the real estate boom in 2006 when 737,186 new buildings were built and only 23,128 dwellings were rehabilitated. The construction of new dwellings decreased sharply during years of the crisis, down to around 125,000 dwellings in 2009 and less than 75,000 dwellings in 2012; while the rehabilitated dwellings have kept constant between the 10,000 and 20,000 annually (Minetur, 2014b, p. 89). It is a clear sign of the need to invest and foster the energy efficiency renovations.

The Energy Performance Directive establishes that the energy performance certificates are to be included in all advertisement for sale or rental o buildings, for the renter or purchaser to be informed of the consumption of the house or flat. In Spain, RD 235/2013 transposes the 2010/31/CE directive, in which states that each regional government legislates and registers the energy efficiency certificate and the external control, in which any architect or engineer could subscribe this energy certification. The procedure established seems to be a more bureaucracy process than a real instrument to foster the energy efficiency.

Also, RD 238/2013 transposes the article of the 2010/31/CE regarding the inspection schemes for heating and air conditioning system, which are again the regional government who regulates these inspections. The Regulation of Thermal Installations in Buildings (RITE) is also affected by the Directive transposition; RITE establishes the performance values of the heating and cooling equipment of new installations.

The most important point of this Directive is the target to have nearly zero energy buildings (NZEB) by the end of 2020, and the public building by the end of 2018, so new buildings should be projected under these parameters and also the renovation of the actual building stock is a must, so the EU countries must set minimum energy performance requirement for new buildings as well as for major renovation or retrofit of buildings. The Spanish Technical Code for Edification (CTE), approved by RD 314/2006 has been recently updated by the Order FOM/1635/2013 which establishes limitations on energy consumption, energy demand of heating and cooling and energy efficiency on lighting, and obligates the usage of renewable energies to produce and cover a certain percentage of the energy consumption.

The last remarkable point on the Building Renovation Directive is the obligation for EU countries to provide list of financial measures to improve the energy efficiency in Buildings. The list of financial measures for Spain can be found in the NEEAP 2014-2020:

- PAREER: Aid Programme for Energy Renovation of Existing Buildings in the residential sector, with the aim to encourage and promote integral measures which favour energy savings, energy efficiency improvement and use of renewable energies in existing buildings, the budget is 125M€. The second part of the PAREER program, called PAREER-CRECE has a budget of 200M€; and the typologies of the aid could be regarding the thermal envelope, thermal installations, biomass and geothermal installations.
- JESSICA-FIDAE, aiming to fund sustainable urban development improving energy efficiency and use renewable energies, and that are developed by ESCOs or private companies, the budget is 122M€.
- PIMA SOL, devoted to reduce the consumption in the tertiary sector by their energetic renovation.
- State plan for promotion of rental housing, building restoration and urban regeneration and renovation, 2013-2016 (RD 233/2013).

On buildings, the Energy Efficiency Directive states that the EU countries have to plan the national building renovation strategies, Spain has launched, according to the Article 4 of the Energy Efficiency Directive the “Long-term strategy for energy renovation in building sector in Spain” (European Commission, 2014). In the Spain NEEAP 2014-2020 it is recollected the points of the EED on make energy efficiency renovations to at

least 3% of the building owned or occupied by the central government, to do so, in the Spanish case, an inventory was done containing a total of 1,763 buildings which has a total energy consumption of 1,111 GWh/year; consisting mostly of electricity at 733 GWh/year (65.98%) and, to a lesser extent, diesel at 216 GWh/year (19.47%), natural gas at 148 GWh/year (13.33%) and propane at 13.5 GWh/year (1.22%). The average consumption ratio for the entire stock is 99.2 kWh/m² per year. To achieve the objective of renovating annually a 3% of the surface, this accounts for a surface of 336,007m2/year to be renovated. In addition to that, the EU governments should only purchase high energy efficient buildings, as well as for the other public bodies for regional governments.

The following Figure 52 represents the policies and regulations that have influenced the construction sector, particularly its energy efficiency in the last years. Below the timeline, an overview the different elements that have driven the energy consumption in the construction sector in Spain are presented.

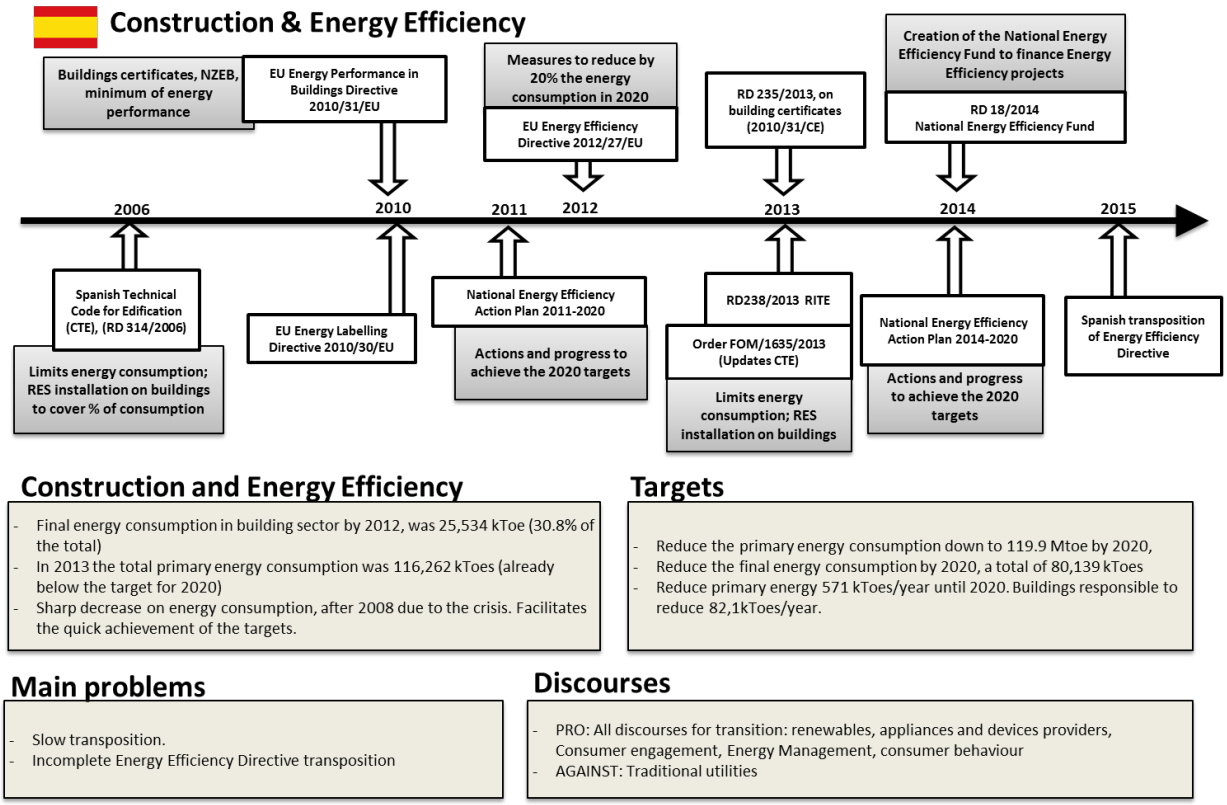


Figure 52: Overview of the construction sector in Spain

Transport

The transport sector includes vehicles, equipment and actions to move passengers or freight. According to its typology, the transport could be divided in: Ground transport, air transport and sea/river transport. In 2012, the final energy in the transport sector was 33,229 kToe, representing almost 40% of the total national energy (82,991 kToe). Since 1996, the transport sector has been the largest energy consumer in Spain, always moving around the 40% of the total energy consumption.

The high level of vehicle's use, an old automobile stock and a low percentage of freight transport by railway; made this sector highly dependent on a single fuel source, 94,3% of the demand are related to oil products; having also a high environmental impact (24% of the total CO_2 emissions).

Spain is still one of the largest energy consumers in transportation of passengers with an almost 0.04 koe/pkm (kilograms of equivalent oil per passenger per kilometre), much higher than the EU average

placed in 0.033 koe/pkm. On the contrary, the transportation of freight indicator for Spain is 0.042 koe/pkm, a bit lower than the EU average that is above the 0,05 koe/pkm (Minetur, 2014b, p. 117). The last figure needed to be commented regards the energy intensity in the transportation sector in Spain, although from 2007 (0.044 koe/€05p) to 2012 (0.035 koe/€05p) it can be seen a constant decrease; it is still above the EU average placed around 0.03 koe/€05p.

All these figures and facts, made Spain adopt measures on energy efficiency on transportation:

Actions focused on promoting mode change mobility towards more energy-efficient ones, according to the "Spanish Sustainable Mobility Strategy (EEMS), municipalities with more than 50.000 inhabitants launched mobility urban plans. Moreover, the law 22/2013 includes the application of evaluation mechanism for evaluation of energy efficiency in the concession of state aids for public transport systems. The aims are to promote sustainable mobility plans to achieve changes on transport modality, user more efficient modes in detriment of private, low-occupancy vehicles, using modes which not consume fossil fuels, promoting cycling and walking.

Actions to improve the efficiency of technologies in transport by renewing fleets; in that sense Spain approved a set of plans, such as the PIVE (Efficient Vehicle Incentive Plan) and PIMA Aire (environmental stimulus plan). These plans were created giving response to the Directive 2008/50/EC on compliance off municipal strategies for improving air quality; as well as to the article 106 of the Sustainable Economy law 2/2011 on the public purchasing of clean and energy-efficient road transport vehicles.

After 7 successful PIVE plan, currently Spain has launched the PIVE Plan 8 (RD 380/2015) which regulates the subsidies of the "Incentives of Efficient Vehicle Program", with a budget of 225M€. PIVE aims to incentive the change of 300.000 vehicles older than 10 years for passenger cars and 7 years for commercial vehicles. The conclusions of the study show that the new vehicles promoted under the PIVE programs reduced the fuel consumption and CO_2 emissions by 30% on average compare to the scrapped vehicles; from 166 grCO_2/km to 116.3 gCO_2/km, accomplishing the emissions reduction target on RD 433/2009.

The other focus of attention is the promotion of the Electric Vehicle, with the approval of the Integrated Electric Vehicle Stimulus Plan (April 2010). In the regulation, RD 647/2011 approved introduces a new rate for time-based energy supply to encourage night time recharging; this law also approved the 11 registered charge managers in Spain authorised to sell electricity for recharging vehicles. The incentives for the Electric Vehicle purchasing started in 2006, up to now all the incentive resulted into the purchase of around 6,880 vehicles and the installations of 800 public recharging points; Spain accumulated a total of 9.000 registered electric vehicles, preventing the emissions of 127,500 ton of CO_2 emissions during all of its life-time.

In 2014, the MOVELE plan was launched with a budget of 10M€ to encourage the purchase of 3,500 electric, plug-in or extended range of electric vehicles. In 2015, RD 287/2015 approved the MOVELE 2015 plan, which finance part of the EV cost. Spain will consider also measures to promote the infrastructure that support alternative transport fuels (LPG, gas, hydrogen, electricity and biofuels).

The contribution of the transport sector to the total of the 571 kToe/year of the targeted energy savings in Spain on the NEEAP, is 145.68 kToe/year which represents a 25.3%; and it is expected to be achieved by the measures and plans described above.

The following Figure 53 represents the policies and regulations that have influenced the transport sector in the last years. Below the timeline, an overview of different elements that allow a better understanding of the policy making in the transport sector in Spain are presented.

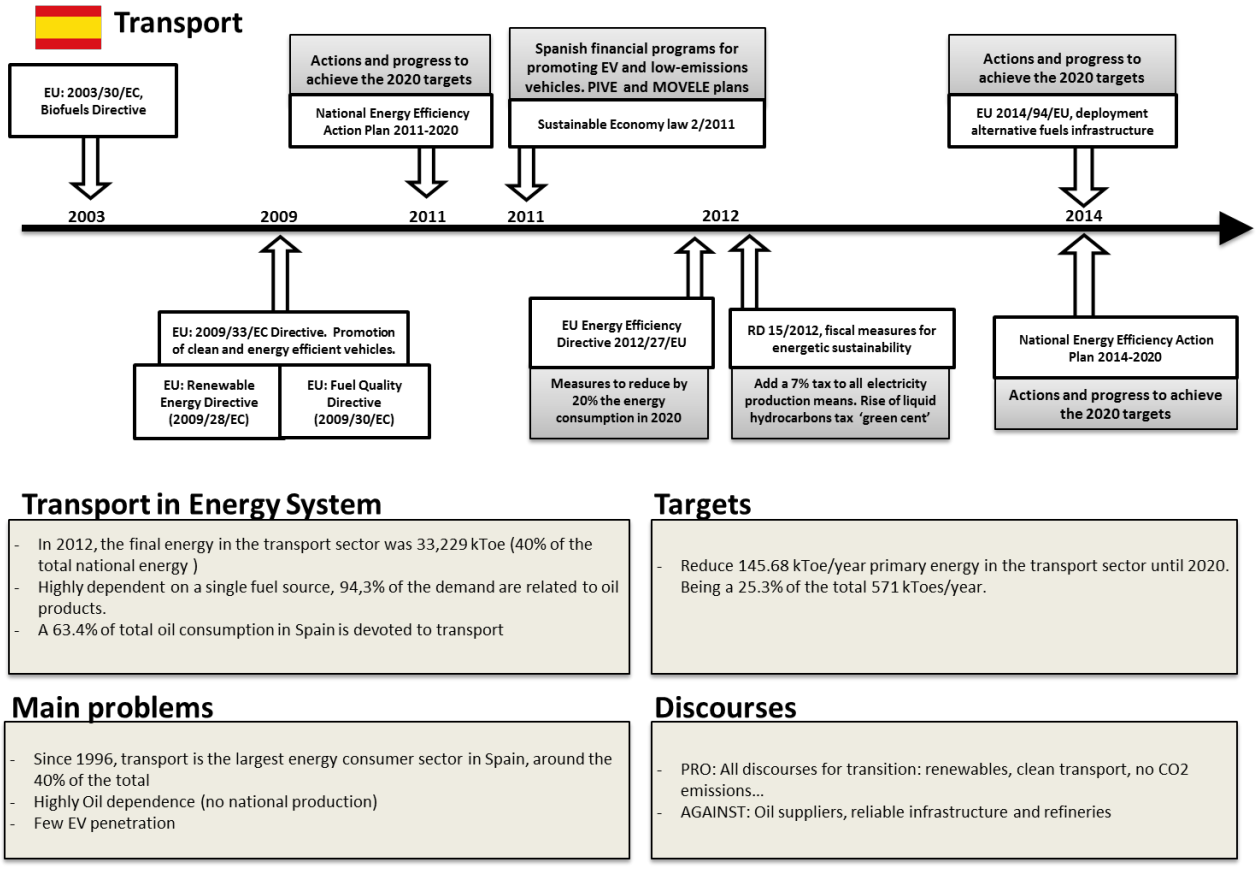


Figure 53: Overview of the transport sector in Spain

7.3 United Kingdom

7.3.1 Energy supply and its related regulation

National overview

The Department for Energy and Climate Change (DECC) indicate that in 1970, fuel consumption was dominated by solid fuel use (e.g. coal) and petroleum that, in total, accounted for 91% of total energy consumption (DECC, 2015a). From the 1980s, the energy mix had diversified and evolved with North Sea gas resources coming on line. Thus, the proportion of solid fuel consumption fell to 36% and petroleum to 37%. The 1990s mirrored the energy supply of the 1980s. From 2000, changes in electricity generation and natural gas had become the dominant fuel responsible for 41% of all energy consumption in the UK, with solid fuels again decreasing from 31% to 16% (DECC, 2015a). Data from the DECC indicates that in 2014 more renewable fuels had entered the energy mix for both electricity and bioenergy consumption. Around 19% of electricity generated in 2014 came from renewable sources, a 4.2% increase from the previous year (DECC, 2015a). In 1970, solid fuels and petroleum accounted for around 91% of total primary energy consumption, gas for around 6% and primary electricity (including renewables) for the remaining 4% (DECC, 2015a). In 2014, solid fuels and petroleum accounted for 50%, gas for around 35%, bioenergy and waste for 5% and primary electricity for 10% (DECC, 2015a).

Energy intensity is a measure of the energy efficiency of a nation's economy, and is calculated as units of energy per unit of GDP. High energy intensities indicate a high price or cost of converting energy into GDP, while the opposite is true for low energy intensities. Overall national energy intensity has fallen since 1970, yet by different amounts in each sector. Between 1970 and 2014, the energy intensity of the industrial sector had fallen by 71%, a quicker rate than all other sectors. In the same period, the service sector fell by 62% and the domestic sector by 37%). However, since 1995 the rate of decline in the industrial sector has slowed whilst the service sector has continued to decrease at an even rate, with changes in the domestic sector being dominated by weather related factors (DECC, 2015a). The only sector to see no significant change between 1970 and 2014 was the transport sector, which showed an increase of 5% with most peaks in this series occurring at times of economic slowdowns.

With respect to future statistics on the national overview of the energy supply and infrastructure little data are provided on how progress towards developing low-carbon energy will be sustained after 2020, apart from the development of nuclear power stations and fracking for shale gas that is expected to replace coal fired power stations.

Fossil Fuels

The world's first public gas works opened in Westminster in 1813, and within 15 years almost every large town and city in Britain had a gas works. The Gas Light and Coke Company supplied most of London's gas until the gas industry was nationalised in 1949. Gas was originally only used for lighting, but cooking with gas (for the wealthy) became popular after the Great Exhibition of 1851. Gas also began to be used for heating water around this time.

Coal remained the most popular fuel for space heating in buildings, but gas for heating grew in use when The Clean Air Act of 1956 restricted the use of solid fuel in urban areas. At this time a new process for developing gas from petroleum products emerged, with naphta or propane applied to produce gas at higher pressures than was possible with coal gasification. This gas could travel further and lead to the closure of many small local gas works. Industries began to adopt natural gas when it was imported to

Britain in 1960 because it was cheaper and cleaner than manufactured gas. Natural Gas was then discovered off the coast of Yorkshire in 1965. In the 1980s the government, led by Margaret Thatcher, decided to sell off the British Gas Corporation in what was then the biggest privatisation of a state-company in British history. The coal mining industry was later privatised in 1994.

The Department of Energy and Climate Change provides statistics on energy use in the UK. Observing domestic energy demand since 1970 (particularly in terms of heating) there is a noticeable shift away from solid fuels. This has been replaced, in the main, by gas coming from finds in the North Sea. Also, a shift towards greater electricity use accounts for part of this. The development of a bioenergy market since 1990 has seen an increase in consumption for fuels in this sector, where it accounts for approximately 8% of overall consumption in 2014. The 1970s, in part as a result of the oil price shocks of that period, saw a steady decline to the mid-1980s before remaining fairly steady since. It continues to make up the greatest share of the UK's domestic energy consumption.

The 2007 White Paper "Meeting the Energy Challenge" set out the UK Government's energy strategy to address the long term energy challenges faced by the UK. As part of this, the policy indicates four key policy goals:

1. To put the UK on a path to cut carbon emissions by 60% by 2050 (this target increased in 2008 to 80%), with real progress by 2050;
2. To maintain reliable energy supplies for the UK;
3. To ensure that every home is adequately and affordably heated;
4. To promote competitive markets in the UK and beyond to help raise sustainable economic growth and productivity.

While the policy recognises that "energy is essential in almost every aspect of our lives" and that tackling the dual challenge of climate change and providing low-carbon energy is integral, the policy outlines that means of heating, specifically the use of natural gas, should be increased. Yet the policy recognises that new methods of electricity generation is needed given that many of the UK's coal and nuclear power plants, built in the 1960's and 1970's will reach the end of their lives.

More recently, in 2015 following the election of the Conservative Party, the UK Government has altered its position on delivering energy from fossil fuels. Given that the UK has predominantly used fossil fuels to power its economy, and as outlined by the 2007 White Paper that additional methods of electricity generation are required in the future (beyond 2020), there have been substantial changes in policy towards fossil fuels. These policy changes are heavily influenced by previous legislation and policy such as the Climate Change Act 2008 and the Low Carbon Transition Plan 2009. Furthermore, international climate conferences such as COP 21 taking place in Paris has also reflected changes in national policy and public opinion towards the sue of fossils fuels as part of the UK's energy mix. These changes are outlined in the following sections. These shifts in energy policy reflect the changes in UK energy politics whereby the main political parties in the UK note that to reduce carbon emissions, substantial changes in the ways in which energy is generated is required.

Coal

While the UK has its own supply of coal it also imports coal, mainly from Russia (49%), Colombia (27%) and USA (20%) (DECC, 2015a), since it is now less expensive to do so than shallow pit mining. Also, due to the utilisation of shale gas for electricity generation in the USA there is more coal available there to export to the UK (DECC, 2014b). UK Coal Production Ltd is the largest producer of coal in the UK. They operate the UK's two deep mines in Yorkshire and Nottinghamshire. One of these is projected to close shortly due to a

perceived unprofitability. A third already closed in 2013. Other coal producers include HJ Banks & Co., Celtic Energy, Hall Construction, Hargreaves, The Kier Groups, Land Engineering and Miller Argent.

While policies such as the 2002 Energy Review indicated that the option of investment into clean coal technology, through carbon capture and storage, should be kept open. In a new direction for UK energy policy, the Energy and Climate Change Secretary Amber Rudd MP outlined that unabated coal-fired power stations will close by 2025 and that their use will be restricted from 2023 (DECC, 2015d). The Climate Change Secretary outlined that this action would place the UK as one of the first developed countries to deliver on a commitment to take coal off the system. Yet, in its place of energy generation would involve a shift to new gas production, nuclear power and targeted renewable energy. This change in policy from previous Acts indicates a significant policy change and approach to diversifying and sustaining the energy sector of the UK. The UK currently has 15 coal fired power stations:

- Aberthaw Power Station 1500MW - RWE npower
- Cottam Power Station 2008MW - EDF Energy
- Didcot A Power Station 2000 MW - RWE npower (closed 22 March 2013)
- Drax power station 3870MW - Drax Group
- Eggborough Power Station 1960MW - British Energy
- Ferrybridge Power Station 1995MW - SSE (units 1 and 2 will close by the end of 2015)
- Fiddlers Ferry Power Station 1961MW - SSE
- Ironbridge Power Station 970MW - E.ON (to close by the end of 2015)
- Kingsnorth power station 1940MW - E.ON (to close by the end of 2015)
- Lynemouth Power Station 420MW - Alcan
- Ratcliffe-on-Soar Power Station 2000MW - E.ON
- Rugeley Power Station 1006MW - International Power
- Tilbury Power Station 1131MW - RWE npower (to close by the end of 2015)
- West Burton Power Station 1972MW - EDF Energy
- Wilton Power Station 197MW - SembCorp Industries

The announcement made by the Energy and Climate Change Secretary places the emphasis of UK energy generation on natural gas, specifically shale gas (fracking), and nuclear power generation (DECC, 2015d). This emphasis is predominately directed towards new nuclear energy power stations, including those at Wylfa in Wales, Moorside in Cumbria and Hinkley Point in Somerset; which combined, could eventually provide almost a third of the low carbon electricity the UK needs.

The following figure represents the coal-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the coal sector in the UK are presented.

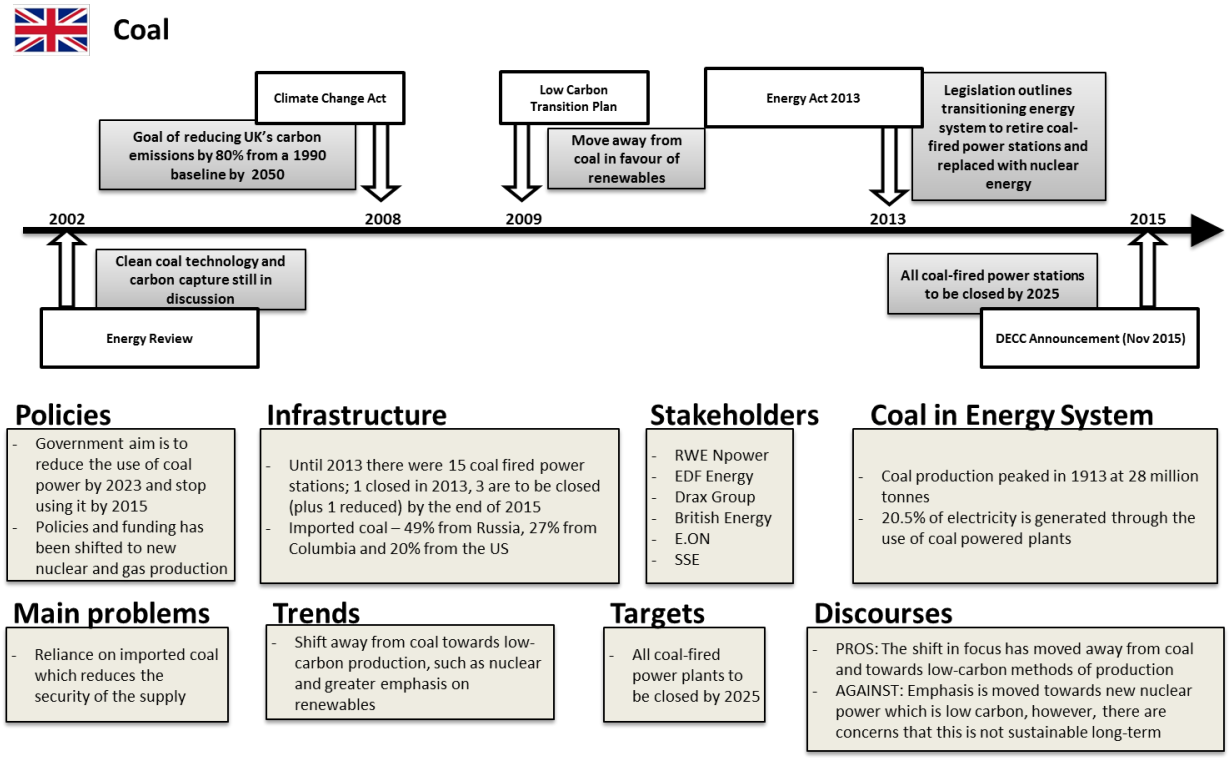


Figure 54: Coal policy overview in the UK

Oil

The Government is committed to ensuring that energy generation using oil reserves contributes to the UK energy mix. In so doing, the UK Government outlines an approach to utilising domestic oil reserves whilst reducing the dependence on foreign imports of coal, oil and gas. Consequently, energy generation from domestic oil reserves is to be sourced from the North Sea, specifically the United Kingdom Continental Shelf. However, in 2015, oil provided only 2.5% of electricity production given oil production had already peaked in the 1980's and late 1990's. With the decommissioning of all unabated coal-fired power stations, oil production is unlikely to grow. Rather, the DECC are committed to natural gas and new nuclear power stations to minimise the growth of carbon emissions (DECC, 2015d). The UK currently imports oil from Norway, Russia and the OPEC countries (DECC, 2014b). The UK is a net importer of oil since 2005.

The following figure represents the oil-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the oil sector in the UK are presented.

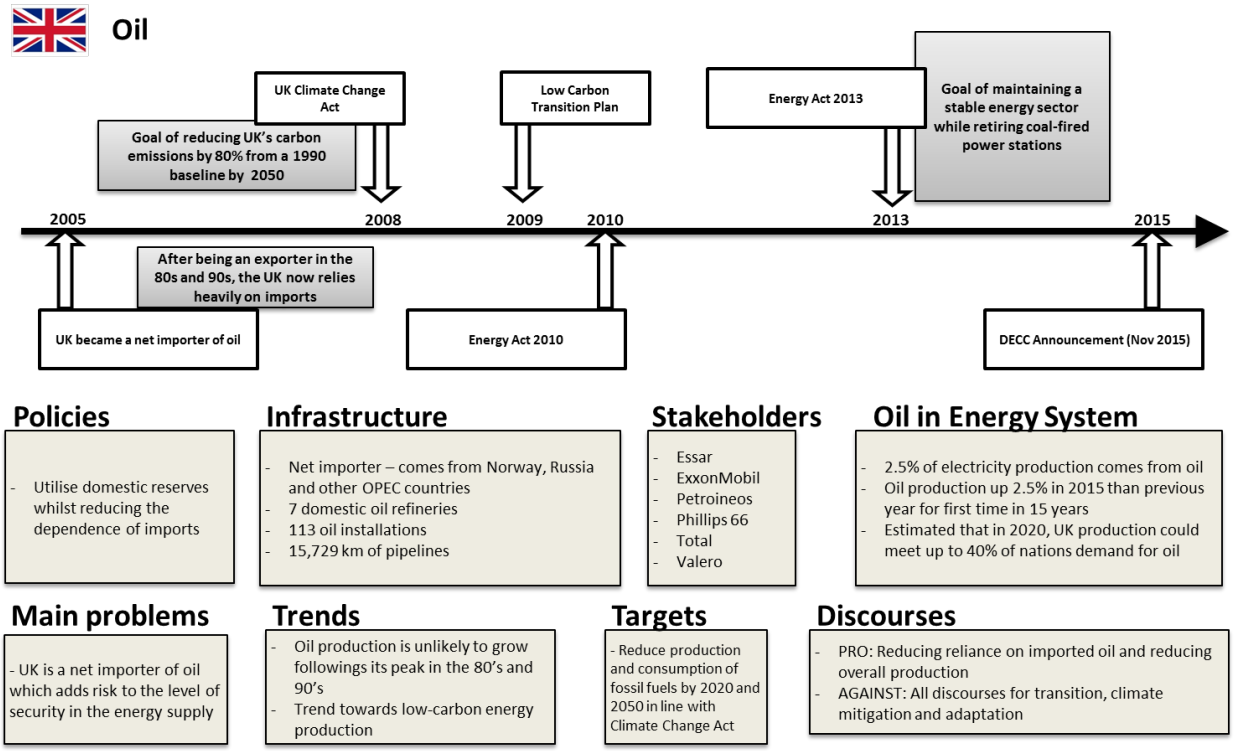


Figure 55: Oil policy overview in the UK

Gas

Natural Gas production in the UK is also in decline due to the fall in production in the UK's Continental Shelf (UKCS). The UK also imports gas from Norway, Belgium and the Netherlands (via pipeline), LNG Gas (by ship from Qatar) (USEIA, 2015). Until 2004 Britain was a net exporter of gas (Gloystein, 2012). Although the UK has the ninth lowest level of import dependency in the EU (DECC, 2014b), it is estimated that gas production is falling to such an extent that by 2020 the UK will be reliant on imports to about 70% of its gas needs (Critchlow, 2014). British Natural Gas companies include: British Gas, Npower, Powergen, Scottish Power, Scottish & Southern Energy Plc, and EdF Energy.

Natural gas provided 30.2% of the UK electricity mix for the second quarter in 2015. In order to make the transition from closing all coal-fired power stations to lower carbon sources of energy, the UK Government has suggested to increase the growth of shale gas exploration and exploitation to add new sources of home-grown supply to the diversity of imports (DECC, 2015d). This, therefore, places the UK at a turning point in fracking natural gas. Substantial opposition to fracking exists within the UK, particularly in rural areas and SSSIs. This could become one of the major barriers to enhancing the growth of natural gas within the UK's energy mix. In the Spending Review and Autumn Statement by Chancellor of the Exchequer George Osborne on 25th November 2015, it was announced that spending on energy research is to be doubled and a new Shale Wealth Fund of up to £1bn for communities affected by the fracking industry (BBC News, 2015).

The following figure represents the gas-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the gas sector in the UK are presented.

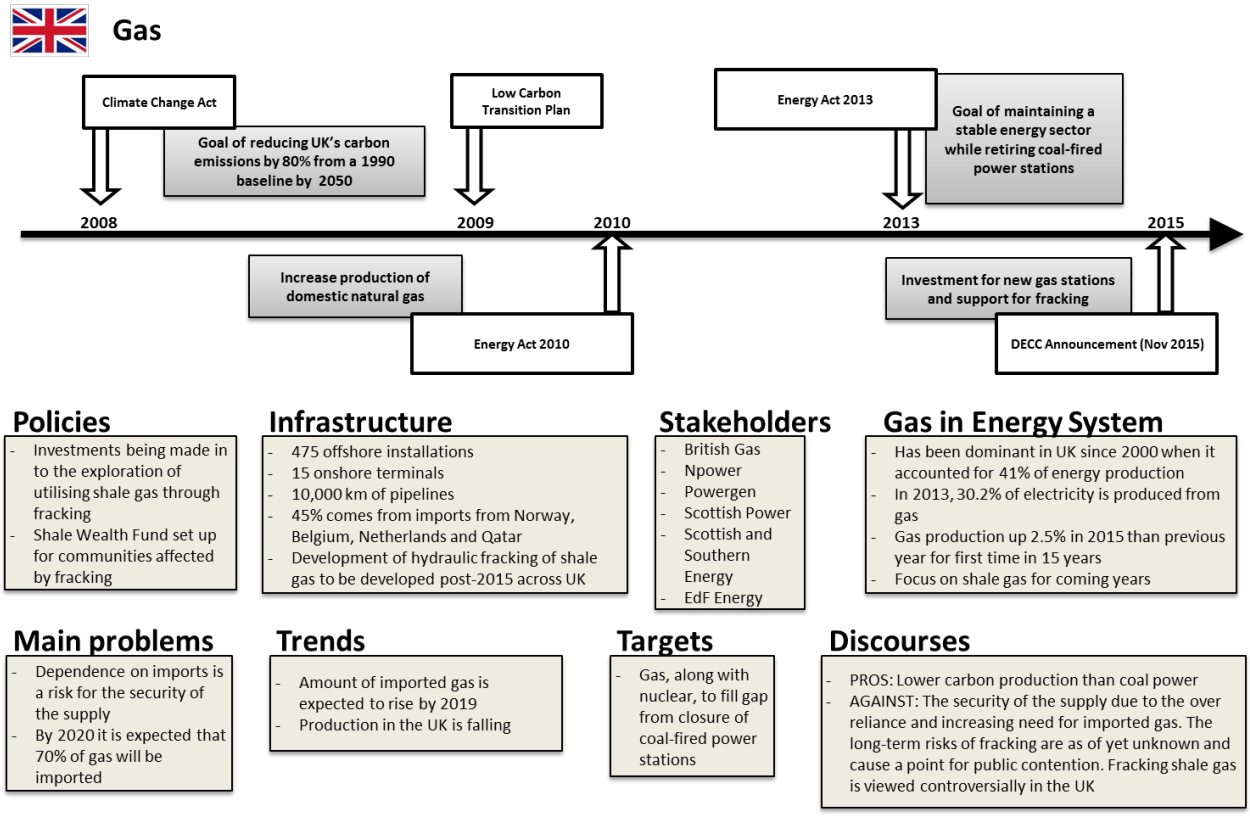


Figure 56: Gas policy overview in the UK

Nuclear

Nuclear power has been promoted in recent UK energy policy for the past 15 years. The 2002 Energy Review paper stated that options for nuclear power were to be 'kept open' with renewable energy capacity to be expanded to address climate change, yet in 2008 the UK Labour Government gave approval for a new generation of nuclear power stations to be built. The Energy Act 2013 outlines a number of positions on different energy resources. With respect to nuclear energy, the Act commits the UK to develop a new generation of nuclear power stations. The Act states that without building the capacity of new nuclear energy, the UK would be forced to rely on imported gas and energy security would be threatened. The Energy Act 2013 was directly influenced by the preceding Energy Act 2010, Low Carbon Transition Plan 2009 and Climate Change Act 2008.

The generation of nuclear energy is generally viewed positively by the three main political parties in the UK (e.g. Labour; Conservatives and the Liberal Democrats). However, the Scottish National Party who led the devolved government of Scotland is firmly opposed to nuclear power. Of those nuclear power stations that currently exist in Scotland, there are no plans for these to be recommissioned. As such, England and Wales remain the key locations for nuclear power generation. However, within England and Wales, the Green Party are firmly opposed to nuclear energy citing that nuclear power will not help meet short-term carbon reduction targets and carries inherent risks that could be vulnerable to design failure or natural disasters.

Despite political opposition from the Green Party and SNP, the development of new nuclear power plants has received support and sites across the UK have been identified where plants will be built. It looks unlikely that support for nuclear power will change. The construction of any new nuclear power plants in the UK will be led and financed by the private sector. This transfers any immediate concerns to the

operator while minimising any government intervention and liability. The development of the new nuclear power plant at Hinkley Point will be developed in collaboration between EDF Energy and China General Nuclear Power Corporation (CGN). This collaborative venture between two corporations illustrates the increasing internationalisation of the UK's energy sector, seeking to attract funding from other nations to develop a low-carbon energy future. Further sites have also received investment from CGN at Sizewell in Suffolk and Bradwell in Essex.

The UK is currently reforming its energy sector and the Energy Act 2013 places an increasing emphasis on nuclear power. There are currently 9 nuclear power plants in the UK and with the development of a further 3 sites (minimum) that have been suggested in 2015. Nuclear energy is viewed as an important part of the UK's energy mix that will replace the majority of coal-fired power stations in the UK. This step is viewed as substantially contributing towards developing a low-carbon future and meeting the targets in the UK Climate Change Act 2008. Conversely, the devolved government of Scotland relies on the contribution of North Sea oil for the majority of its energy supply, yet in 2011 produced 35% of its energy from renewable sources.

There are few results regarding how the Energy Act 2013 is being implemented in terms of nuclear power as negotiations for the development of new sites across the UK are currently being discussed. Given the UK is committed to reducing carbon emissions in the Climate Change Act 2008, there is a need for low-carbon energy which the UK Government identify that nuclear power can fulfil a larger role for meeting carbon reduction targets whilst reducing the reliance on fossil fuels and imported gas.

While differences across the political spectrum have marred the debate on nuclear energy, public opinion has fluctuated, particularly in the last 10 years. In 2005, 62% of the UK public supported the use of nuclear power combined with renewable technologies, with 36% in support for nuclear alone. Since 2011, 63% support the use of nuclear power generation as part of the country's energy mix and recently in 2013 found that nuclear is the most popular choice to provide energy. In the wake of the Fukushima disaster in 2011, support for nuclear energy did drop, yet this recovered within a few months. There are currently 8 nuclear power stations in the UK, these are as follows:

- Bradwell, Essex;
- Hartlepool;
- Heysham, Lancashire;
- Hinkley Point, Somerset;
- Oldbury, South Gloucestershire;
- Sellafield, Cumbria;
- Sizewell, Suffolk;
- and Wylfa, Anglesey.

The UK currently has 16 nuclear reactors, although many of these are due to be retired or replaced with 11 new facilities in Somerset, Suffolk, Wales, Gloucestershire and Cumbria in the next decade. The first of these, which will be operated by the French power company EdF, is due to open in Hinkley Point, Somerset in 2023. A recent 2012 YouGov survey found that 63% of Britons support the use of nuclear power. The UK's nuclear plant capacity increased up to 1998 but has since declined with the closure of old stations.

Renewable Sources

In 2013, bioenergy accounted for 70.5% of renewable energy sources used, with most of the remainder coming from hydro and wind generation. Wind provided 21.8% and accounted for around six times the share of hydropower in terms of primary input (DECC, 2014a). Of the 11.2 million tonnes of oil equivalent

of primary energy use accounted for by renewables, 8.4 million tonnes was used to generate electricity, 1.7 million tonnes was used to generate heat and 1.1 million tonnes was used for road transport (DECC, 2014a).

Renewable energy use grew by 21% between 2012 and 2013 and is now nearly four and a half times the level it was in 2000 (as shown in Table 2). Observable in Table 2 is the significant rise of wind power, landfill gas, municipal waste combustion and solar power. Conversely, the use of co-firing and hydro power for renewable energy generation peaked in 2010 and 2012 respectively and its use has been declining. However, cuts to subsidies and feed-in tariffs by the current UK Government will significantly influence these figures. Yet despite cuts to solar energy and onshore wind power, the Government has decided to keep investments in offshore wind (DECC, 2015d). It should be acknowledged that this support is conditional upon the offshore wind technology becoming cheaper. A failure to do so from energy industry suggests that financial support from the Government will only apply to new nuclear and new gas (DECC, 2015d).

Table 17: Total use of renewables from 2000 to 2013 (DECC, 2014a)

Total use of renewables				**Thousand tonnes of oil equivalent**
	2000	**2010**	**2012**	**2013**
Solar PV and active solar heating	11	101	268	365
Wind	81	875	1,691	2,445
Hydro (large & small) and wave	437	307	455	404
Landfill gas	731	1,666	1,704	1,709
Sewage gas	169	286	300	318
Wood (domestic and industrial)	458	714	797	943
Municipal waste combustion	375	685	873	856
Heat pumps and deep geothermal	1	29	69	91
Transport biofuels	-	1,217	958	1,091
Cofiring	-	625	401	54
Other bioenergy	265	1,052	1,773	2,925
Total	2,529	7,560	9,287	11,201

A number of subsequent Energy Policies, Reviews and Acts have shaped renewable energy policy over the last 15 years. For example, in 2011, the government launched its Renewable Energy Roadmap, with a commitment to meeting its target of 15% of UK energy consumption from renewable sources by 2020. Much of this will be met by onshore and offshore wind energy projects, with significant investment into

marine energy technologies. Biomass, both in terms of electricity production and heat generation are also being promoted. In terms of micro-generation ground and air source heat pumps are also promoted. The Energy Act 2013 commits future UK Governments to produce 30% of electricity from renewable sources by 2020 and cut greenhouse gas emissions by 50% by 2025.

Across the UK, and in addition to overall UK renewable energy targets, the Devolved Administrations have set ambitious but achievable goals of their own. The Scottish Government aims to see renewable energy technologies deliver 100% of its electricity by 2020. While, the Northern Ireland Executive expects to see 40% of its electricity generated from renewable sources and 10% of its heating requirements by 2020. The Welsh Government estimates that it has the potential to produce twice the amount of electricity it currently uses from renewable sources by 2025, with 4 GW of this coming from marine energy.

Wind

Previous energy policies such as the Climate Change Act 2008; the Low Carbon Transition Plan 2009 and the Energy Act 2013 have stated that both onshore and offshore wind power is to play a substantial part of a renewable energy revolution that will transform the UK energy mix. Yet recent announcements by the Department for Energy and Climate Change have indicated that subsidies for onshore wind power are to cease and that offshore wind energy will only be financially supported if the cost of the technology is reduced (DECC, 2015d). As such the energy policy towards wind power has significantly changed since November 2015 as part of a new broader strategy to invest in the energy sector and facilitate the growth of low carbon energy, including new nuclear and gas (DECC, 2015d). This move represents a shift away from the dominance of coal-fired power stations that remain in place within the UK's energy mix.

The following figure represents the wind energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the wind energy sector in the UK are presented.

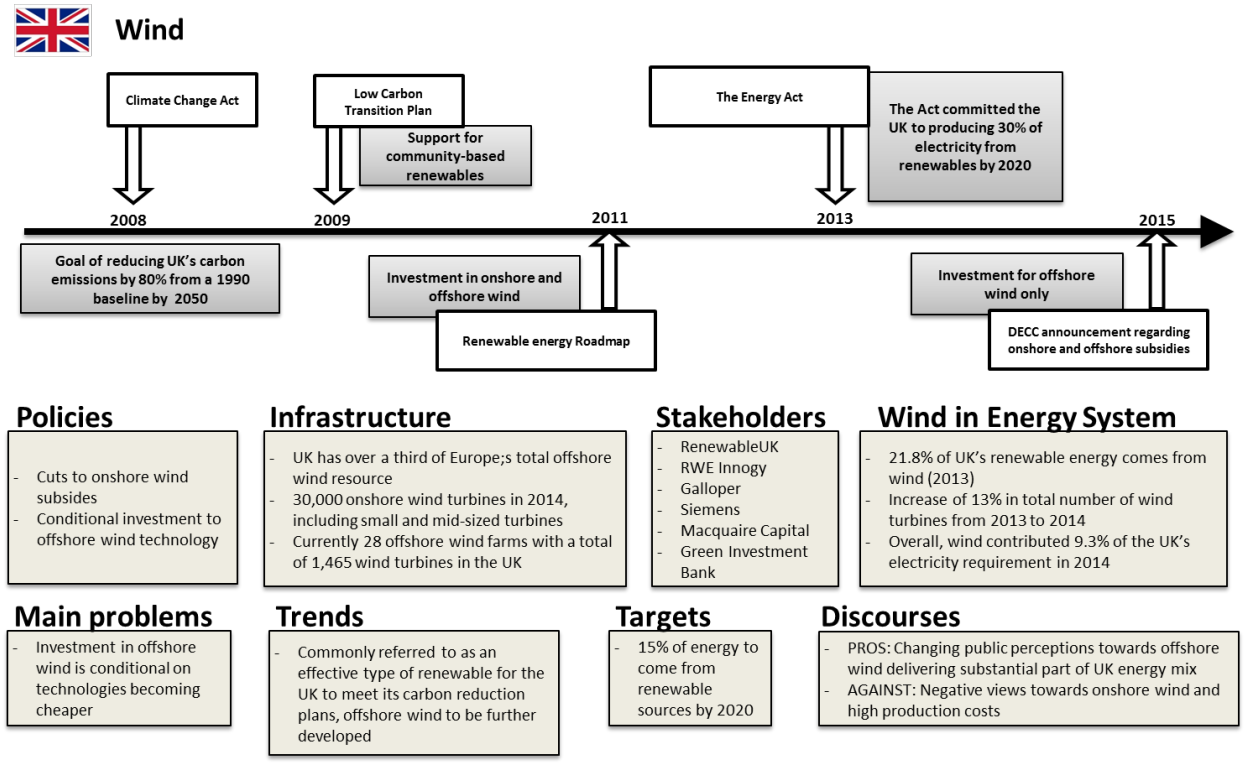


Figure 57: Wind energy policy overview in the UK

Solar

Much like wind power, subsequent energy policies have argued for solar energy to play a major part in contributing to the energy sector. Again, the Climate Change Act 2008; the Low Carbon Transition Plan 2009 and the Energy Act 2013 all indicate that the solar energy market, particularly domestic solar energy should be supported. Indeed, financial support has previously been provided as part of The Green Deal to encourage the growth of domestic solar energy. However, following the election of the Conservative Party in 2015, solar energy subsidies have been cut and the three largest solar energy companies in the UK have gone into administration (The Guardian, 2015; The Independent, 2015). Such policy changes against renewable sources of energy have been criticised as leading to carbon emission increases (BBC News, 2015b).

The following figure represents the solar energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the solar energy sector in the UK are presented.

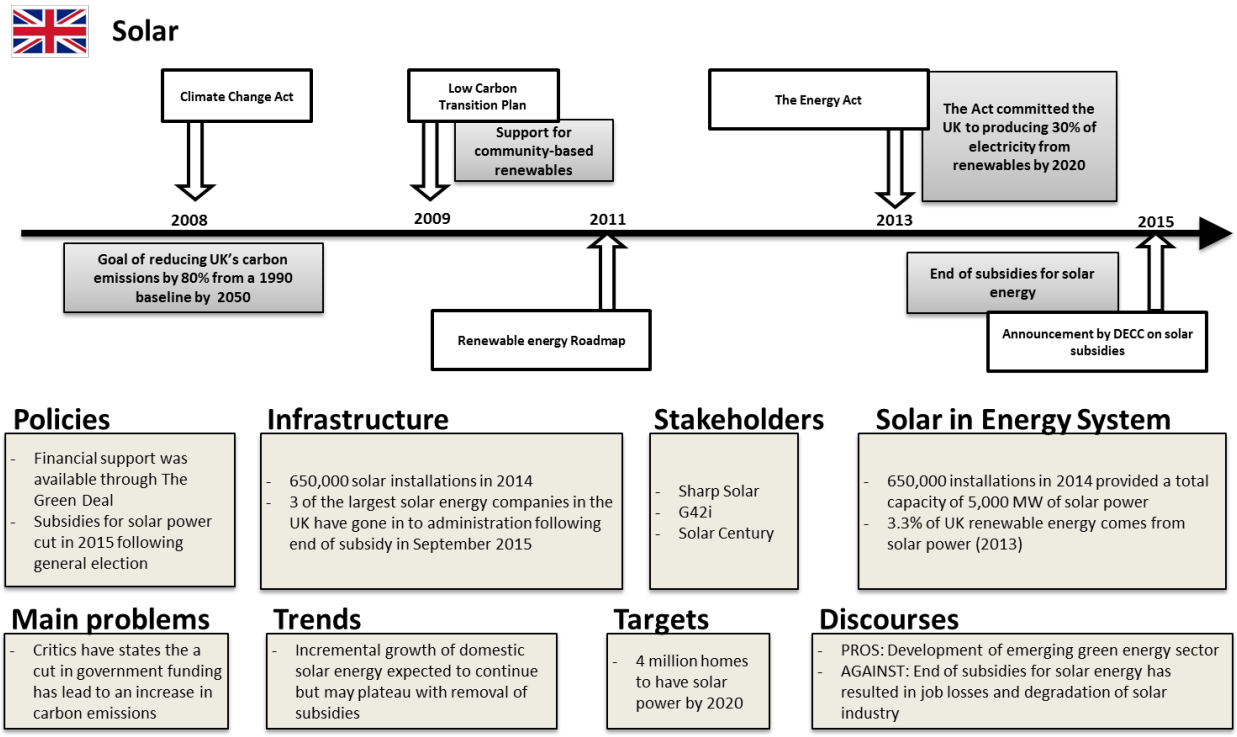


Figure 58: Solar energy policy overview in the UK

Hydropower and tidal

While not contributing as much energy as wind and solar power, the UK Government, since June 2015, has increased funding for hydro and tidal power. As part of this, there are projects seeking permission including the Mersey Estuary and those that have gained funding such as the Swansea tidal lagoon in Wales. The Swansea tidal lagoon is to provide power for 150,000 homes yet also provides substantial tourism opportunities. Such projects have been exemplified in the Low Carbon Transition Plan 2009 and the Energy Act 2013, yet until 2015 little progress has been made to their development following delays (The Guardian, 2015b).

The following figure represents the hydropower-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the hydropower sector in the UK are presented.

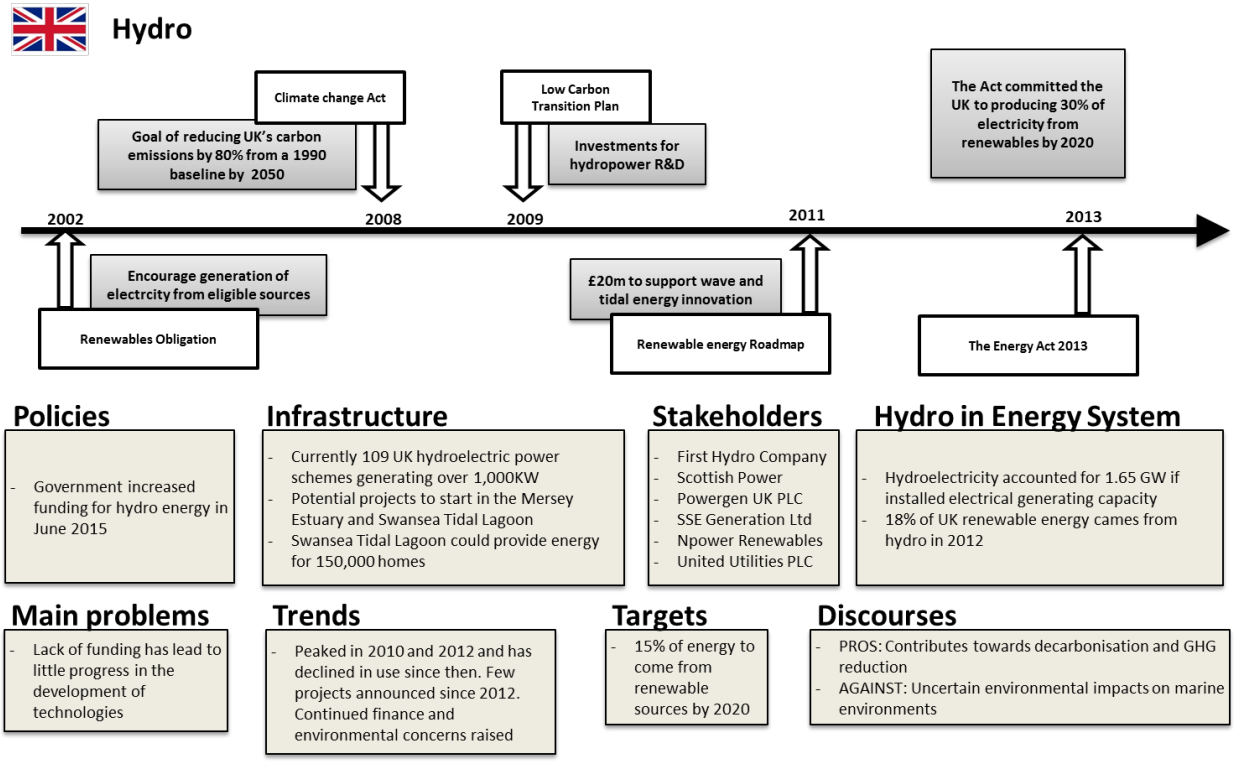


Figure 59: Hydro-Energy policy overview in the UK

Electricity

In 1881 street lighting became the first public supply of electricity. By 1921 there were more than 480 authorised suppliers of electricity in the UK. The Electricity Act of 1926 created a central authority to promote a national transmission network. The Electricity Act of 1947 brought the distribution and supply activities of 505 separate organisations in England and Wales under state control and integrated them into 12 regional area boards. The Electricity Act of 1957 established the Central Electricity Generating Board (CEGB) and the Electricity Council. Until the 1980s, coal was used to generate the majority of electricity. This share has since been overtaken by gas with under 20% each is derived from nuclear reactors and from renewables.

In 1990 under the Electricity Act 1989 the privatisation and restructuring of electricity saw the CEGBs assessed transferred to four companies – fossil-fuelled stations were divided between National Power and PowerGen, nuclear power stations were transferred to Nuclear Electric, the national grid and two pumped power stations were transferred to The National Grid Company, and the 12 area boards became 12 Regional Electricity Companies (RECs) (Mac Sweeney and Lennon, 2015). In 2005 the electricity industries of Scotland, Northern Ireland, England and Wales were integrated through the British Electricity Trading and Transmission Agreements introduced by the Energy Act 2004. The UK electricity network is connected to Ireland and France via inter-connectors that are used to import or export electricity when it is most economical.

With respect to electricity production, the share of generation from coal decreased from 28.2% in 2014 Quarter 2 to 20.5% in 2015 Quarter 2. The gas share of generation remained unchanged over the same period, at 30.2%. The nuclear share of generation fell from 22.2% in Quarter 2 of 2014 to 21.5% in the same Quarter in 2015. The share of renewables (hydro, wind and other renewables) increased from 16.7% in 2014 Quarter 2 to 25.3% in 2015 Quarter 2. This was due to increased wind and solar generation as well as the conversion of a second unit at Drax from coal to biomass.

In terms of electricity consumption per sector, fuel used by generators in 2015 Quarter 2 fell by 4% from 16.7MToe in 2014 Quarter 2 to 16Mtoe in 2015 Quarter 2. In 2015, gas use was 2.8% lower than in 2014 and coal use was 27.2% lower in 2015 than the previous year, while nuclear sources were 3.3% lower.

Final consumption of electricity rose by 1% in 2015 Quarter 2, from 71.1TWh in 2014 Quarter 2, to 71.9TWh. Domestic use fell by 0.6% from 24.3TWh to 24.2TWh as impacts of energy efficiency exceeded that of lower April and May temperatures. Industrial use of electricity, including iron and steel, rose by 0.8%, from 22.5TWh to 22.7TWh, and consumption by commercial and other users increased by 2.8. In Quarter 2 of 2015, temperatures were on average 1.2 degrees lower than in the same period during the previous year.

7.3.2 Energy Efficiency

The Low Carbon Transition Plan outlines a number of energy efficiency plans that seek to build momentum for further changes to energy infrastructure. The Plan outlines a "whole house approach" that details a number of areas where efficiency savings can be made. A 'whole house' approach means considering a household's energy needs and carbon dioxide impacts as a whole, and establishing a comprehensive package of measures to address them. The aim would be to include all the measures available that are suitable for a property and which could pay back through energy bill savings over their lifetime. This should result in a coordinated package, which will also include renewable energy measures where appropriate to the property. A key benefit of the 'whole house' approach is that it ensures that the needs of the property are assessed as a whole, that they happen in the right order, and that disruption is minimised.

This approach is supported by wider energy efficiency measures and community-based approaches, such as the Great British Refurb, Feed-in Tariffs for small-scale generation of renewable energy, and the Community Energy Saving Programme (outlined in Section 3.6.5).

The 2012 Energy Efficiency Strategy was a flagship policy document outlined by DECC as part of the UK Coalition Government's efforts to place energy efficiency at the heart of energy policy. The policy indicates a number of actions that comprise multiple stakeholders that implement specific measures within the strategy. In 2013, the UK Coalition Government published an update to its original energy efficiency strategy delivered in 2012 that places energy efficiency at the forefront of energy policy; focusing on supporting economic growth; households; the public sector and businesses. The energy efficiency strategy is noted to be at the heart of action to decarbonise the UK in a cost-effective way, maintain secure energy supplies, and increase business productivity. The policy responds to specific themes within the EU Energy Efficiency Directive 2012. The energy efficiency strategy outlines a number of key initiatives:

- The roll out of smart meters across the UK will commence from Autumn 2015 and expected to deliver a benefit of over £6 billion over the next 20 years, providing a platform for smart electricity grids and the development of a smarter energy market;

- Supporting organisations to gain access to finance to invest in energy efficiency from the UK Green Investment Bank (of which, energy efficiency is one of its key priorities). Established in 2012, the bank has £3.8 billion available to invest until March 2016;
- The energy entrepreneurs fun, worth £35 million, supports 31 companies to develop innovative technologies within the energy efficiency, building technologies, power generation and energy storage sectors; awarding grants of £16 million, with two-thirds developing energy efficiency products;
- The Green Deal supports improvements in a number of areas related to energy saving including: insulation (e.g. solid wall, cavity wall or loft insulation); heating improvements; draught-proofing; double glazing; and renewable energy generation (e.g. solar panels of ground source heat pumps). Launched in 2013, homes are assessed to help customers make energy-saving improvements;
- Alongside the Green Deal, the Energy Companies Obligation replaces the Carbon Emissions Reduction Target (CERT) and the Community Energy Saving Programme (CESP) provides added support for energy efficiency measures. It does so through three distinct targets. Firstly, the carbon emissions reduction obligation focuses on hard-to-treat homes and, in particular, measures that cannot be fully funded by the Green Deal. Secondly, the carbon saving community obligation focuses on the provision of insulation measures and connection to district heating systems to domestic energy users that live within an area of low income. Thirdly, the home heating cost reduction obligation under which suppliers provide measures which improve the ability of low income and vulnerable households to affordably heat their homes;
- The 2013 Budget committed the Government to ensuring all new homes are zero-carbon from 2016 that was reinforced with strengthening building regulations, which came into effect in April 2014. Alongside this, the commissioning of the Zero Carbon Hub to review differences between design and build performance in new housing to maximise energy efficiency performance in new build homes;
- The development of the Green Deal Communities scheme in July 2013 encourages local authorities working with community partners to develop innovative Green Deal projects. The Green Deal Communities scheme increases investment in energy efficiency for supporting hard-to-treat homes. This is supported by the Community Energy Strategy (published 2014) identifying the potential of community energy projects in the UK to bring benefits to communities, informed by community outreach programmes the Government has funded over a 12 month period;
- With respect to businesses, the Energy Efficiency Strategy outlines that the next manufacturing revolution programme that aims to gather support of organisations to stimulate greater resource and energy efficiency;
- £500 million in 2013 was signposted for the development of the ultra-low emissions vehicle market from 2015-2020, which builds on the £400 million package of support already committed between 2010 and 2015. Additionally, the Government is working with the Energy Saving Trust to ensure that there is publicly available information on the potential financial benefits of eco-driving.
- With respect to the rail network, the energy efficiency strategy indicates that further electrification of the network will bring substantial efficiency benefits such as reduced rail journeys, operating costs and dependency on fossil fuels;
- Through training schemes such as the Build Up Skills UK project, such programmes identify skills gaps and implement long-lasting training infrastructure to improve the skills related to the installation and maintenance of building energy efficiency technologies;
- Within the public sector, the Energy Efficiency Strategy outlines that a 25% reduction in greenhouse gas emissions from the central government estate will be made through energy efficiency measures and has implement an energy management system certified to the ISO15001 standard. This complies with the EU Energy Efficiency Directive 2012.

The Energy Efficiency Strategy was welcomed as supporting the Low Carbon Transition Plan, and outlining specific actions that will contribute towards the decarbonisation of the UK. Despite this, however, there have been a number of barriers that have impeded the progress of specific initiatives within the Energy

Efficiency Strategy, such as the Green Deal. This combined with a differing political ideological approaches towards addressing environmental issues has resulted in policy changes that have also led to the scrapping of the zero-carbon homes.

The Community Energy Strategy also supports energy efficiency in a number of ways, but primarily focused at the community level given that community-led action can often tackle the most difficult issues more effectively than government alone. Communities can mobilise and engage people effectively by tailoring their community engagement to an audience they understand well, using their existing presence and representative voice to good effect. As such, the Community Energy Strategy indicates a number of approaches that are of benefit to the identified 5,000 community energy projects that exist across the UK (Seyfang *et al.*, 2013). This is highlighted in Section 3.6.5, outlining the contribution of the community energy strategy that has a number of social impacts on the ways in which the public use energy and are influenced by Government policy.

7.3.3 Sectoral and horizontal analyses

Construction

The Low Carbon Transition Plan outlined in 2009 that new homes and communities were to be built to a high environmental standard. As such, the Plan indicated that all new homes will be built to a zero carbon standard from 2016, resulting in their net carbon emissions over a year will be zero. This policy to create zero carbon homes heavily relies on high standards of energy efficiency. Furthermore, this policy is underpinned by the Code for Sustainable Homes (2007), which supports the zero carbon target and the changes in regulation. In combination with the zero carbon homes policy, the Plan was supported by £100 million funding for local authorities to deliver new energy efficient homes. However, in Autumn 2015, the zero carbon home policy was scrapped by the UK Conservative Government after the election in May 2015.

Construction 2025 is a partnership between industry and Government to transform the construction industry, and aspires to achieve the following 4 goals:

1. A 33% reduction in both the initial cost of construction and the whole life cost of assets;
2. A 50% reduction in the overall time from inception to completion for new build and refurbished assets;
3. A 50% reduction in greenhouse gas emissions in the built environment;
4. A 50% reduction in the trade gap between total exports and total imports for construction products and materials.

The goals outlined in Construction 2025 are based on The 2011 Localism Act which contained a number of measures simplifying the planning system, incentivising growth and removing top down targets. Better design methods, the transition to a digital economy and applying new technology will all play a key part in the burgeoning of the Smart City agenda, where Construction 2025 outlines where the global market is set to be worth £200 billion per annum by 2030. As such, Construction 2025 outlines that the transition to a low carbon economy presents the UK construction industry with both opportunities and challenges. Construction 2025 indicates that there are a number of areas where the construction industry can, and should, position itself in driving opportunities and contributing to the low carbon agenda, such as energy efficiency and renewable energy technologies incorporated as part of improved design. Barriers to the Construction 2025 strategy are recent implications raised by the UK Conservative Government outlining several changes to existing green policies such as the Green Deal, another measure heavily referenced in

the strategy. As such, Construction 2025 may face a number of challenges related to building upon previous policies given support for these have been withdrawn.

The existing building stock in the UK is some of the oldest and most traditionally constructed in the EU. The performance of these buildings varies greatly. The first building regulations requiring energy efficiency were introduced in 1972 for new homes, and 1974 for non-domestic buildings. The UK has 27 million homes, and these are responsible for 32% of final energy use in the UK. Over three quarters of these homes were built before 1980 and one fifth are over 100 years old (DECC, 2014d). Energy Performance Certifications (EPCs) were introduced in compliance with the EU Energy Performance of Buildings Directive (EPBD), rating buildings from A to G, with A+ being the most efficient. Display Energy Certificates (DECs) are required for buildings occupied by a public authority where the building has over 1000m2 of usable floor area and is frequently visited by the public.

In addition to mandatory certification there are several schemes in place to assist with the transition to more sustainable energy use in buildings. The Green Deal provided targeted information about potential energy efficiency to households through a two-stage independent assessment. The first stage is based on the EPC, and the second is a more tailored report based on actual occupancy information. The Green Deal can then support households to install measures such as instillation, draught proofing, improved heating controls, double-glazing, and renewable energy technologies (DECC, 2014a). The Carbon Trust was originally set up by the government (and now a self-financing company) to promote energy efficiency and carbon reduction. The following figure represents the overall construction and energy efficient building policy overview in Italy.

The following figure represents the policies and regulations that have influenced the construction sector, particularly its energy efficiency in the last years. Below the timeline, an overview the different elements that have driven the energy consumption in the construction sector in the UK are presented.

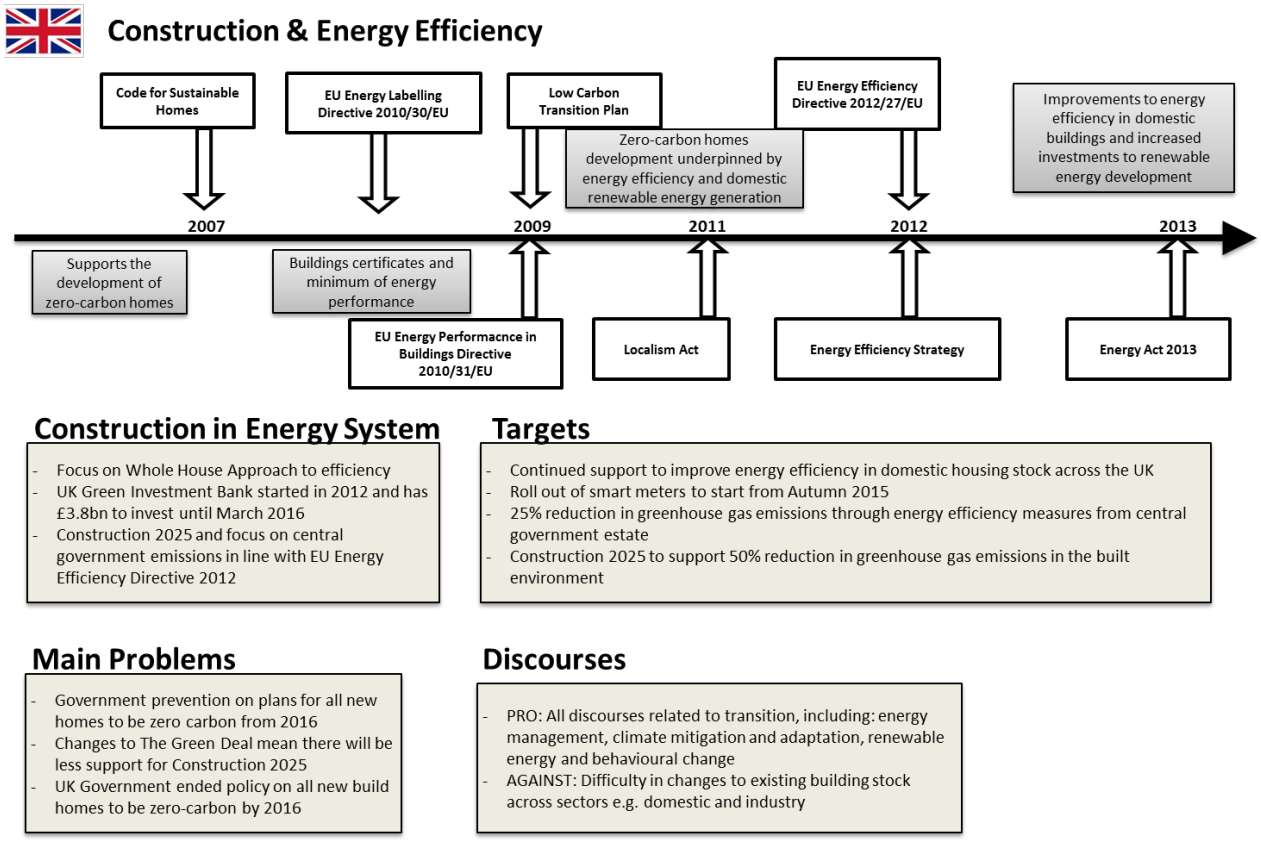


Figure 60: Overview of the construction sector in the UK

Transport

The Low Carbon Transition Plan outlines a number of approaches that aims to transform the transport sector. The first step is to improve the efficiency of our conventional vehicles so they emit less greenhouse gases. We must move away from petrol and diesel in the long-term. The Labour Government (1997-2010) is supporting the vehicles and fuels of the future and the radically different technologies needed. Cutting transport emissions is not just about changing technologies. The Government is helping people to make low carbon travel decisions. Emissions from international flights and ships are growing and the only effective way to tackle this is internationally. The Labour Government is pushing hard for an international agreement to reduce emissions from international aviation and shipping.

The Plan aims to undertake a range of market-based and financial incentives to support the development of a low-carbon transport network across a number of different transport sectors. While energy efficiency aims to support greater savings in energy across the transport sector, from design; building; and use, the Low Carbon Transition Plan seeks a broader change in transforming the transport sector:

- From 2011, the Government will provide financial assistance to between £2000 and £5000 to reduce the price of electric or plug-in hybrid cars;
- Invest up to £30 million between 2009-2011 in low-carbon bus technology;
- Regulate carbon dioxide emissions from all new car sales (in line with EU regulations) that must reduce 95g per kilometre;
- Set a target for the rail industry that makes the sector more efficient and will receive similar backing to the road networks. The rail industry also has environmental targets set through the High Level Output Specification;
- Committed £400 million to research and development under the Low Carbon Vehicle Innovation Platform;
- Enforce suppliers to ensure the share of biofuels increases to 5% of the fuel blend by 2013-2014;
- Under the EU Renewable Energy and Fuel Directive, source 10% of the UKs transport energy from renewable sources by 2020 and achieve a 6% decline in carbon emissions from the sector by 2020;
- Spend £140 million promoting cycling in the UK, particularly helping individuals integrate cycling and rail transport;
- From 2012, all European flights will become part of the EU Emissions Trading Scheme, resulting in air operators needing to build more efficient planes, reduce demand, and/or purchase emission allowances.

The announcement of a second generation of high speed rail lines in 2010 indicates the UK Governments' commitment to improving the efficiency to rail lines. High Speed Rail 2 (HS2) is a planned high spend rail network that will directly link the city centres of London, Leeds, Manchester and Birmingham. Extensions to the HS2 network to Newcastle and the central belt of Scotland have been proposed. Questions have been raised regarding the environmental impact of the rail network. Specifically, a number of research reports have suggested that there would be no net carbon benefit from the proposed HS2 network and instead have indicated that the project would likely to be roughly carbon neutral. Furthermore, the Eddington Report cautioned against a shift from aviation to high speed rail as a carbon emissions benefit as only 1.2% of UK carbon emissions arise from domestic commercial aviation. Given that rail transport energy efficiency is reduced as speed increases, the report indicates that there would be minimal carbon emission benefits. This is supported by the 2007 Government White Paper Delivering a Sustainable Railway that stated that trains travelling at 220mph used 90% more energy than at 125mph. However, the paper notes that with a

switch to carbon free or neutral energy production, the case for high speed rail becomes much more favourable. The UK Conservative Government is committed to delivering HS2 despite questions regarding environmental impact, property demolition and relocation of people's homes.

On a regional basis, the Greater London Authority (GLA) (through the Office of the Mayor) is committed to cutting greenhouse gas emissions (GHGs) by 60% from their 1990 levels by 2025. As a result, the GLA have rolled out a suite of measures to realise these goals. They include:

- The purchasing of 600 new Routemaster buses for the city's bus fleet with the latest electric hybrid engines in an effort to reduce CO_2, NOx and particulate emissions;
- Included to this fleet the GLA intends to incorporate eight hydrogen fuel buses on the important tourist bus route, the RV1 between Covent Garden and Tower Gateway. Plans to roll out fully electric buses along routes across the city with the first to be introduced between Croydon and Norwood Junction. Benefits envisaged include reductions in GHGs and noise pollution levels;
- Plans are in development to make London "Europe's electric vehicle capital", with infrastructure being put in place to accommodate privately owned electric vehicles. 1,400 charge points have been established, through Source London, to support this. The GLA has also provided a 100% discount for vehicles that emit less than 75 g/ CO_2 per km and meet the Euro 5 emission standard. Electric vehicle infrastructure has also been included in The London Plan.
- All new taxis will now need to be emission-free by 2018, since the 2014 licencing system came into effect. Working with Transport for London (TfL) and the Office of Low Emission Vehicles (OLEV), other measures are being explored to facilitate this transition to zero emission capable taxis;
- The Low Emission Zone (LEZ) is in operation across the greater London area and is in operation 365 days of the year. It operates under a system of charges, penalties and exclusion zones for high-polluting vehicles. It has also been proposed that by 2020 this will be replaced by an Ultra Low Emission Zone (ULEZ) for a central London. This would require cars to meet either a Euro 6 diesel emission standard or a Euro 4 petrol emission standard, with cars that do not meet these standards being subject to additional charges. It will also operate separately to the Congestion Charge.

Other UK cities have green transport policies of their own. In Bristol, a pilot project there saw one of the buses that service the main transport route to the airport being fuelled on methane harvested from Bristol Sewage Treatment Works. Across many UK cities, a pay-per-use bike scheme is in operation e.g. London and Liverpool. Such schemes have been introduced by local authorities to support the use of carbon-free methods of transportation and healthier lifestyles.

The following figure represents the policies and regulations that have influenced the transport sector in the last years. Below the timeline, an overview of different elements that allow a better understanding of the policy making in the transport sector in the UK are presented.

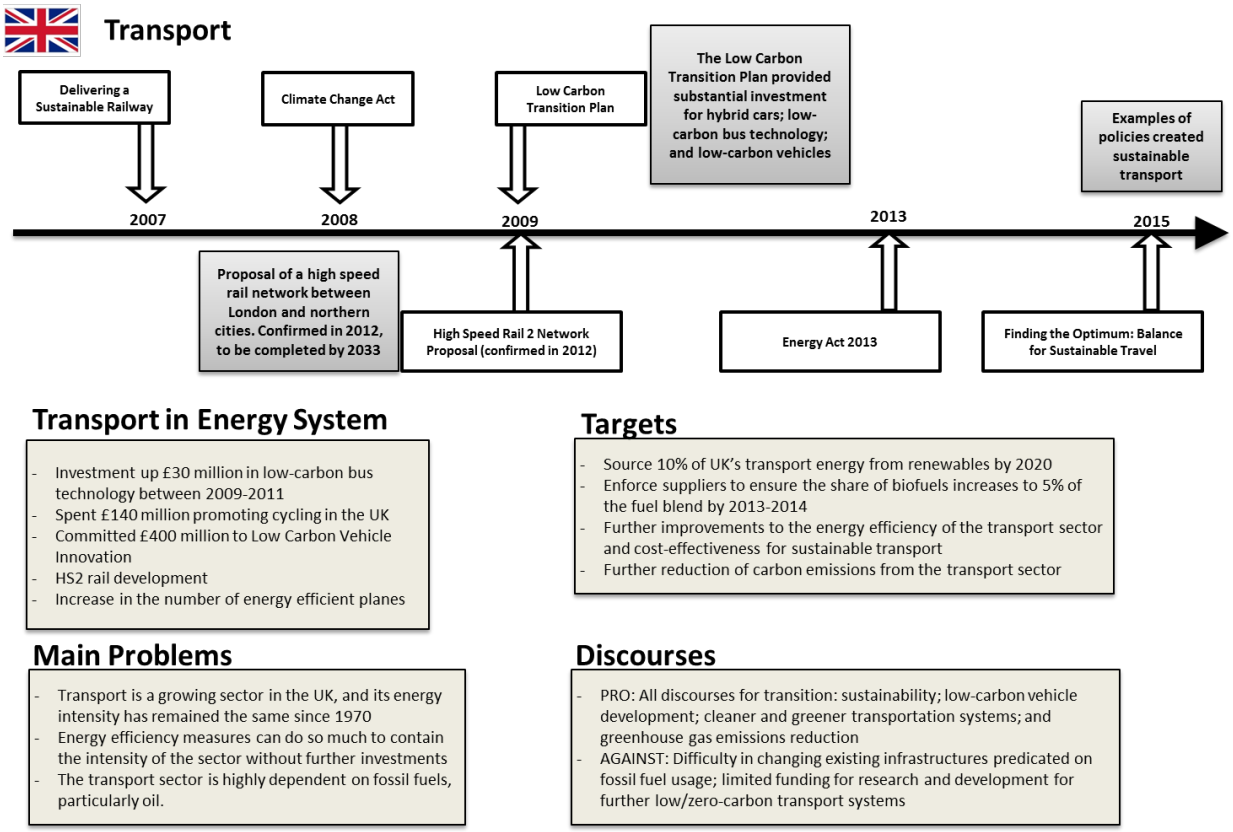


Figure 61: Overview of the transport sector in the UK

7.4 France

7.4.1 Energy supply and its related regulation

National overview

The next series of graphs illustrate the French energy situation. Figure 62 shows the energy mix in 1990 and 2014, allowing us to see how it has evolved in the last few years. In 2014, the domination of nuclear power is clear. With over 42% of the total primary energy mix, nuclear energy is well above the second energy source, oil, with around 30%. Nonetheless, fossil fuels combined (oil, natural gas and coal) amount to around 47.5% of primary energy needs of France. This is relatively low for an advanced economy.

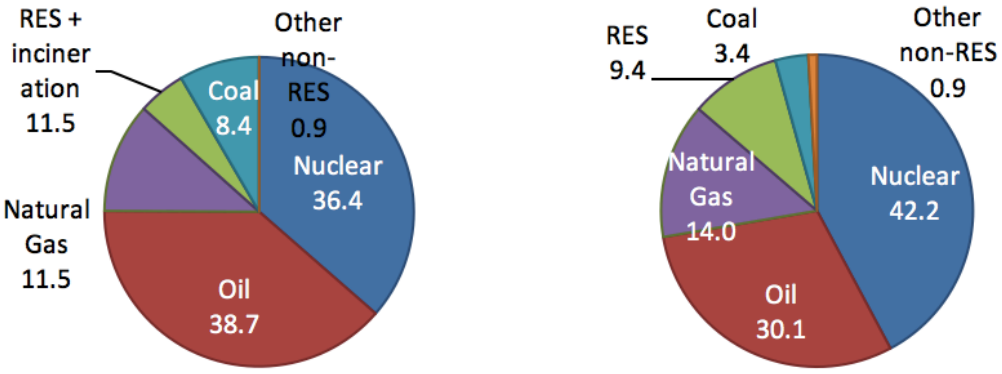


Figure 62: Primary Energy Breakdown in France (1990 & 2014)

When looking at the data from 1990-2014, two main changes appear: the strong decline of coal and the relative decrease of oil, which was then the first energy source. Natural gas is the only fossil fuel that rose in significance between 1990 and 2014. This simple trend is actually revealing the deeper, longer-term trend that France experienced since the oil crisis, from an oil-dependent mix, to a more diverse but nuclear-dependent one. In any case, the evolution between these years also shows that there is still a long way to go before reaching a carbon-neutral society even if coal has been virtually phased out and that oil is not as important as it used to be.

Fossil Fuels

As it was shown earlier, France still depends to a large degree on fossil fuels, especially the transport sector. Therefore, policies have tried to discourage the use of fossil fuels through taxation and other fiscal means and the financial support of alternative energy sources or energy efficiency. Industry-related laws, such as the Emission Trading Scheme, will be discussed under the Industry section later.

Coal

France does not exploit its coal reserves any longer, as its mines were not competitive. Overall, coal provides only a minor fraction of France's energy needs. However, through an industrial export agency, the Coface, France is subsidising the development of coal power plants. From 2011 to 2015, €1.2 billion was invested in coal projects, ranking fifth among OECD countries. Recently the government announced that these funds could not be invested any more in coal projects that did not include CO_2 capture and storage systems (Euractiv, 2015).

Oil

Oil use in France has declined by 12% between 1990 and 2014. The most significant declines relate to industry with a decrease of 76% and the residential-tertiary sector, with a drop of 43%. This most likely reflects deindustrialisation and the shift away from oil as a heating source (in favour of natural gas and electricity). The transportation sector, however, saw a rise of 11% in oil consumption. Transport is the largest oil-dependent sector by far, with 58% of total oil use. Transportation is thus a key problem in the decarbonisation of French energy needs, in spite of improvements in the energy efficiency of private vehicles. The fiscal tool to discourage oil use in France is called TICPE (Domestic tax on consumption of energy products).

Table 18: Oil use in France

Oil usage	Growth %	Quantity (Mtoe)		Shares %	
		1990	2014	1990	2014
Energy sector	**-45%**	**7.3**	**4.0**	**8%**	**5%**
Final consumption	**-14%**	**70.8**	**60.7**	**80%**	**78%**
Industry	-76%	9.3	2.2	11%	3%
Residential-tertiary	-43%	18.0	10.3	20%	13%
Transportation	11%	40.1	44.7	45%	58%
Agriculture	6%	3.3	3.5	4%	5%
Non-energy use	**22%**	**10.3**	**12.6**	**12%**	**16%**
Total	-12%	**88.3**	**77.4**	100%	100%

The following figure represents the oil-related policies and regulations in the few last years. Below the timeline, an overview of the different elements that have driven the oil sector in France are presented.

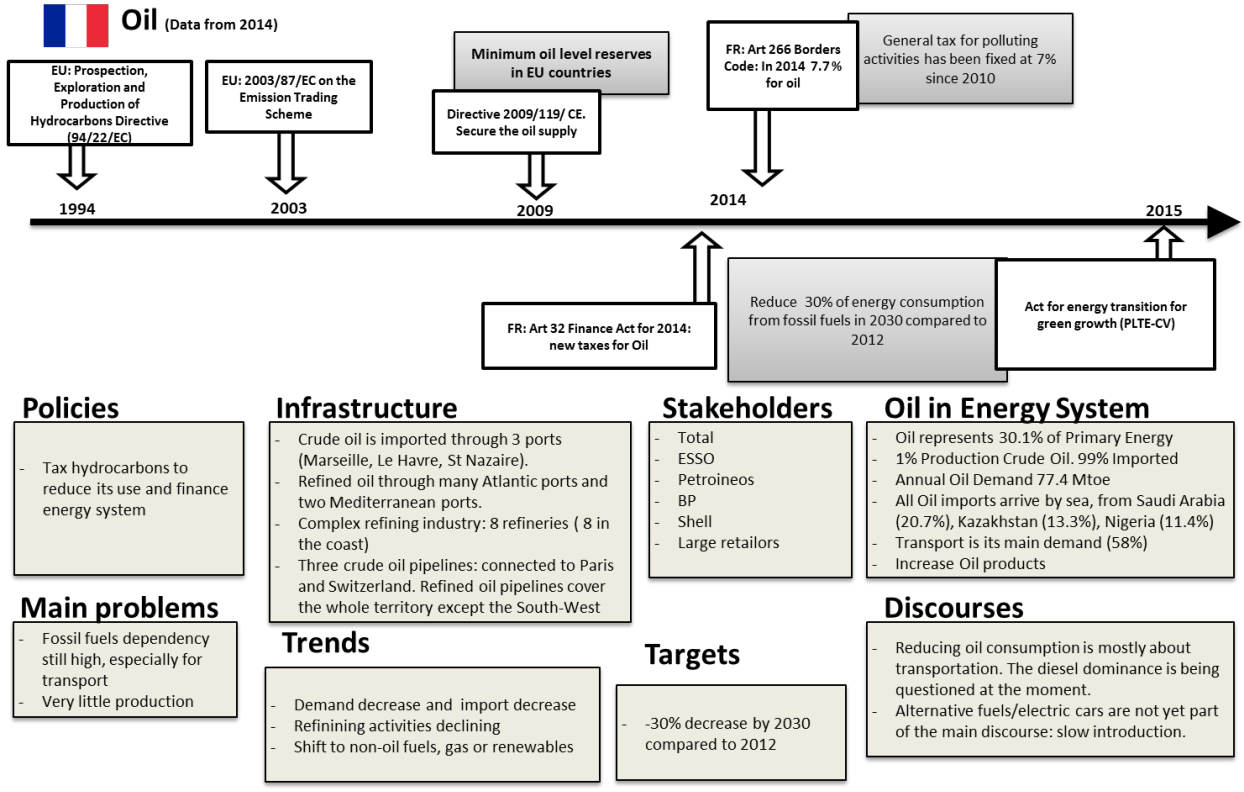


Figure 63: Oil policy overview in France

Gas

In 2011, France published a law banning hydraulic fracking for shale gas exploitation, contrary to other countries in the European Union, such as the United Kingdom. This decision was confirmed in 2013 by the Constitutional Council, because a Texan oil company, Schuepach, was contesting the new law. It is estimated that France may have one of the largest shale gas potentials in Europe.

Natural gas usage has shown a strong increase of 37% in France between 1990 and 2014. This was mostly due to an increase of 55% in the residential-tertiary sector. Almost two thirds of all natural gas is used by this sector.

Table 19: Natural Gas use in France

Natural gas usage	Growth %	Quantity (Mtoe)		Shares %	
		1990	2014	1990	2014
Energy sector	**200%**	**1.1**	**3.3**	**4%**	**9%**
Final consumption	**34%**	**23.3**	**31.3**	**89%**	**87%**
Industry	**2%**	9.3	9.5	**35%**	**26%**
Residential-tertiary	**55%**	13.8	21.4	**52%**	**60%**
Non-energy use	**-24%**	**1.7**	**1.3**	**6%**	**4%**
Total	**37%**	**26.3**	**35.9**	**100%**	**100%**

The following figure represents the gas-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the gas sector in France are presented.

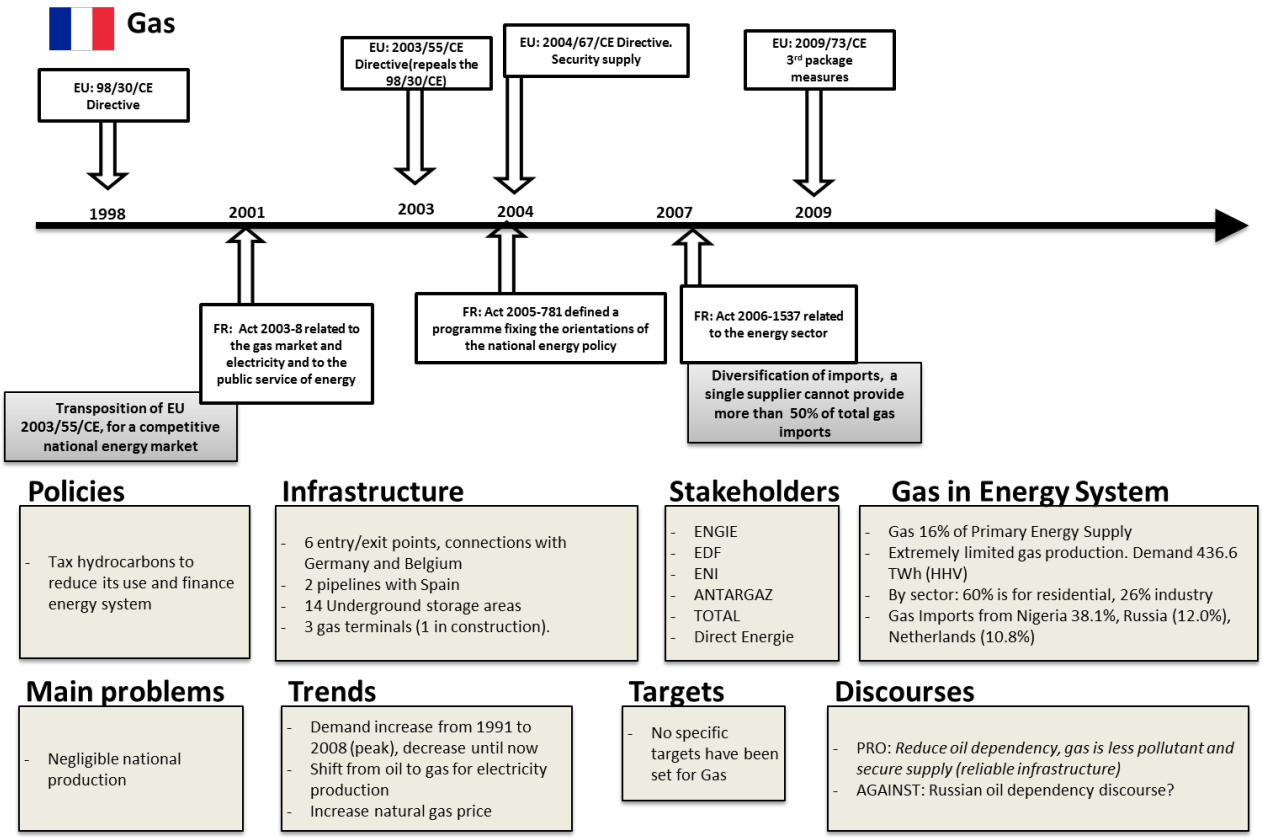


Figure 64: Gas policy overview in France

Nuclear Energy

France has 58 active nuclear reactors in 19 power plants. Additionally, three plants are being dismantled and 13 reactors have been permanently stopped. There is one single reactor, the EPR3 in Flamanville that is under construction at the moment. France is the second largest nuclear energy producer in the world after the United States, but is the country where nuclear energy is the largest percentage source of electricity production.

France's nuclear programme has been one of the largest and most ambitious in the world. None of it would have been possible without decades of public funds and support for this technology. As explained earlier, the oil crisis marked a key point in the history of the French nuclear industry. Although it was already developed, the troubles of the 1970s encouraged successive governments to invest more and faster in nuclear energy in order to boost energy independence (although nuclear ores are not domestic resources).

The last reactors to open were in the early 2000s, and since then, there is only one other reactor under construction, the EPR3 (European Pressurised Reactor, Third Generation). Because of successive delays, the reactor will not be open before late 2018, instead of 2012, the estimated date when construction began in 2007.

The only major policy change in recent times about nuclear energy can be found in the Energy Transition Law of 2015. For the first time in French history, nuclear energy is capped to the current nuclear capacity of 63.2 GW. This means that the opening of the EPR3 will lead to the closure of the oldest nuclear reactors (a campaign promise of Hollande that he admittedly will not able to hold). This cap also means that by 2025, nuclear energy cannot produce more than 50% of the total electricity production.

Alongside this change, EDF and the government are going to prolong the lifespan of current nuclear plants from 40 to 50 years. It usually takes about 2 years to refurbish a plant and get a permit for an additional 10 years. Since 2002, other measures mostly concern the organisation of nuclear safety authorities. The Fukushima nuclear catastrophe in Japan did not cause any major debate in France, although some safety measures were updated.

The following figure represents the nuclear energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the nuclear energy sector in France are presented.

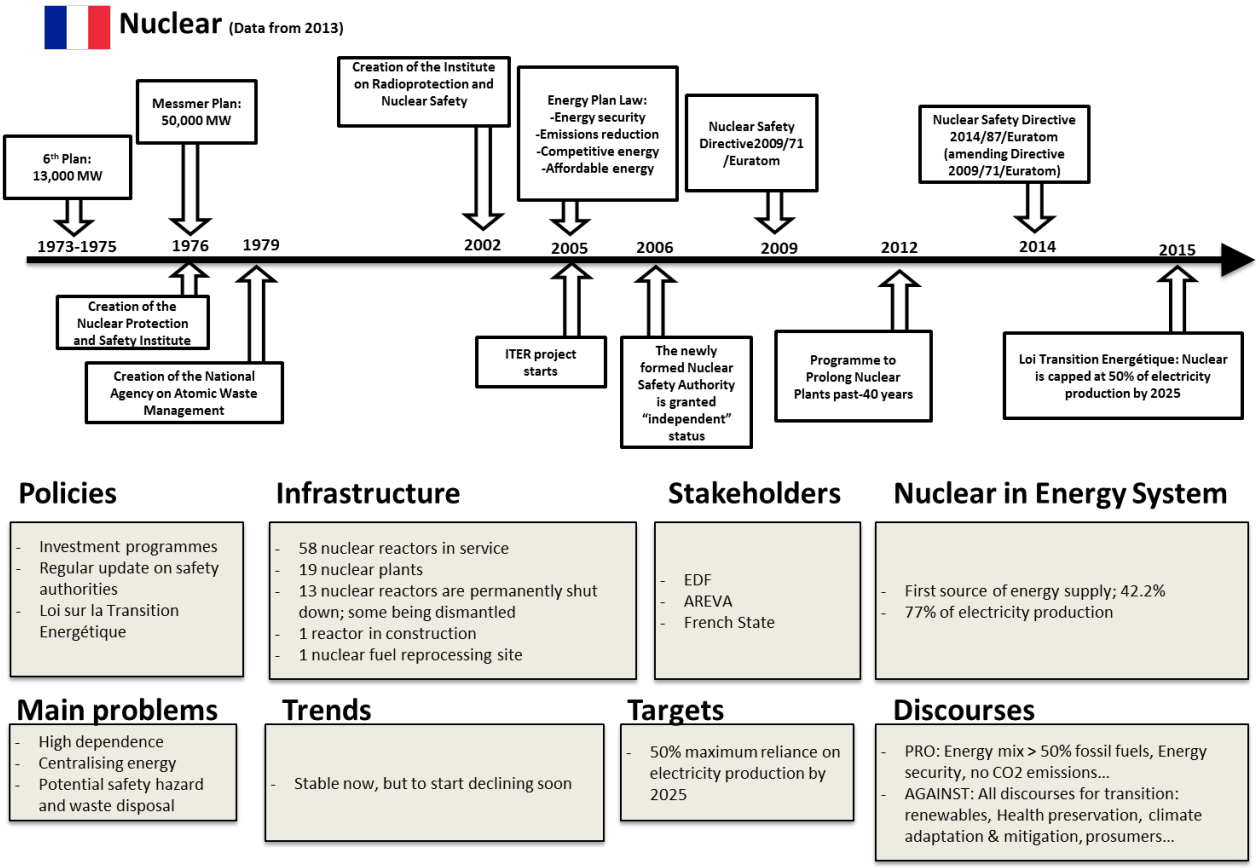


Figure 65: Nuclear policy overview in France

Renewable Sources

The French renewable energy sector, including both electricity and other energy forms such as heating, is dominated by wood-biomass, with almost 45% of the total renewable primary energy. This is an interesting fact since most debates and controversies relate to other sources that do not occupy a significant role at the moment, such as wind with 5.7% or PV with 1.6%. The second major source is hydroelectricity, with 22.4% of total renewable energy production.

This shows the traditional reliance on wood for heating, especially in rural and semi-rural areas. Wood burning for individual households, however, does not have a large future potential. It is rather for other uses, such as industrial or larger-scale collective heating that biomass might double in absolute quantity of energy produced. Wood-burning stoves are not necessarily very energy efficient, and there are hopes that newer kinds of biomass-utilising facilities may improve this situation.

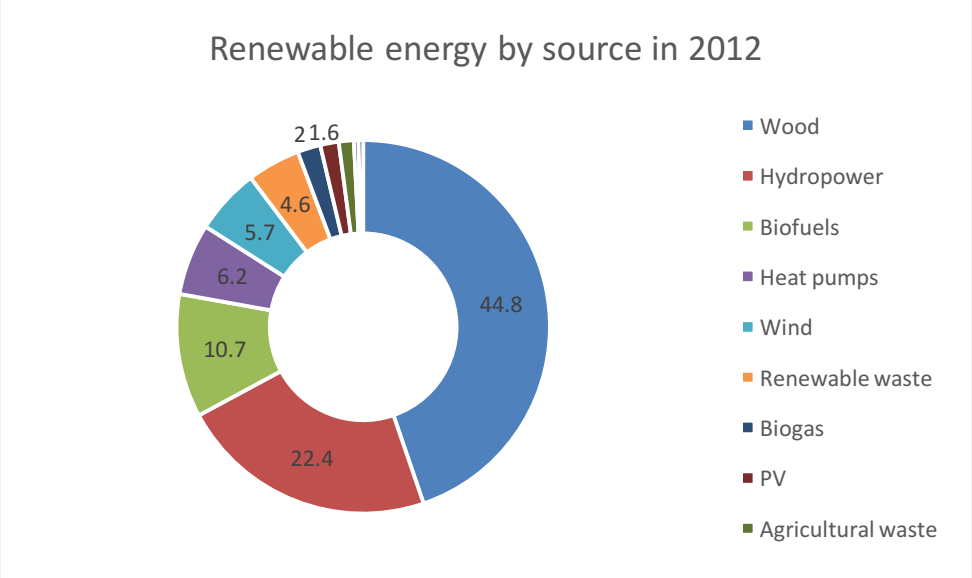


Figure 66: Share of renewable energy source

Figure 66 shows that wood and hydropower have been a strong duopoly up until recent times. Between the year 2005 and 2010, the diversification of renewable energy sources was a particularly important phenomenon: biofuel became an important source along with heat pumps and wind. The long-term trend for renewables is positive, especially in the diversification of renewable sources, with about a third of all renewable energy productions coming from other sources than wood and hydropower.

Biofuels are clearly the frontrunner of new renewable energy in France. Biofuels are part of the broader 2020 targets, and France has performed exceptionally well in this sectoral target, as it will be shown in later sections. The large quantities of arable lands and a well-developed large-scale industrial agricultural sector are favourable conditions for the development of biofuels. Nonetheless, they still represent a minor proportion of all fuel usage in France.

As one of the pillars of the environmental policy of the European Union, the Renewable Energy Directive (2009/28/EC) mandates renewable energy targets for each member state to follow. These objectives coincide with the development earlier in 2005 of the Kyoto protocol, a global text on greenhouse gases emission reductions. The Renewable Energy Directive is one of the most significant measures for transforming the energy system of the EU into a more sustainable one by having at least 20% of its energy needs met through renewable sources by 2020. It is part of a broader framework on energy efficiency and emissions trading. Each individual member state's targets are binding but they do not each have to meet the 20% target. Depending on a Member State's current progress on renewable energy, potential, and economic characteristics, targets may be as low as 10% in Malta and as high as 49% in Sweden. More specifically, 10% of the EU's transportation energy needs must also be met by renewables by 2020.

EU countries set out how they plan to meet these targets and the general course of their renewable energy policy in national renewable energy action plans (NREAP). Progress towards national targets is measured every two years when EU countries publish national renewable energy progress reports. National action plans and progress reports specify national renewable energy targets for each country, taking into account its starting point and overall potential for renewables.

France's 2020 target is 23% overall renewable energy, with 27% renewable electricity production, 33% in heating and cooling, and 10.5% in transportation fuels. In 2014, 14.6% of final energy consumption came from renewable sources. This is 5.4 percent points higher than in 2005, but it is still below the interim target of 16.0% for 2014. Table 15 shows the gross final consumption of renewable energy by sector of production relative to their 2020 target and the 2014 target.

Table 20: Gross final consumption of renewable energy by sector of production

Unit : thousands of toe	Achieved		Interim target	Target	Degree of completion (2014 target)	Degree of completion (2020 target)
	2005	2014*	2014	2020		
	(A)	(B)	(C)	(D)	(B/C)	(B/D)
Gross final consumption (Electricity + heating/cooling + fuel)	**15,376**	**21,870**	**25,836**	**36,121**	**85 %**	**61%**
Électricity (total)	**6,123**	**7,884**	**8,836**	**12,729**	**89 %**	**62%**
Hydropower	5,686	5,343	5,513	5,541	97 %	96%
Wind	96	1,492	2,245	4,979	66 %	30%
onshore	*96*	*1,492*	*1,729*	*3,431*	*86 %*	43%
offshore	*0*	*0*	*516*	*1,548*	*0 %*	0%
Solar PV	2	549	204	592	269 %	93%
Marine energy	41	41	62	99	67 %	42%
Geothermy	8	7	24	41	29 %	17%
Solid biomass and renewable urban waste	250	301	632	1,158	48 %	26%
Biogas	40	151	156	318	97 %	47%
Heating/cooling (total)	**8,662**	**11,031**	**14,100**	**19,732**	**78 %**	**56%**
of which heating district	*nd*	*673*	*1,105*	*3,200*	*61 %*	21%
Solar	49	159	370	927	43 %	17%
Geothermy	108	129	270	500	48 %	26%
Heat pumps	201	1,787	1,440	1,850	124 %	97%
of which geothermy	*77*	*260*	*400*	*570*	*65 %*	46%
Solid biomass and renewable waste	8,256	8,846	11,815	15,900	75 %	56%
of which wood consumption by households	*6,627*	*6,185*	*7,060*	*7,400*	*88 %*	84%
Biogas	49	111	205	555	54 %	20%
Fuels (total)	**591**	**2,955**	**2,910**	**3,660**	**102 %**	**81%**
Bioethanol	103	414	550	650	75 %	64%
Biodiesel	488	2,541	2,350	2,850	108 %	89%
Other (biogas, vegetable oil)	-	-	10	160	-	-

It is worth noting that biofuels are reaching their interim target, while electricity is just 11% behind. The heating and cooling sector, however, is 22% behind. This is particularly problematic as it is the largest contributor to renewable energy. This is mostly due to solid biomass and renewable waste, since very little progress (8,256 to 8,846 ktoe) has been achieved between 2005 and 2014. Interestingly, PV electricity has

almost reached its modest 2020 target already, while offshore wind has yet to begin producing any electricity in France.

The Renewable Energy Directive coincided with the "Grenelle de l'Environnement".

Some key measures in the Grenelle laws relating to energy include:

- The creation of Regional Blueprints on Climate, Air and Energy (Schéma régional du climat, de l'air et de l'énergie): These blueprints have to be drafted by the regional prefets, taking into account regional energy production, capacities and potential. They also have to be approved by regional councils and include a Wind Energy Blueprint as an annex, defining the favourable zone to develop wind energy.
- A renewable energy monitoring committee is created to track the EU 2020 target of France.
- A renewable energy connection blueprint must be created to integrate future renewable energy capacities.
- District heating support mechanisms for local territories when over 50% of the energy comes from renewable sources.
- Feed-in tariffs are updated. Local authorities are allowed under conditions to develop their own capacities while private individuals can benefit from additional financial support for marine energy, solar thermal energy, geothermy, small hydro, on top of PV.
- Biogas producers, under certain conditions, can also benefit from feed-in tariffs.

Renewable energy was further supported by the Energy Transition Law: Section 5 on renewable energy sources specifies that the 2030 goal is to have 32% renewable energy, meaning doubling the current share of renewable energy in 15 years. It also seeks to ease the integration of renewable energy. Some of the key measures are:

- Citizens and local authorities are encouraged to invest in local renewable energy projects.
- Larger calls for tenders are created to ensure a regular and reliable deployment of renewable energy technologies.
- A new financial support mechanism replaces feed-in tariffs for mature renewable sources (such as onshore wind and PV). Electricity will be sold on the market but a complementary tariff will be paid if the price falls under a certain threshold.
- Hydroelectric contracts are updated to allow all plants of the same valley to be grouped together.
- Procedures on wind, gas bioreactors and water facilities are simplified to reduce the costs of these projects and limit the length of judicial processes for offshore wind.
- Small hydro and biomass are also encouraged in new calls for tenders.

Wind

Table 21: Wind energy progress in France relative to 2020 objectives

ktoe	Achieved		Interim target	Target	Degree of completion (2014 target)	Degree of completion (2020 target)
	2005	2014*	2014	2020		
	(A)	(B)	(C)	(D)	(B/C)	(B/D)
Wind	96	1,492	2,245	4,979	66%	30%
onshore	*96*	*1,492*	*1,729*	*3,431*	*86%*	43%
offshore	*0*	*0*	*516*	*1,548*	*0%*	0%

As shown in Table 16, wind energy has fallen behind in France, with only 66% of the 2014 interim target achieved and 30% of the 2020 final target in spite of numerous legislations to push for the development of

this sector. This is problematic as wind will represent close to half of the entire renewable electricity production.

For instance, the Grenelle laws, which launched the 2020 targets, aimed at installing 19,000 MW of wind, 6,000 of which must be offshore. The regional blueprints on wind energy and the simplification of procedures for offshore wind do not seem to have been enough to promote the development of the sector. One of the key measures was the development of regional wind blueprints, consisting of a map outlining where wind implementation would be acceptable, taking into account ecosystem needs, historical buildings, airports, and other characteristics. Indeed, in 2013, under a new government, the Brottes law recognised the need to further remove obstacles for the development of wind energy. This law simplified the procedure for wind onshore and allowed for exemptions concerning the coastal protection law and urban code to facilitate the grid connection of all renewable marine energies.

The law of energy transition of 2015 also brought in new measures targeting the wind sector specifically. Imposing a target of 40% renewable electricity by 2030, the policy aimed the wind sector to develop rapidly. The law deleted the provision for a minimum of five wind turbines per project, allowing 1,500 MW of wind energy development to go ahead in Western France. Wind Development Zones are deleted, since they were a double requirement very similar to Regional Wind Blueprints. Some exemptions from the Coastal Protection Law can also exist for the development of sea energy projects. Feed-in tariffs will also apply for self-consumed electricity by individual households and private companies.

The following figure represents wind energy-related policies and regulations in the last few years. Below the timeline, an overview of the different elements that have driven the wind energy sector in France is presented.

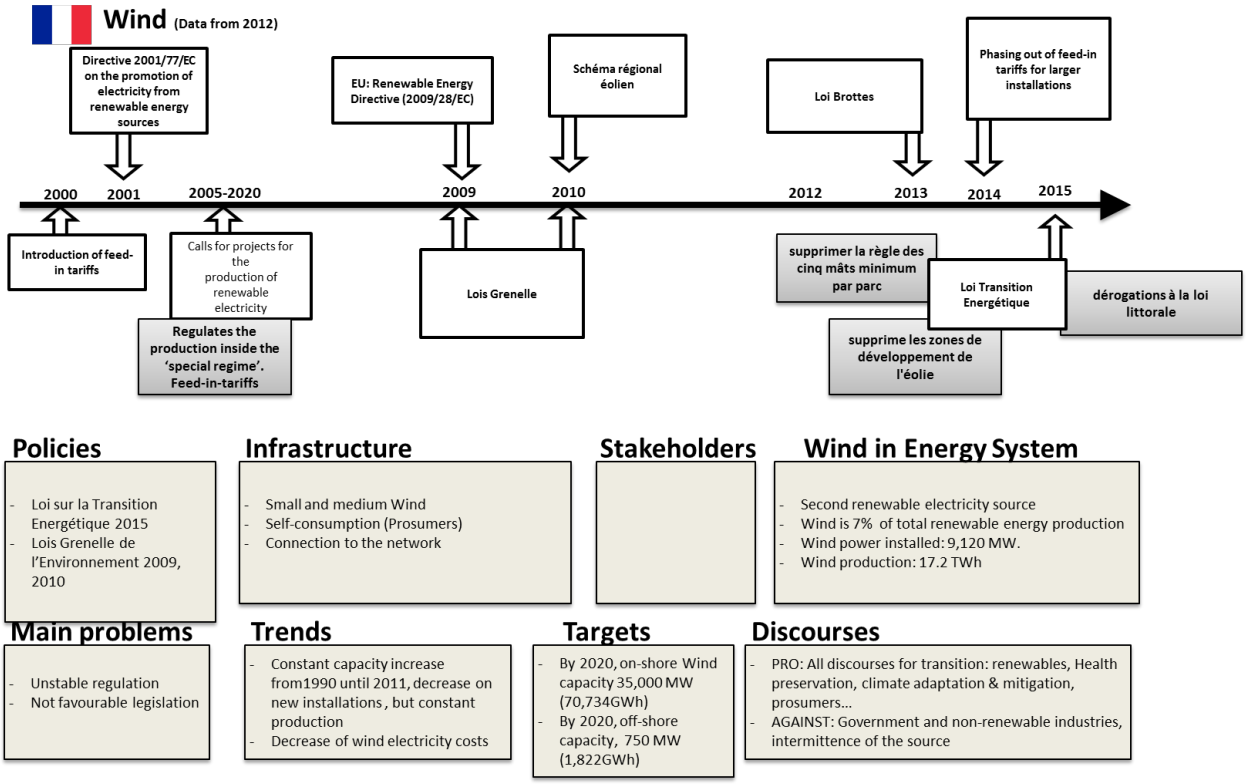


Figure 67: Wind energy policy overview in France

Solar

Table 22: Solar energy progress in France relative to 2020 objectives

ktoe	Achieved		Interim target	Target	Degree of completion (2014 target)	Degree of completion (2020 target)
	2005	2014*	2014	2020		
	(A)	(B)	(C)	(D)	(B/C)	(B/D)
Photovoltaic	2	549	204	592	269%	93%
Thermal	49	159	370	927	43 %	17%

The situation of solar energy in France is paradoxical: photovoltaic energy production 269% ahead of schedule (and close to the 2020 target) while solar thermal energy for heating is lagging behind its interim target with 43% and is only at 17% of its 2020 target.

Concerning both types of solar energy, a law on biodiversity, nature and landscape of 2015 mandates that new urban commercial buildings integrate on some or all of their roof renewable energy installations or a green living space insulating the building.

On photovoltaics, there have been very few recent changes. The energy transition law includes the doubling of calls for tenders for PV, from 400 to 800 MW, in order to reach 8,000 MW by 2020 instead of 5,400 MW. This means that the objectives are higher than originally and that PV is being used by the government to compensate for the delays in the wind sector.

For small scale PV, there are feed-in tariffs in place, after a moratorium in 2010. All feed-in tariffs decrease every three months, taking into account technological progress. For PV integrated into the building (less than 9 kW, the tariff is €0.2539 per kWh; for PV installed on/near a building, it is €0.144 (less than 36 kW), €0.1368 (36-100 kW), and €0.612 for all other (0-12 MW). These prices are valid until December 2015. EDF, and sometimes local suppliers, are mandated to purchase this electricity. [11]

Another set of rules concern solar thermal energy. In order to incentivise the development and use of the technology, the French state gave out zero-interest eco-loans between 2009 and 2013, while the VAT rate has been reduced, on investments that reinforce energy efficiency and sustainable heat. These are available for houses more than two years old. The plan is to have 4 million homes with solar heating installed by 2020, but this goal is seemingly out of reach at the moment.

The Heat Funds is a broad financial tool that supports many renewable heat projects. In the case of solar thermal power, the project must meet a minimum solar productivity and maximum investment cost, both characteristics depending on the geographical location, as France's solar productivity map varies significantly. It is not allowed to combine Heat Funds support with other regional aids, such as ENERPLAN, which depend on local authorities.

The following figure represents the solar energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the solar energy sector in France is presented.

[11] http://www.developpement-durable.gouv.fr/IMG/pdf/Tableau_tarifs_PV_2015_-_v2.pdf

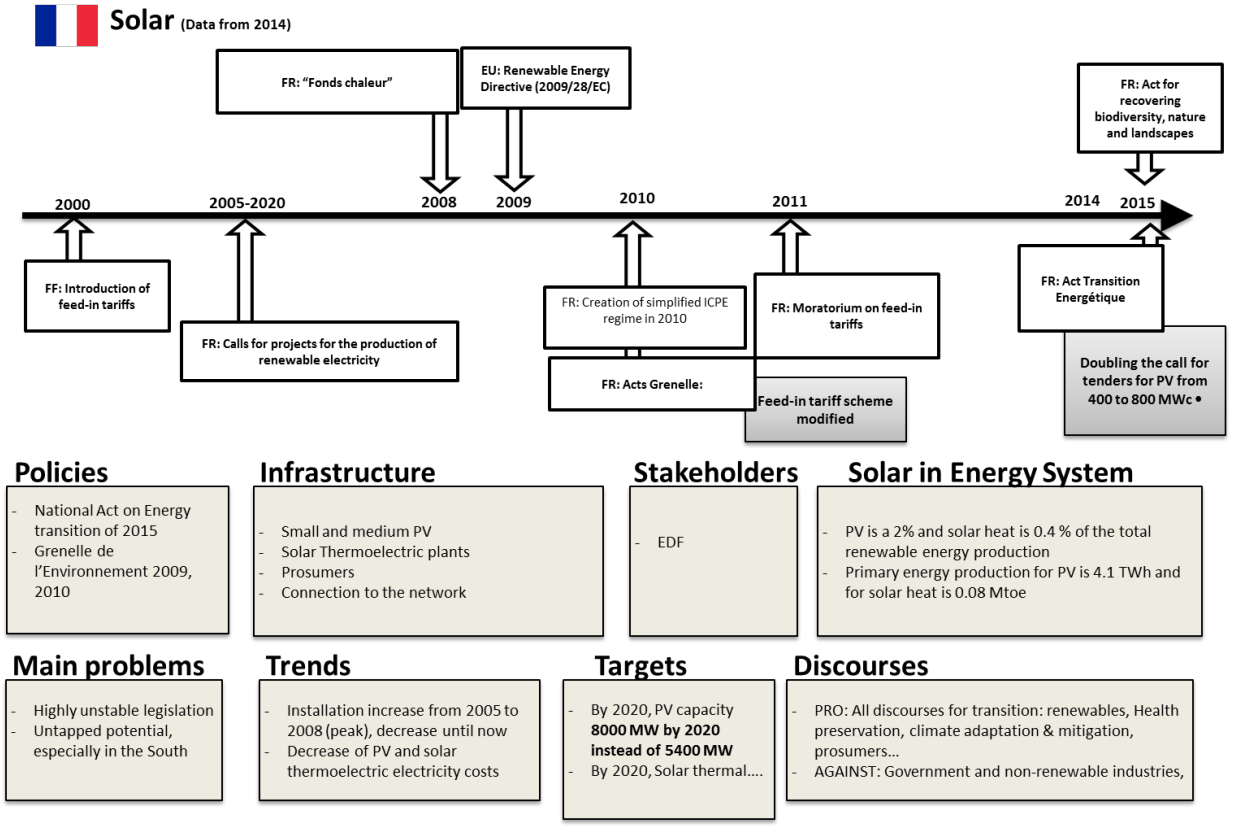


Figure 68: Solar energy policy overview in France

Biomass, biogas and waste

Table 23: Bioenergy production progress in France relative to 2020 objectives

ktoe		Achieved		Interim target	Target	Degree of completion (2014 target)	Degree of completion (2020 target)
		2005	2014*	2014	2020		
		(A)	(B)	(C)	(D)	(B/C)	(B/D)
Electricity	Solid biomass and renewable urban waste	250	301	632	1,158	48%	26%
	Biogas	40	151	156	318	97%	47%
Heating	Solid biomass and renewable waste	8,256	8,846	11,815	15,900	75%	56%
	of which wood consumption by households	*6,627*	*6,185*	*7,060*	*7,400*	*88%*	84%
	Biogas	49	111	205	555	54%	20%
Fuels	**Fuels (total)**	**591**	**2,955**	**2,910**	**3,660**	**102%**	**81%**
	Bioethanol	103	414	550	650	75%	64%
	Biodiesel	488	2,541	2,350	2,850	108%	89%
	Other (biogas, vegetable oil)	-	-	10	160	-	-

In this broad subsection is included various types of energy sources, but they all have in common to come from living organisms. There are interesting trends in the 2020 targets. For instance, biomass-generated electricity and biogas heat are well behind schedule, while biogas-generated electricity and biofuels in

general are on schedule, on even earlier than anticipated. It is also worth recalling that wood biomass is the first renewable energy source used in France.

The European Commission recognised in 2005 the importance of biomass, publishing the Biomass Action Plan. The goals were to diversify Europe's energy supply, reduce greenhouse gas emissions, and lead to 200-300,000 job creations. It also prioritised biomass use in heat, electricity production and in transportation. The use of bioenergy in transportation will be discussed later in the transport section.

The Heat Funds, created in 2008, was in line with that strategy. It originally had a budget of 1.28 billion euro during 2009-2013 supporting 3,000 projects. In 2015, the government announced it would double the money allocated to the Heat Funds. Its target sectors are collective housing, the tertiary sector, agriculture, and industry. The Heat Funds encourages renewable energy but also energy efficiency through the development of district heating. It functions through calls for tenders for large projects (<1,000 toe) and guarantees that renewable heat projects are 5% cheaper than conventional sources.

The Grenelle laws introduced feed-in tariffs for biogas for certain producers meeting specific requirements. There are other regional aids supporting bioenergy.

Hydropower and tidal

France's first experiment with electricity began with hydroelectricity. As seen earlier, it is the largest renewable electricity source in terms of share of production and second overall after nuclear energy. There have been two recent legal changes in the hydroelectric sector: the first one concerns hydroelectric concession and the second one is about small hydroelectricity and other renewable alternatives.

A law from 1919 relative to energy use states that nobody can use energy from water resources without a concession or authorisation from the state. If a hydroelectric facility has a power of less than 4.5 MW, a simple authorisation is sufficient. For installations larger than 4.5 MW, concessions are necessary. There are over 400 hydroelectric concessions in France, amounting to 24 GW, or 95% of the total installed capacity of hydropower. Concessions generally last for 75 years, after which the concession is brought back to state, which decides once again who should be granted this concession. About 150 concessions are set to expire before 2023. The State retains ownership of the installations but the concession concerns the management and operation of the installations. Currently, 80% of the hydroelectric resources are exploited by EDF, the historical operator. Its concessions were granted when it was a public company and there was no competition for these concessions. Because of rules imposed by the European Union, France now has to allow a free competition for concessions that will expire soon. The European Commission has issued a formal notice to the French government to ensure that this will happen.[12]

In order to support small hydroelectric plant (less than 12 MW), a cheap renewable energy source, the French government has specific feed-in tariffs. Regarding tidal energy, France exploits a tidal power station in Brittany and it is the second largest in the world with 240 MW installed. However, the potential is rather limited.

Electricity

[12] http://www.euractiv.fr/sections/energie/le-secteur-hydroelectrique-francais-peine-souvrir-la-concurrence-320409#_ftn1

As the entire primary energy mix of France is mainly supported by nuclear power, it is logical to see it largely dominate the electricity mix, with 77%, well above hydroelectricity, the next electricity source with 12.6%.

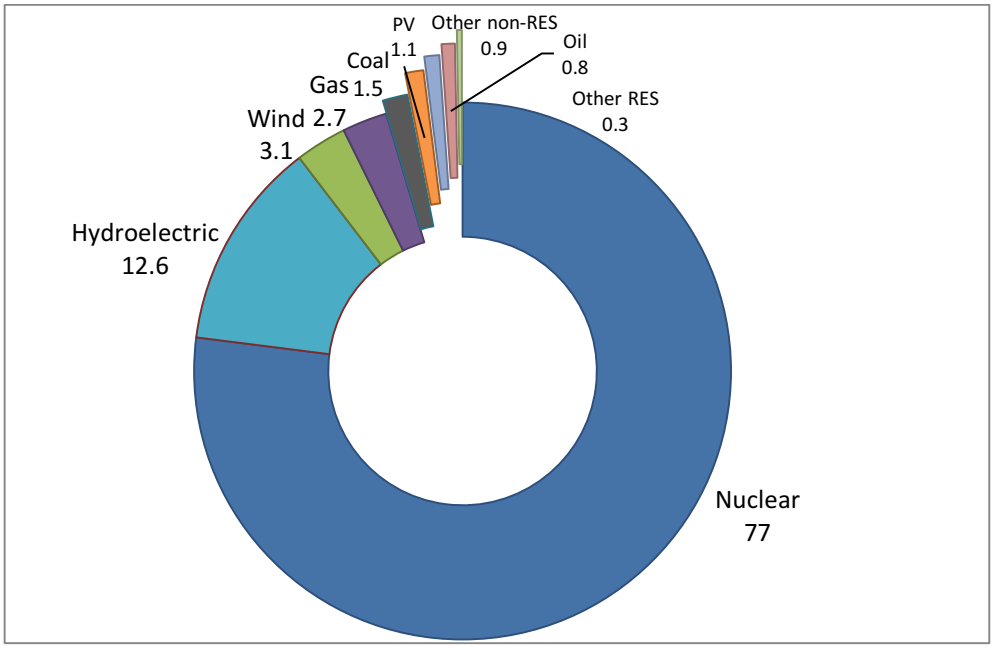


Figure 69: Electricity Production by source in France in 2014

As wind is the third largest electricity source with 3.1%, and PV and other renewable amount to 1.4%, virtually 95% of the French electricity sector is carbon-free.

In 2015, the ADEME, the French energy agency, published a document "Vers un mix électrique 100% renouvelable en 2050" (*Towards a 100% renewable electricity mix)* to assess the potential production of electricity based 100% on renewable sources. The forecasts are established on sectoral and regional basis. The statistical findings reveal that the potential maximum production could be about 1200 TWh, or about triple the current demand of 422 TWh.

Table 24: Renewable electricity potentials

	Maximum potential capacity (GW)	Maximum theoretical production (TWh)
Total	706.35	1259.4
Rooftop PV	364.3	403.1
Land-bases wind turbines	181.7	374.2
Floating Sea Wind Turbines	46.2	190.4
Sea Wind Turbines	20.1	79.1
Ground PV	47.2	62.5
Wave power converter	3	43.8
Run-of-the-river hydroelectricity	7.63	33.9
Lakes and locks	13.21	27.4
Wood Cogeneration	3	26.3

Marine current turbine	9.9	13.2
Waste incinerator	0.43	3.8
Geothermic	0.14	1.2
Tidal power turbine	0.24	0.5
Pumped-storage hydroelectricity	9.3	-

7.4.2 Energy Efficiency

At the European level, there are a series of directives with direct implications for energy efficiency requirements. For instance, some directives looked at specific items, such as Council Directive 92/42/EEC on energy efficiency of new hot-water boilers or Commission Directive 2003/66/EC on energy labelling of household electric refrigerators, freezers and their combinations. Laws and directives on energy efficiency in buildings, such as Directive 2002/91/EC on the energy performance of buildings will be discussed later in the construction/building section.

Among all these directives, the broadest and most significant is Directive 2012/27/EU on energy efficiency, which determines binding measures to help achieve a 20% energy efficiency improvement target by 2020. It requires all EU Member States to use energy efficiently at all stages of the energy chain. Different means are accepted, such as forcing energy distributors to achieve the energy savings, or taking direct measures themselves to reduce energy consumption (i.e. installation of double glazing for instance). Article 24 mandates each Member State to submit a National Energy Efficiency Action Plan (NEEAP) every three years. France's 2020 final energy consumption target is 131.0 MToe by 2020, 25% below the 2014 consumption with 164.0 Mtoe.

The POPE[13] law of 2005 on energy policy strategy was a major broad policy package that defined long term strategy and encouraged the diversification of energy sources. One of its most ambitious objectives is the "Factor 4": the division by 4 of total greenhouse gas emissions by 2050 compared to 1990. Control of energy demand is logically one of its main issues as well. In order to improve energy efficiency, the text included an innovative measure: the White Certificate Scheme.

Hailed by many European experts as a cost-effective tool, the White Certificate Scheme (CEE in French, for Certificat d'Economie d'Energie) managed to save 1.1 Mtoe per year between 2006 and 2010, and it is expected to further save between 5 and 8 Mtoe per year by 2020 (for reference, total final consumption in 2014 was 164 Mtoe). One CEE represents 1 kWh of avoided energy consumption. Energy suppliers are responsible for issuing CEEs, depending on their personal targets. Energy suppliers, first included electricity, gas, LPG, heat and cold network suppliers above a certain threshold, and domestic fuel retailers from the first litre sold. In a second phase, car fuel retailers, beyond a certain threshold, were included in the scheme.

These energy suppliers must therefore promote energy efficiency to their own clients (private households, local authorities, businesses, including the tertiary sector). About 87% of the energy efficiency initiatives concern the residential sector, such as replacing inefficient heating systems. If they did not comply, energy suppliers had to pay a penalty of €0.02 per missing CEE. What is remarkable is the cost of this measure. The government has to bear the price of €700,000 annually to maintain the CEE registry and organise the scheme. For the mandated organisations, the cost was about €200 million per year. Taking into account the

[13] From French "loi Pope" (programme fixant les orientations de la politique énergétique – programme fixing French energy policy directions)

quantity of CEEs issued, this leads to a cost of €0.0039 per avoided kWh, five times less than the penalty of €0.02.

In general, objectives were exceeded, showing the efficiency of this scheme. Started in 2015, the third round of the CEE scheme doubled its ambitions, with €3 billion invested by the energy sector. The Energy Transition law further defined energy efficiency objectives, such as the reduction of final energy consumption by 50% in 2050 compared to 2012. It also mandates to have at least 30% of total CEEs to target households in fuel poverty.

Despite this progress, France is underperforming in the application of other directives, such as the Combined Heat and Power (CHP) Directive of 2004, compelling Member States to promote cogeneration, France failed to maintain CHP high on the energy agenda. Bio-CHP has a high target of 2.3 GW by 2020, compared to 877 MW in 2008, but this seems highly unattainable considering current trends. Although there are purchase obligations, tax credit support and eco-loans, and even feed-in-premiums for bio-CHP, hard competition from other technologies and cheap electricity thanks to the vast nuclear park are hindering the development a vibrant CHP sector in France.

7.4.3 Sectoral analyses

Construction

Part of the Grenelle laws, the RT2012 energy performance standards of buildings intend to divide building energy consumption by 3. They imposed a requirement that by 2012 the average low-energy standard for housing becomes the minimum requirement for new construction. The longer term intention is that by 2020 all new constructions will be energy positive.

The law on energy transition contains many measures and initiatives to boost building renovations. Its objective is to fully renovate 500,000 residential buildings per year, the priority being households living in fuel poverty. As such, every building with energy consumption higher than 330 kWh/m^2 needs to be fully refurnished by 2025. By 2050, all buildings will have to comply with the French low-energy house standard (50 kWh/m^2). The law also tightens the energy performance standards of new buildings by encouraging energy positive buildings by 2020.

Additionally, a digital textbook will exist for each dwelling in order to improve knowledge of certain characteristics such as previous investments in order to ease refurbishing work. A new tax rebate for energy transition is created, allowing a 30% reduction in construction works for energy refurbishing, under a certain threshold. City mayors are also now able to allow exemptions on urban regulations if these hinder insulation works. Energy positive buildings are also encouraged in the new law through regional aids of €500,000 for projects related to energy efficiency and citizen engagement. This aid is intended to be rapidly given out to about 200 local authorities.

The following figure represents the policies and regulations that have influenced the construction sector, particularly its energy efficiency in the last years. Below the timeline, an overview of the different elements that have driven energy consumption in the construction sector in France is presented.

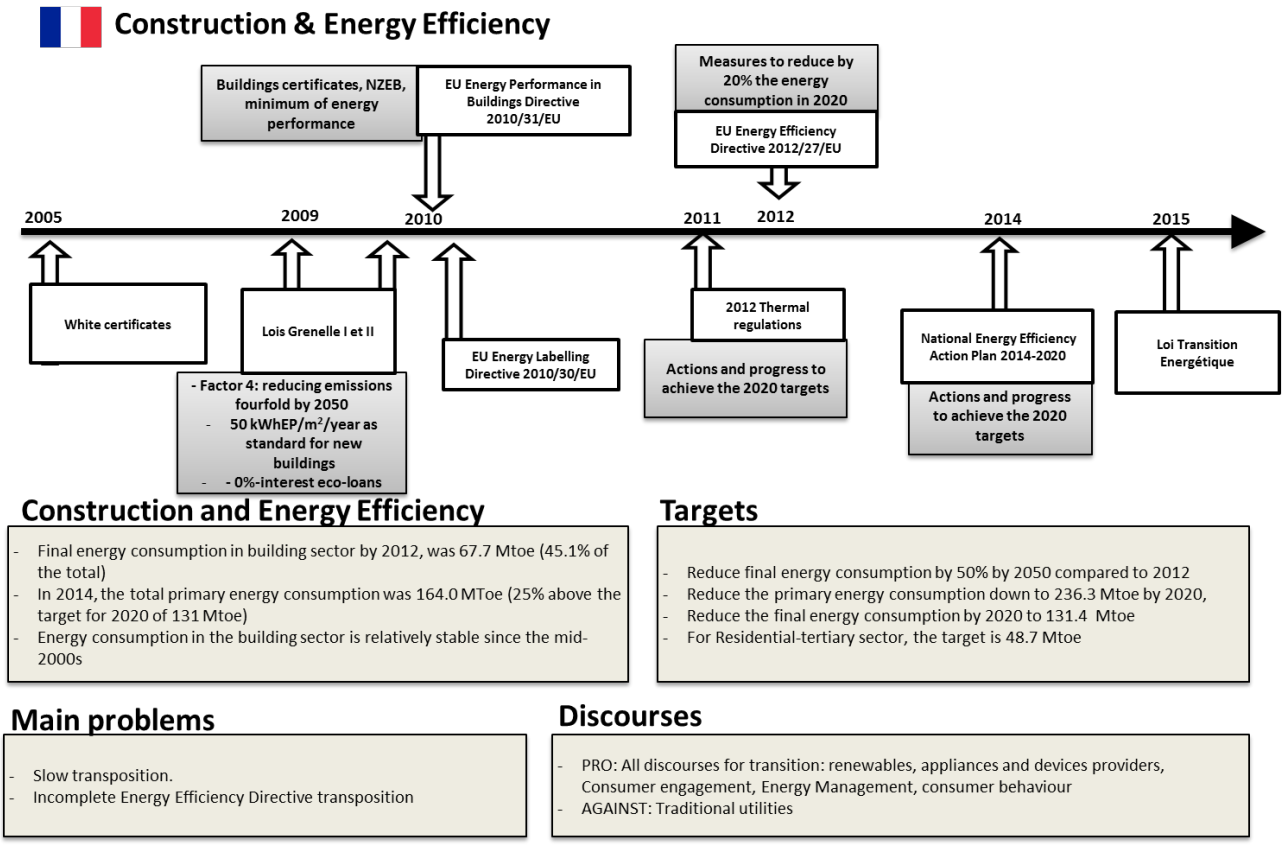


Figure 70: Overview of the construction sector in France

Transport

Since the 2009 Grenelle law, the government has been active in promoting two kinds of sustainable transportation policies. The first one relates to the modal shift, by accelerating the development of non-road, non-air alternative modes of transportation. The second one relates to the energy efficiency of vehicles with the aim of reducing greenhouse gas emissions in the transportation sector to 1990s level by 2020. For instance, about 1500 km of new public transportation lines were financially supported in 2010.

In 2013, the Mobilité 21 report on a national sustainable mobility plan was submitted to the Ministry of Transport. It entailed a series of proposed measures:

- *Freight transport*: promotion of "sea motorways" (ferry lines replacing highway road transport) and inland waterways are some of the EU-related policies. The "ecotax" on trucks is also mentioned in the report. The implementation of the ecotax failed however, and remains one of the most significant ecological policy controversies of the current government. Although it was approved by the previous government, there was a consensus on its usefulness. The tax levied on trucks using high-traffic roads (excluding highways that are already taxed in France) was supposed to fund a sustainable transportation investment funds, bringing out €800 million euros annually. However, a strong and sometimes violent movement of truckers, especially in the rather isolated region of Brittany, destroyed some of the infrastructure needed for the application of the tax. The government then backed down. The current Environment minister, Ségolène Royal, has repeatedly called for the end of "punitive ecology" and the way the government backtracked on the ecotax is an example of this vision.

- Passenger transport: similar to other investment programmes, the government supported co-funding of 52 public transport projects.
- The use of active transport and soft mobility is encouraged: funds for bicycle commuting (similar to financial support for other types of commuting methods) has begun since 2015.

On the topic of energy efficiency in transportation, Regulation (EC) 443/2009 on the fuel efficiency of new vehicles pushes for a decrease in private vehicles' emissions. France's goal is 120g/km by 2020 for new cars. To reach this goal, there are two main policy tools in place:

- Annual tax on business vehicles depending on kilometres travelled and CO_2 emissions
- Environmental "bonus-malus" scheme since 2007: it consists of penalties paid by purchasers of high-CO_2 vehicles that are transformed into premiums given to purchasers of low-CO_2 vehicles, so that it is technically not costing the government anything. It hastened the decrease of carbon emissions (French Ministry of Ecology Sustainable Development and Energy, 2014)

In addition, France has been active in the promotion of biofuels, thanks to its large agro-industry. For instance, the consumption of biofuels surged by +10.3% in 2012 after the production of biofuel in France was approved, in particular that of vegetable oil methyl esters, entering the composition of biofuel and the super fuel SP95-E10. In 2012, 24% of super fuel now contains domestically produced bioethanols.

In France, the potential for biofuel production to replace fossil fuels exists. The issue stems from the technical difficulty in making such massive biofuel production sustainable, not only from an environmental standpoint, but also socio-economically. Indeed, biofuel production can compete for productive arable lands with food production.

The following figure represents the policies and regulations that have influenced the transport sector in the last years. Below the timeline, an overview of different elements that allow a better understanding of the policy making in the transport sector in France is presented.

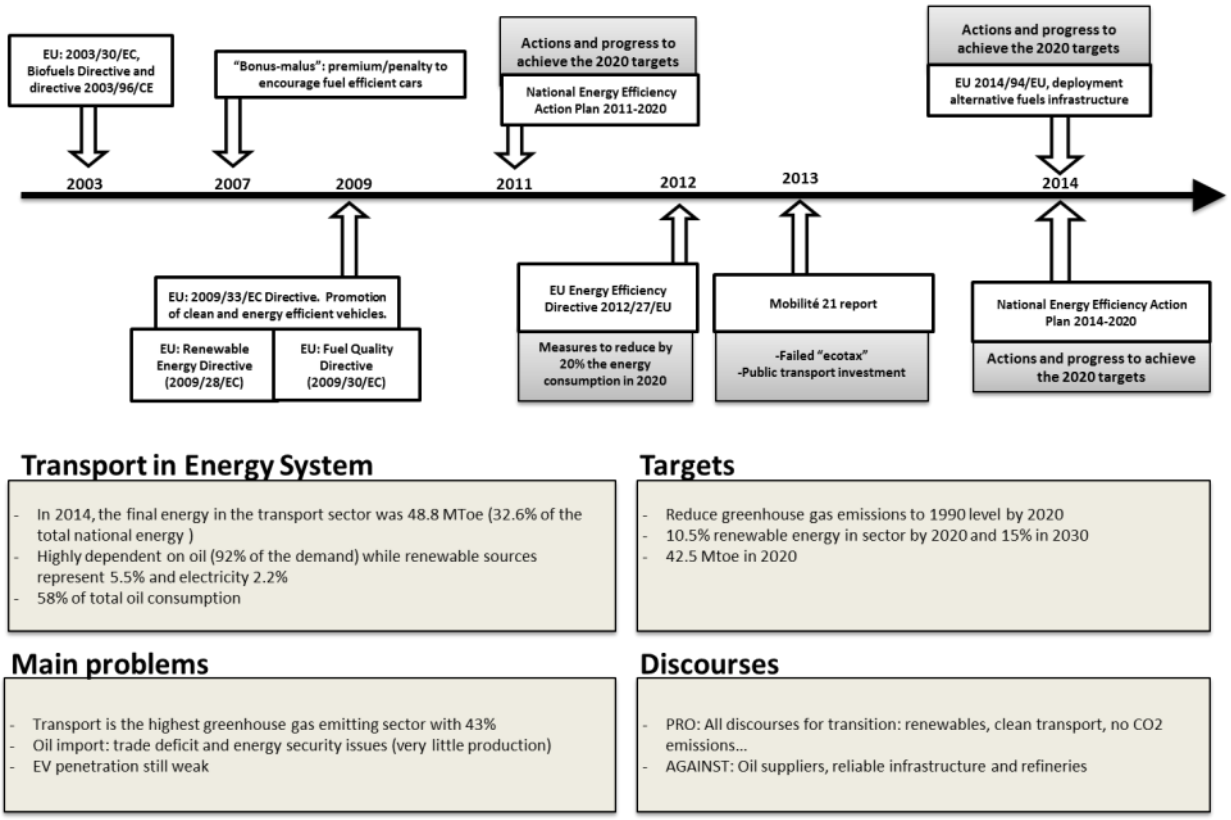


Figure 71: Overview of the transport sector in France

7.5 Italy

7.5.1 Energy supply and its related regulation

National overview

In 2014 national supply of energy sources grew by 2.8% vs. 2013 (from 43.82 to 45.04 Mtoe). Analysing each energy source, it results an increase of oil production (+4.8%) and a reduction of solid fuels (-11.7%) and natural gas (-7.6%). The energy portion related to renewable sources increased by 4.7%.

The energy net import in 2014 dropped by 5.1% compared to 2013. This variation is mainly due to oil and natural gas contraction of net imports. The quota of net imports, toward to the national energy requirement, reduced from 74.7% in 2013 to 73.6% in 2014.

The Italian primary energy breakdown with respect to energy production activities is reported for the last available year in Figure 72. Italian energy production system depends for 66% by renewable resources. The missing 34% is ascribable to the production of oil and natural gas.

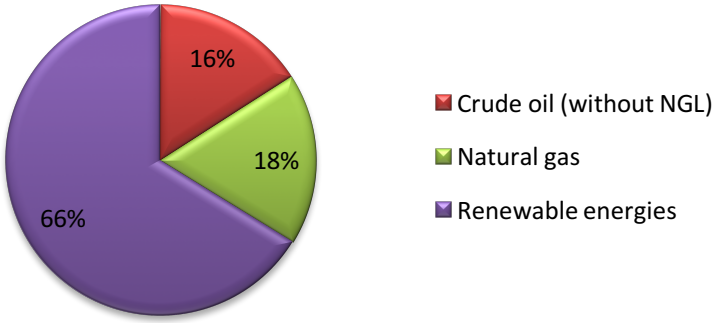


Figure 72: Primary energy breakdown by sources for Italy (adapted from Eurostat)

Although the increasing trend in energy consumption over last 40 years and the only recent decrease due the economic crisis, it is worth mentioning that the energy intensity of the overall Italian system has been radically decreased over time. According to Figure 73, focusing on the last decade, the ratio between gross inland energy consumption and Gross National Product in Italy is going to be constantly reducing from 2003. The slight increase observable in 2009-2010 is not related to a relatively higher increase in energy consumption, but to a fast reduction of the Italian GNP due to the crisis.

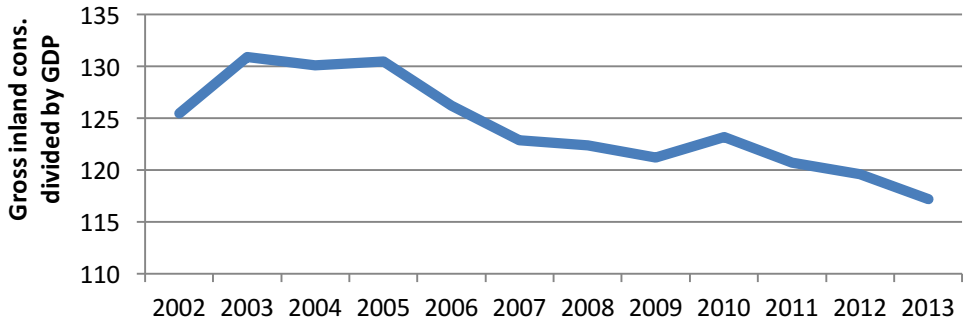


Figure 73: Energy intensity trend for Italy 2002-2013 (adapted from Eurostat)

Fossil fuels

In the following the energy consumption of fossil fuels by sector in 2014 is described. As revealed by Figure 74 in the industry and domestic sectors, natural gas is the most consumed resource. On the other hand, in transport, agriculture, bunkering and not energy use sectors oil is the prevailing resource. Solid fuels are

relevant mainly for the industry sector. At the general level, oil is still the most consumed fossil fuel, followed by natural gas.

With regard to main operators acting as energy producers in Italy, it is necessary to distinguish among different sources. Eni S.p.A. is an Italian oil and gas multinational company and it is by far the largest energy company excluding electricity. It has operations in 79 countries, and is currently world's 11th largest industrial company with a market capitalisation of 68 billion euros (US$ 90 billion), as of August 14, 2013. The Italian government owns a 30.3% golden share in the company, 3.9% held through the state Treasury and 26.4% held through the Cassa Depositi e Prestiti. People's Bank of China holds another 2% of the shares. Eni holds a dominant position in the Italian upstream oil and gas sector and remains the leading refining and marketing company, with about 30% of the market.

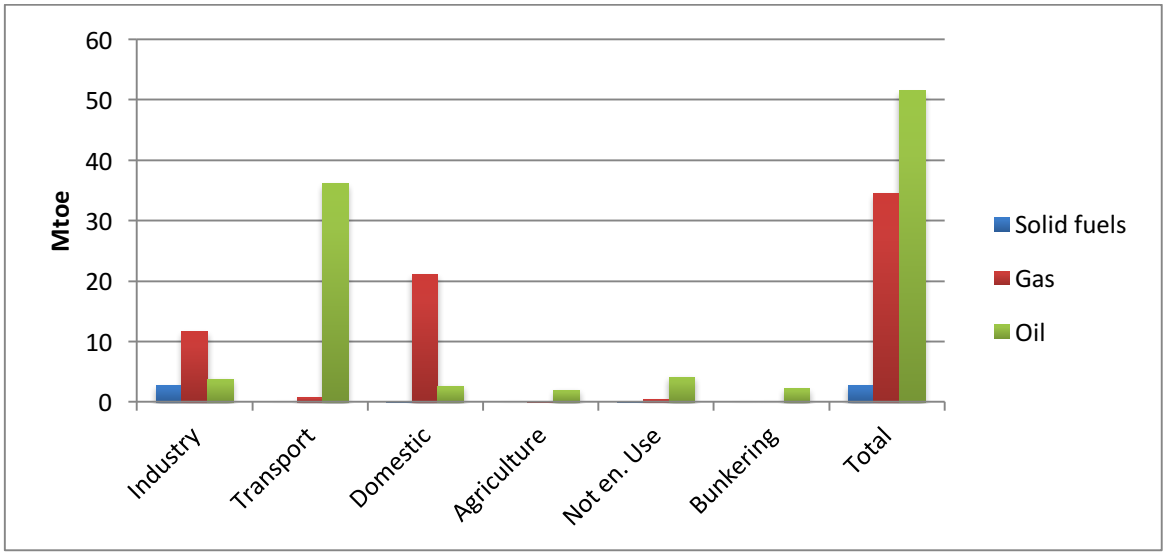


Figure 74: Fossil fuels consumption by sector for Italy 2014 (own elaboration on Eurostat)

Eni is a leader in the downstream gas market too, through its 50% ownership of the main gas group, Snam Rete Gas, which controls most of the physical gas infrastructure in Italy. This includes almost the entire transmission network (Snam Rete Gas), a liquefied natural gas import business (GNL Italia), almost all the underground gas storage capacity in Italy (Stogit), and the leading local distribution network operator (Italgas).

Another important producer is Edison (in which the French company, EDF, has a majority stake), whose primary activities are production and distribution of electricity and natural gas. Edison and its subsidiaries operate across Europe, Africa, and the Middle East. Edison is the second largest power producer in Italy (about 15% of national output). The other leading generators are E.On produzione and Enipower.

Oil

Italy has some domestic production of oil and natural gas, but both oil and gas production will progressively decline in the coming years. In 2012, Italy's total domestic oil production fulfils only 7.7% of its domestic demand, a level that is expected to increase marginally, until 12% of domestic demand by 2018.

Domestic supply of crude oil and other hydrocarbons has decreased overall between 2005 and 2012 – from 124.5 thousand barrels per day (kb/d) in 2005 to 104.6 kb/d in 2012. However, there was a slight 1.2 kb/d

increase in oil production from 2011 to 2012, with the level of production projected to continue to increase – reaching 135.6 kb/d by 2018.

Italy plays an important role as Europe's largest exporter of refined products, providing finished products (gasoline, diesel and residual fuels) to foreign countries.

There are 14 major oil refineries operating in Italy, 11 of which are located along the coast and are supplied by sea transport systems. The other four are situated in the Po Valley, in the North of Italy, and are supplied by pipelines from Genoa, Venice and Vado Ligure. In 2012, total refining output stood at around 1.7 mb/d – down from 2.1 mb/d in 2008.

The continuing decline in domestic demand for oil products (a reduction of 7 Mt in 2012) has led to a decrease in the refining volumes of both crude oil and semi-finished products to one of the lowest levels in the last two decades. The average utilisation rate of domestic Italian refineries declined to 78% in 2012. In order to visualize a geographical mapping of Italian oil infrastructure, the following picture shows all oil infrastructures existing and functioning in Italy.

With regard to the specific regulation of the oil sector in Italy and future development path, the National Energy Strategy for 2030 published in 2013 contains several issues related to oil as an energy source. The main objectives are a significant reduction of the energy cost gap between oil-based energy and the other energy sources, the achievement and overrun of the environmental and decarbonisation targets, the improvement of Italian security of supply, and the fostering of a sustainable economic growth. In order to satisfy these challenging objectives, the strategy has been divided in seven priorities, each with its detailed supporting measures. One of the priorities is directly oriented to the restructuring process of the refining industry and the fuel distribution sector, and the sustainable production of domestic hydrocarbons.

When the strategy will be applied, the system will be able to evolve, gradually but significantly, in order to overcome the 20-20-20 European targets. The outcomes expected by 2020 are the education of fuel consumption and an evolution of the energy mix with a focus on renewables.

A more practical norm published in 2012 is the "Strategic infrastructure law for simplifying administrative decisions for thermal electric power plants". In this strategy, an exclusive system of legal authorisation with a single jurisdiction (the Ministry of Economic Development) is implemented in order to reduce bureaucracy in management, development and new elements in thermal power plants, and oil extraction infrastructures. The law is effective for power plant with installed capacity larger than 300MW.

The following figure represents the oil-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the oil sector in Italy are presented.

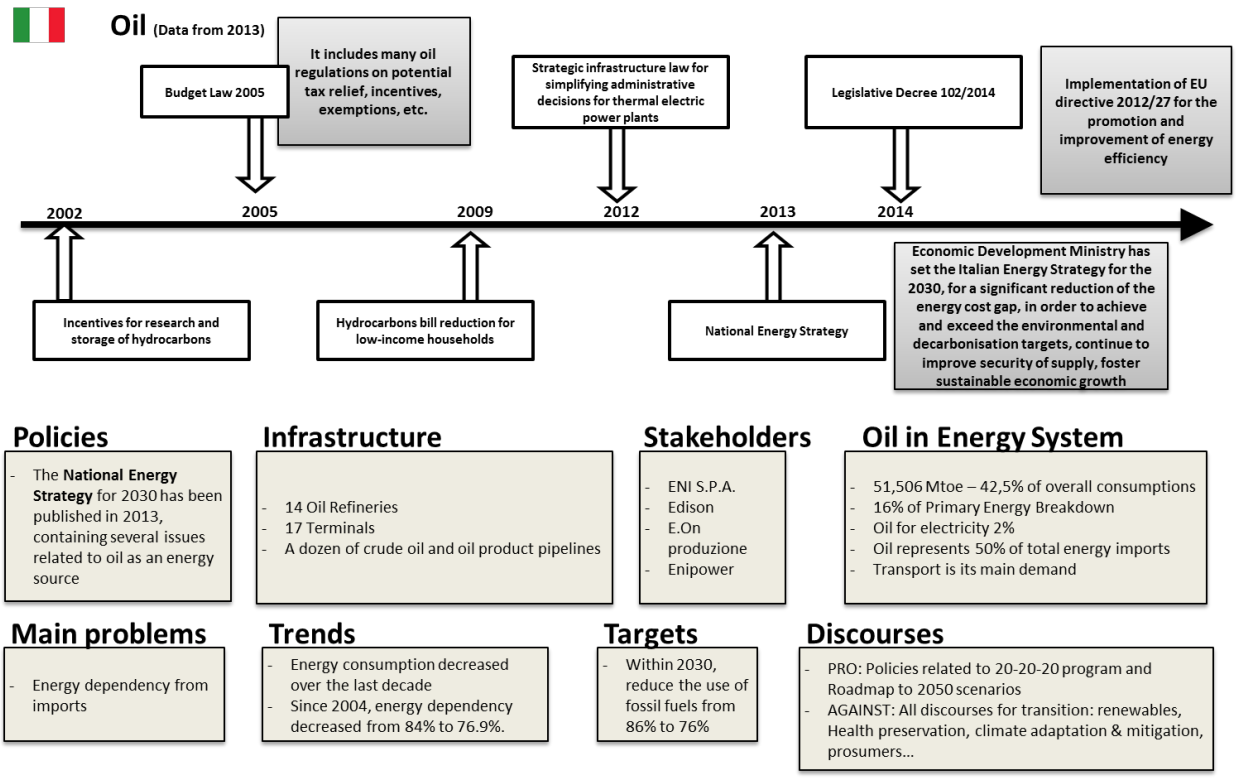


Figure 75: Oil policy overview in Italy

Natural Gas

Concerning natural gas supply system, it is worth mentioning that around two-thirds of Italy's gas reserves are located offshore. In 1973, internal production fulfilled almost 90% of Italy's supply needs. Production has slowly declined over the last four decades, from 15.4 billion cubic metres (bcm) in 1973 to 8.6 bcm in 2012 (around 11% of Italy's supply needs).

There are four natural gas pipelines (TransMed, Greenstream, TAG, TENP/Transitgas) and three LNG terminals to import natural gas into Italy. Two pipelines entry points (Tarvisio and Mazara del Vallo) account for almost 40% of Italy's gas imports. Italy's biggest entry point is the TAG pipeline interconnection through Tarvisio in the northeast of the country, which in 2012 delivered 23.8 bcm of natural gas (maximum capacity of 4.99 mcm/h), equivalent to 35.3% of total gas imports to Italy. The TransMed interconnection to Tunisia through Mazara del Vallo in Sicily is also significant, delivering 20.8 bcm (30.8% of total gas imports to Italy) in 2012 (maximum capacity of 4.40 mcm/h).

With respect to legislation and regulation specific for the natural gas, a first important norm is the Legislative Decree 23/05/2000 n°164 accepting the Directive n° 98/30/CE on common directives for the internal market of natural gas. The decree defines the liberalisation of the natural gas market.

Subsequently, the Ministerial decree 29/11/2002 lists standards and modalities for incentives concessions provided by Legislative decree n° 164, 23/05/2000.

In 2005, a part of the Financial Law addressed the "Tax relief for industrial users of natural gas". Thanks to this law, large industrial users of natural gas can benefit from a reduction in the rate of excise tax usually levied on sales of natural gas in Italy.

As a longer term strategy, the NES 2013 indicates natural gas as one of the key elements of future decarbonisation, as a less carbon intensive choice with respect to oil and coal, especially in the electricity sector, and also a key driver in the energy security strategy.

In the distribution and commercialisation chains, there are few big operators in the Italian territory. The first one is Snam Rete Gas, which currently manages 32,339 km of pipelines in Italy and reaches almost the whole national territory. The holder company is Snam, an integrated operator that includes, together with Snam, Italga that is the company distributing natural gas in the urban areas.

2i Rete Gas is the second largest gas distribution operator and the only independent player in the gas distribution sector in Italy, with a widespread and diversified network of concession over the whole Italian territory, a market share of approximately 17% and more than 3.8million customers served.

Hera group is the third larger player in gas distribution (2.6 billion cm) and fourth in the Italian Electricity business in terms of electricity sold (9.1 TWh).

The following figure represents the gas-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the gas sector in Italy are presented.

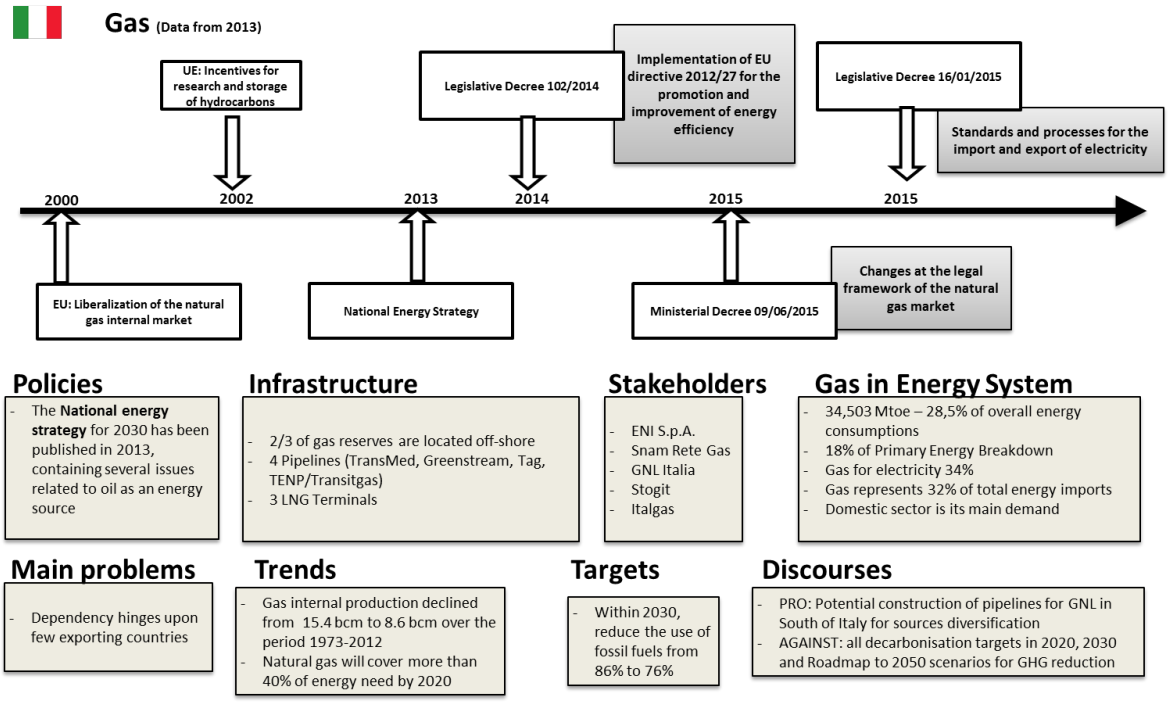


Figure 76: Gas policy overview in Italy

Coal

Italy imports via sea about 90% of its coal demand, on a fleet composed by 60 ships with a carrying capacity of 4.6 Mton. Import countries are different: the main ones are the USA, South Africa, Australia, Indonesia and Colombia, but there are also Canada, China, Russia and Venezuela.

The only coal source in Italy is located in Sulcis Iglesiente basin, in South-West of Sardinia. In 1972 mining activities in this basin were suspended but since 1997 several researchers have studied the basin in order to evaluate new solutions to use in an environmental friendly way the coal of Sulcis. At present, the production is about 1 Mton yearly. Italian operators have in pipeline projects for the conversion of coal of a

big part of their production and for the deployment of existing plants never used for coal combustion. In 2015, in Italy there are 13 coal plants.

The following figure represents the coal-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the coal sector in Italy are presented.

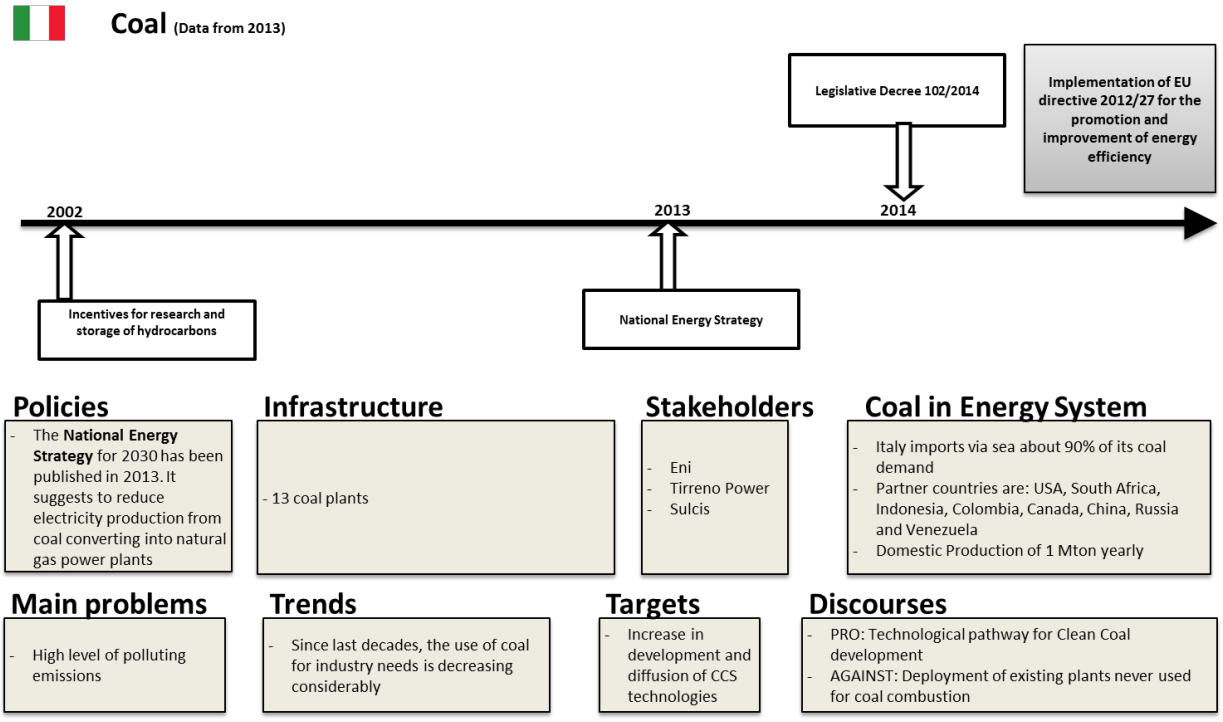


Figure 77: Coal policy overview in Italy

Nuclear

Italy does not produce energy using nuclear source since the Referendum held in 1987.

After the Chernobyl accident, with a referendum, in 1987 it was substantially reduced the power of the central government (CIPE) in deciding the sites for new installation of nuclear power plants. In 1990, the four existing nuclear plants were closed for obsolescence, and no other plants were programmed. In 2008 there was a public debate on investing again in nuclear energy. Nonetheless, after the Fukushima nuclear accident, a strong opposition to the national nuclear programme led to a popular referendum: key legislation about nuclear energy production in Italy was abrogated. Through Law Decree 34/2011 the Government had already suspended (moratorium) the effects of the Legislative Decree 31/2010 for one year, and as a consequence of the referendum, nuclear plants can no longer be planned, sited or built on the Italian territory.

Renewable sources

In Italy, the total use of renewables is equal to 7.87 Mtoe. This value represents 6.5% of the Italian overall energy consumption. Leaded by public support mechanisms, RES consolidated, over last years, a primary role in the Italian energy system. They are broadly exploited in the thermic sector (50% of overall energy consumptions from renewables), in the production of electricity (45%) and finally in the transport sector (5%). Concerning the electric sector, there are more than 600,000 plants fuelled by renewables for an installed power of 50,000 MW. In 2014, these plants have generated 118 TWh of electricity.

Italian overall energy consumption distinguished by specific consuming sector is reported for the year 2013 by single renewable source. The total consumption counts 20.7 Mtoe, equivalent to 868,000 TJ. The portion of renewables consumed for transport sector amounted to 6%. More than half of total consumption happened in thermic sector, thanks most of all to bio-energies contribution (see Table 20). It is also worth mentioning the important role played by RES specifically in the electricity sector.

From a total production point of view, the hydroelectric power is the most exploited renewable resource for the generation of electricity (48% of overall generation by RES), followed by solar energy (19-20%), biomasses (14%), wind (13%) and geothermal (5%).

Table 25: Italian overall energy consumptions by renewables, 2013 (ENEA)

	ktep	%
Electricity sector	**8,883**	**42.90%**
Hydraulic	3,868	18.70%
Wind	1,214	5.90%
Solar	1,856	9.00%
Bio-energies	1,458	7.00%
Geothermal	487	2.30%
Thermic sector	**10,603**	**51.10%**
Solar	168	0.80%
Bio-energies	7,781	37.50%
Geothermal	135	0.60%
Heat pump	2,519	12.10%
Transport Sector	**1,250**	**6.00%**
Total	**20,737**	**100%**

In addition, it is worth mentioning that by comparing electricity production values of 2013 with 2014 data, all RES have increased from 2013 to 2014, with a particularly good performance achieved by the hydroelectric. The increase reached by the other RES is lower but uniformly distributed across sources (Table 21).

Table 26: Electricity generated by renewables in Italy, TWh, 2013-2014 (ENEA)

Sources	2013	2014
Hydroelectric	52.8	57.0
Wind	14.9	15.1
Solar	21.6	22.3
Geothermal	5.7	5.9
Biomasses	17.1	17.2
Total	112.0	117.5

The largest energy producer in the renewables sector is Enel Green Power. Enel Green Power is engaged in the production of electricity from renewable sources at a global level: in March 2015, with 735 active

power plants, it is present in 4 continents (Europe, North America, South America, Africa). In every country the activity is managed through a national division. The production mix includes geothermal energy, hydropower, solar energy, biomass, and wind power, with a total production capacity of 9.789 MW.

Another emerging electricity operator in the renewables field is represented by Sorgenia, a private company born in 1999 after the electricity market liberalisation. Today it is a big Italian operator in the electricity and gas branch of the energy market, with power plants with installed capacity of about 3.200 MW.

Solar

In 2013 the photovoltaic power plants installed in Italy were 591,029, producing a total amount of electric power equal to 18,053 MW. Until 2013 the photovoltaic plant size was generally medium. On the contrary, in last two years the new installed plants are mainly of small dimensions, due to several policy interventions that are pushing micro RES production instead of medium and large scale power plants across the whole Italian territory.

Lombardia and Veneto are the regions where there is the largest number of plants, followed by Emilia Romagna, Piemonte, Puglia and Sicily. It is worth mentioning that Puglia represents the region with the greatest photovoltaic power installed, since there are large power plants, while in the North the majority of photovoltaic plants are of small and medium scale.

In 2008, Italian government published the Decree on "Feed-In Tariff for Solar Thermodynamic Energy". It aimed to stimulate the electricity generation by solar thermodynamic plants, including hybrid ones, connected to the electricity grid, built in Italy. Plants must be equipped with thermal accumulation systems. The major innovative laboratory working on solar photovoltaic are still public research agencies that are analysing the commercialisation phase of these still extremely costly technologies.

After six years the law n° 116/2014 ("Decree on the cut of incentives for photovoltaic plants") modified the previous Decree, applying a reduction to the tariffs that have been awarded under any Energy Account to photovoltaic plants with a nominal peak power exceeding 200 kW, with the following three options:

A. Tariff reduction by a ratio ranging from 17% to 25% depending on the residual incentivised period compensated by an extension of the incentivised period to 24 years starting from the date of entry into operation of the relevant plant (instead of the current 20 years).
B. Without changing the length of the incentivised period (i.e., 20 years), during a first part of the residual incentivised period, the tariff will be reduced and that, during a second part of the remaining incentivised period, the feed in tariff will be increased. The Italian Ministry will establish the re-modulation ratios for Economic Development.
C. Flat decrease of the tariff, for the remaining incentivised period without modifying the duration of the same, equal to 6% for plants with a capacity between 200 and 500 kW, 7% for plants with a capacity between 500 and 900 kW, 8% for plants with a capacity above 900 kW.

The following figure represents the solar energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the solar energy sector in Italy are presented.

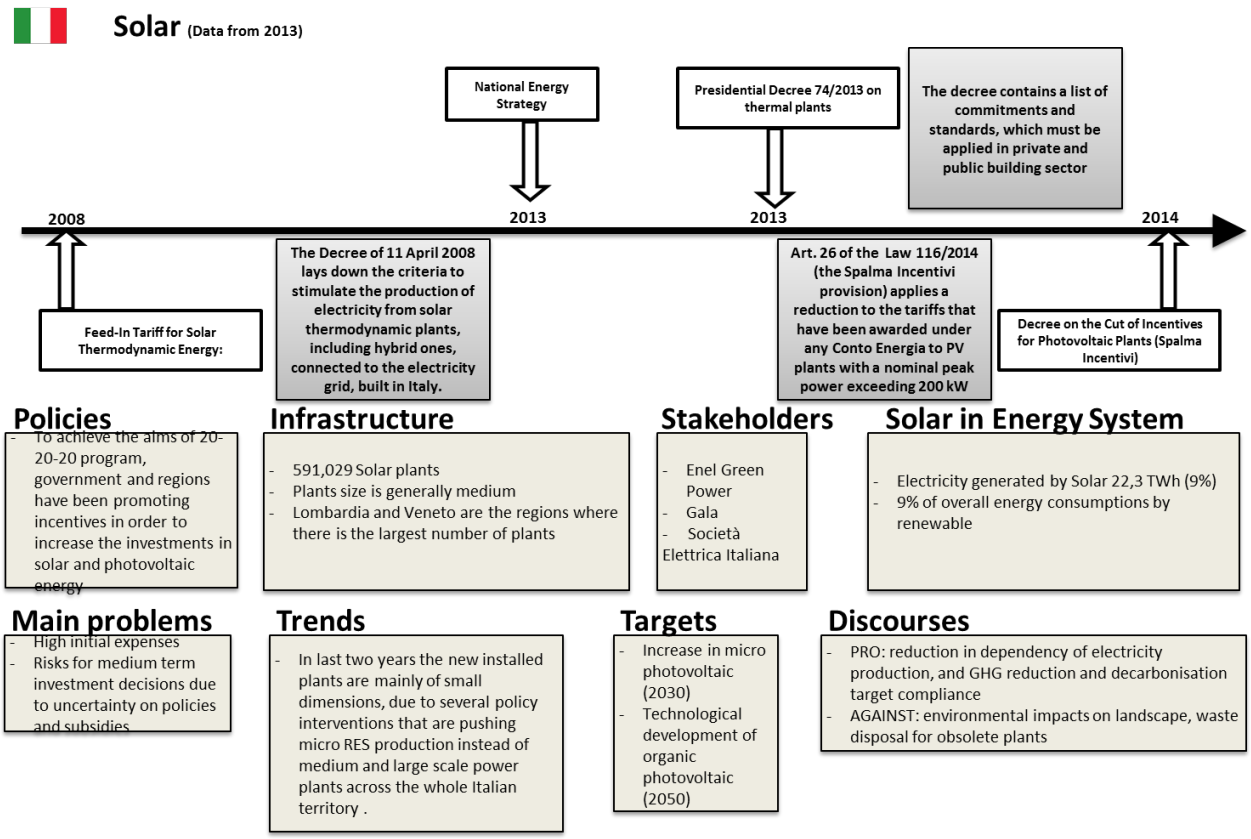


Figure 78: Solar energy policy overview in Italy

Wind

At the end of 2013, in Italy there were 1,386 wind plants. The greatest part of them had small size (74%), with an installed power up to 1 MW. Wind plants power represented 17% of overall renewables power. In 2013, energy production by wind source was equal to 14,897 GW, which results to be 13% of the total. The plants with a power over 10 MW produced 92% of the total electricity by wind plants.

Puglia is by far the region in which there is the largest quantity of wind plants (33.7% of the total), followed by Basilicata, Campania and Sicily. Regardless, because of climate factors, South of Italy produces much of wind power. There are several regulatory acts and norms referred to the wind power sector.

The 10/07/2012 Ministerial Decree introduced the "Feed-in premium for renewable energy sources other than photovoltaic". By this decree, a level of 5.8 billion Euros per year has been set in aggregate for all incentives to be paid under the regime of incentives for renewable energies excluding solar photovoltaic. The new incentive started to be granted from 01/01/2013. Plants that were already allowed before the date of entry into force of the decree and that will enter into operation by 30/04/2013 can decide to be admitted to the green certificates regime (anyway they may be converted into the new regime in the future).

The following figure represents the wind energy-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the wind energy sector in Italy are presented.

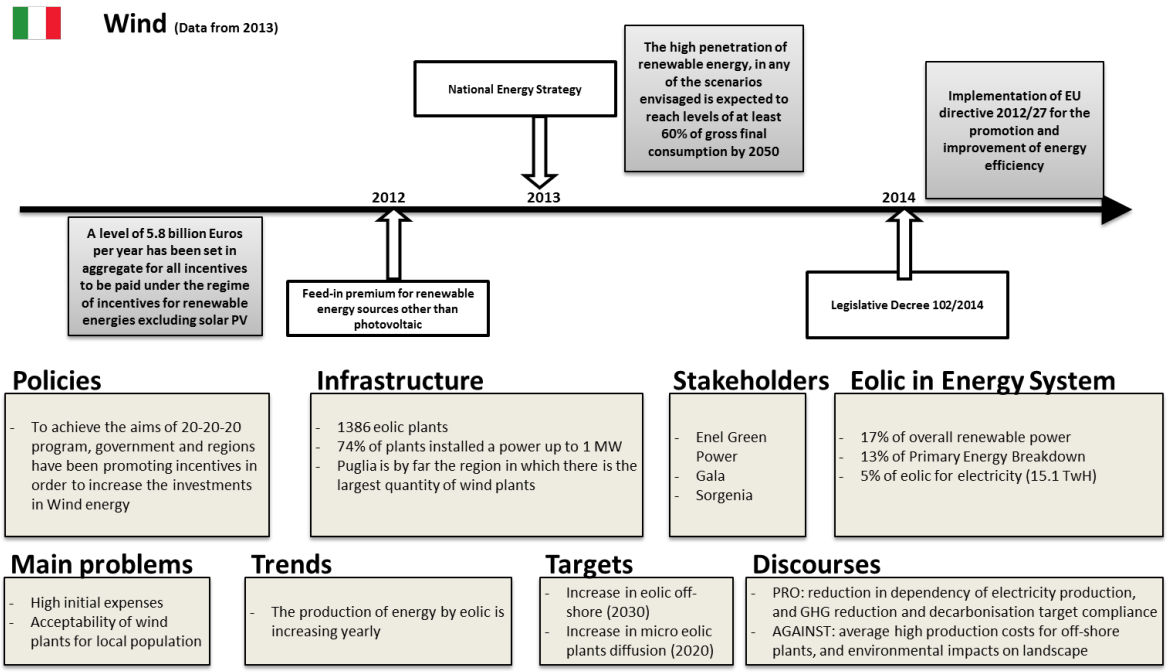


Figure 79: Wind energy policy overview in Italy

Hydro

Excluding the pure water pump, in Italy there were 3,250 hydroelectric plants in 2013. The greatest part of these is small in size, with a power inferior to 1 MW. In 2013 the supply by hydraulic source was equal to 52,773 GWh, representing the 47% of the total production by renewables. The largest number of plants is in Piemonte and Trentino for geographical features, while in the Centre and in the South the hydroelectric power capacity is rather smaller and decreasing from the North the South.

The following figure represents the hydropower-related policies and regulations in the last years. Below the timeline, an overview the different elements that have driven the hydropower sector in Italy are presented.

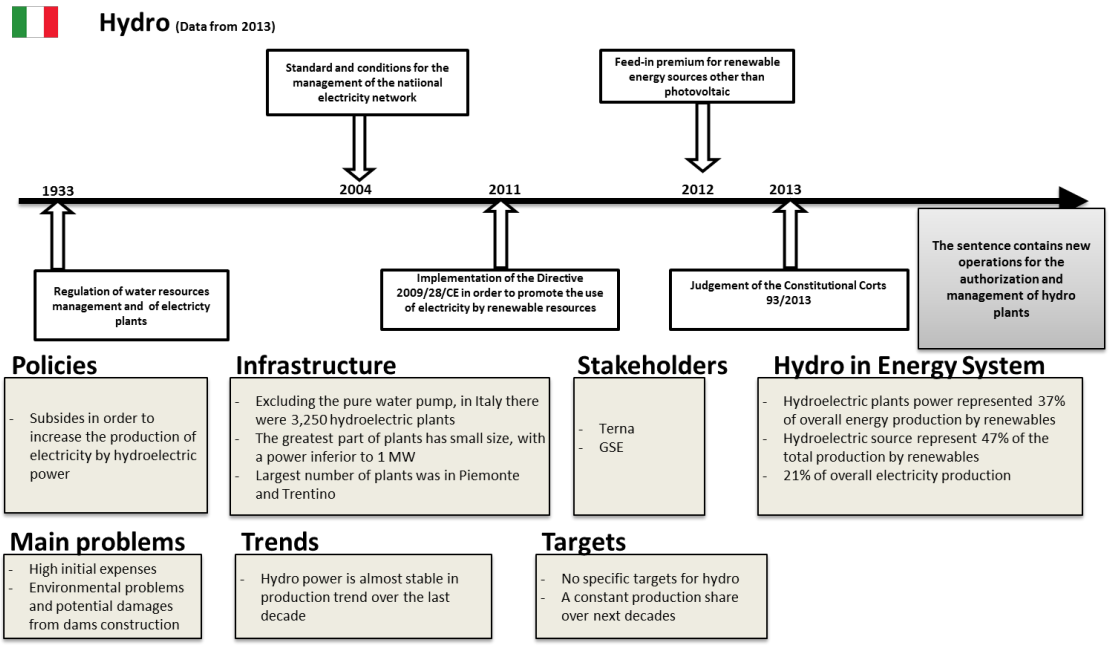


Figure 80: Hydro-Energy policy overview in Italy

Biomass

The total number of bioenergy production plants in Italy was 2,049 (in 2013). They generated a power of 17,090 GWh, representing the 8% of the total power produced by renewables. Among the Italian regions, Lombardia is by far the territory in which there is the highest number of bioenergy plants. At a general level, as for the case of hydroelectric, the North of Italy has the highest potential bioenergy production with respect to the rest of Italy, revealing a North-South divide also in the renewable energy production system (with the only exception of Puglia for the photovoltaic and wind sectors).

The biomass legislation context includes the Ministerial Decree 10/07/2012 that we have seen in the 3.1.1 paragraph for the wind sector. In addition, there are several additional laws that involve the biomass sector.

One of the most important is the legislative decree 55/2011 regarding the "National System of sustainability certification for Biofuels". The verification of compliance with the sustainability criteria for biofuels and bioliquids of art 18 Directive 2009/28/EC implemented by Decree 28/2011, has been transposed by means of Legislative Decree No. 55 of 2011, which also implements Directive 30/2009/EC. Decree 55/2011 establishes that economical operator have to comply with a National System of sustainability certification. For the purposes of acknowledgment of the increased energy contribution for biofuel provided under the support schemes for the use of RES in transport, traders shall provide information that contributes to demonstrate the compliance with the sustainability criteria. Biofuels must guarantee through their use the saving of Green House Gas (GHG) emissions by at least 35%. In the case of biofuels produced by installations already in operation on 23/01/2008 that value has been applied from 01/04/2008. From 01/01/2017, the saving of GHG emissions must be at least 50%. From 01/01/2018 that savings must be equal to at least 60% for biofuels produced in plants started production 01/01/2017 or later. If biofuels are produced from agricultural raw materials cultivated in the Community, they must be gained in accord with the requirements and standards set down in Regulation (EC) No 73/2009.

A second important step is represented by the Ministerial decree 10/10/2014, also named "Biofuels aid scheme: quotas", which provides that fossil fuel producers should annually supply a minimum quota of biofuels based on the total amount of fuel supplied. The decree no. 128/2005 established a national indicative target of 2.5% of substitution of traditional fuels with biofuels by 31 December 2010. From 1 January 2007 the quota for that date has been increased to 5.75%. The 2015 amendments established the trajectory from 2015 (5%) onwards for biofuel blending quota obligation (2016 5.5%, 2017 6.5%, 2018 7.5%, 2019 9%, from 2020 on 10%), updating the provision of previous legislation. A mandatory quota for "advanced biofuels" has been introduced, as well (2018 1.2%, 2019 1.2%, 2020 1.6%, 2022 2%).

Electricity production and consumption

The electricity production at the general level in Italy is mainly due to natural gas (34%), hydroelectric (21%), and coal (16%), followed by other sources as photovoltaic (9%), as shown in Figure 81.

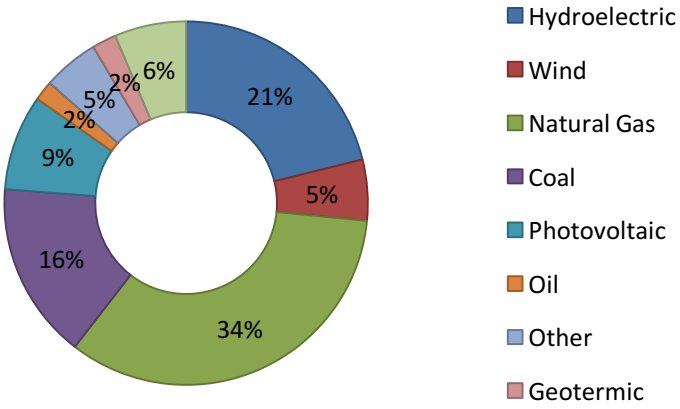


Figure 81: Electricity production by source in Italy, 2014 (Terna)

With respect to the major consumers in the Italian electricity system, the Industry sector is the largest electricity consumer, followed by the tertiary and the residential sector (see Figure 82). Total consumption by the Industry sector equal to 122,505 MWh, followed by tertiary (98,951 MWh) and domestic (64,255 MWh).

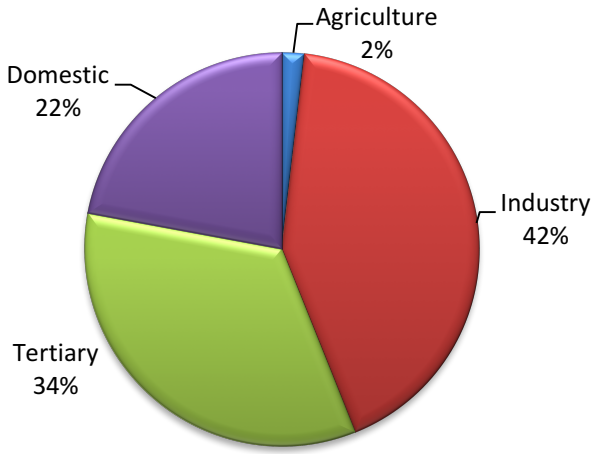


Figure 82: Italian electricity consumption by sector, 2014 (Terna)

The organisation of the electricity distribution across the Italian territory is entirely assigned to a public operator, Terna. "Terna S.p.A. - Rete Elettrica Nazionale" is an Italian electricity transmission system operator. With 63,500 kilometres of power lines or around 98% of the Italian high-voltage power transmission grid, Terna is the first independent electricity transmission grid operator in Europe and the sixth in the world based on the size of its electrical grid. Terna is listed on the Borsa Italiana and is a constituent of the FTSE MIB index.

With respect to the organisation of the commercialisation system is rather complex. The total cost of commercialisation for the electricity sector is included in the energy bill for the final consumer as a portion of energy selling services that companies transfer to final consumers. The amount of this transfer is centrally decided by the Authority. The amount of electricity commercialisation costs is clearly express in the electric bill received by the consumer, in order to be compliant with transparency laws and consumers protection rules. In the case of the other energy sources, the commercialisation process depends on the

level of market liberalisation. All producing firms have specific contact points or the commercialize contracts and special offers with telephonic interviews and or door to door information campaigns.

As a general remark, the commercialisation system is highly diffused over the territory, and there is a large communication potential with final consumers.

7.5.2 Energy Efficiency

Furthermore, in accordance with the EU Directive 32/CE/2006, Italy submitted its National Energy Efficiency Action Plan (NEEAP) in July 2007. The plan considers measures already undertaken under the budgetary law of 2007 and other measures, such as application of energy efficiency standards in buildings and the promotion of high efficiency CHP plants. The proposed measures aim to achieve an energy saving target of 9.6% by 2016, comprising 118,464 GWh. The industrial, residential, tertiary and transport sectors are addressed.

In addition, the National Strategy for GHG emissions was approved in 1994 with the aim to stabilize CO_2 emissions by 2000 at 1990 level. Afterwards the programme was enhanced and updated (CIPE deliberations of 1997 and 1998) and in 2002, when the Kyoto Protocol was ratified, an overall national strategy to meet the Kyoto Protocol target was approved (CIPE deliberation 123/2002). The financial support and legislative instruments to implement the strategy are identified through the Financial Law and allocated at the central and local bodies on the basis of the respective competences.

The implementation of the EU Directives arisen with the Legislative Decrees 79/1999 and 164/2000 (both amended in 2012), implementing the European Directives on the opening of the electricity and gas markets, require the government concession to electricity and gas distribution companies include an obligation to implement measures and interventions aimed at improving energy efficiency in end uses, measured according to quantitative targets. A relatively new strategy programming system is also represented by the National Electric System Research. The Decree establishes the 2010 annual operative plan, with a total fund of EUR 103 mill divided into:

- a) Management and development of the national electric system (EUR 34.5 mill);
- b) Electricity production and environmental protection (EUR 23 mill);
- c) Rationalisation and saving of electricity use (EUR 45.5 mill).

The research plan is centrally controlled by the Ministry of Economic Development, and practically implemented by the Italian national energy Agency (ENEA) in accordance with several research institutions and academic departments.

There is a strong involvement with the scientific community as well as the civil society and private firms, since the strategy is implemented by conducting different analyses based on different approaches, starting from pilot projects on the technology commercialisation side, to customer and consumer behaviour surveys in order to detect which kind of information and education channels are most effective in changing consumption habits.

7.5.3 Sectoral analyses

Construction

There are several national norms that involve the building sector. In particular, there are some norms and regulation tools that are directly settled for the building sector, and others that are transversal to different sectors. This complexity is valid for all energy intensive sectors, which are often included in systematic

energy planning and also regulated by specific policies. Concerning the building sector, the Legislative Decree 63/2013 - Law 90/2013 is the transposition of the European Directive 2010/31/UE on the energy performance of buildings.

The objectives of the Decree are:

1. to encourage improvements in the energy performance of buildings;
2. to encourage the development, enhancement and integration of renewable energy sources in buildings;
3. to support energy diversification;
4. to promote the competitiveness of the domestic industry through technological development;
5. to achieve the national targets for energy and the environment;
6. to extend and enhance the system of tax exemption for the redevelopment of Buildings (Eco-bonus) and building renovations, from 55 % to 65% (divided into 10 equal amounts for 10 years).

Another important norm in the building sector is the Presidential decree of 2-04-2009, n°59. This is the implementation of the EU Energy Performance of Buildings Directive (EPBD). In accordance to this decree, all new buildings are obliged to satisfy at least 50% of hot water demand by mean of solar generation.

In the framework of the on-going transposition of the European Directive EPBD 2002/91/CE, the decree of 22/11/2012 implements the energy performance certificate provisions of Directive in all Regions through a homogeneous framework, with a package of instruments to harmonise government and regional legislation. The guidelines apply to Regions that have not as yet implemented provisions under the EPBD for building certification, and apply until any regional legislation takes effect. Regions will need to harmonise their implementation of the Directive with the guidelines. The Decree sets up a coordination forum between central government ministries, regions, provinces, and communes, supported by various agencies and bodies. The forum is designed to facilitate monitoring implementation of the legislation, sharing information and best-practice, formulating legislative proposals, assessing costs and conditions of access to certification, and ensuring the harmonisation of regional instruments.

The following figure represents the policies and regulations that have influenced the construction sector, particularly its energy efficiency in the last years. Below the timeline, an overview the different elements that have driven the energy consumption in the construction sector in Italy are presented.

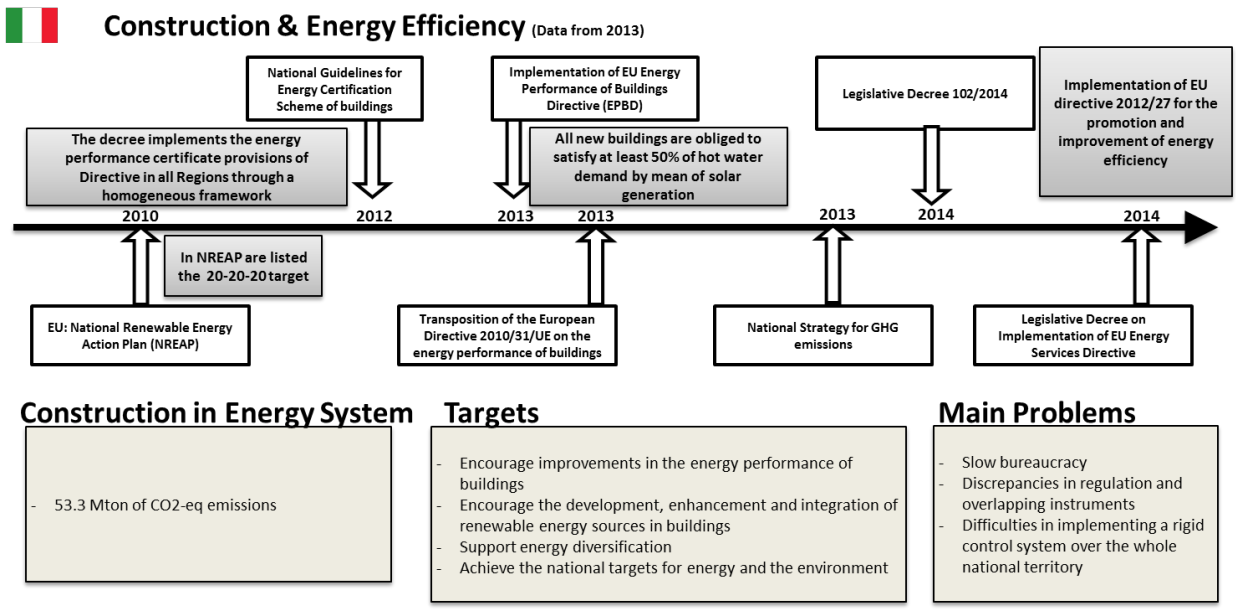


Figure 83: Overview of the construction sector in Italy

Transport

As for the building sector, also in the transport sector there several norms that interact in complex framework. The National Intelligent Transport System (ITS) Action Plan (2014) identifies the national priorities by 2017. It analyses the state of the Art of ITS deployment in Italy and identifies strategies and policies to be undertaken, for each of the priority areas included in the EU Directive. It is currently under discussion by the entire involved stakeholder in order to identify and launch concrete action for the deployment of the Action Plan.

The National Infrastructure Plan for Recharging Electric Vehicles defines an annual plan to guarantee the minimum level of service in main cities, defining standards and inter-operability among energy utilities and providers, with incentives to petrol network to install charging point within their local distributors. The Plan foresees incentives for Low Emission Vehicles. This policy in particular needs to be coordinated with Municipal laws especially in case of big metropolitan areas.

The following figure represents the policies and regulations that have influenced the transport sector in the last years. Below the timeline, an overview of different elements that allow a better understanding of the policy making in the transport sector in Italy are presented.

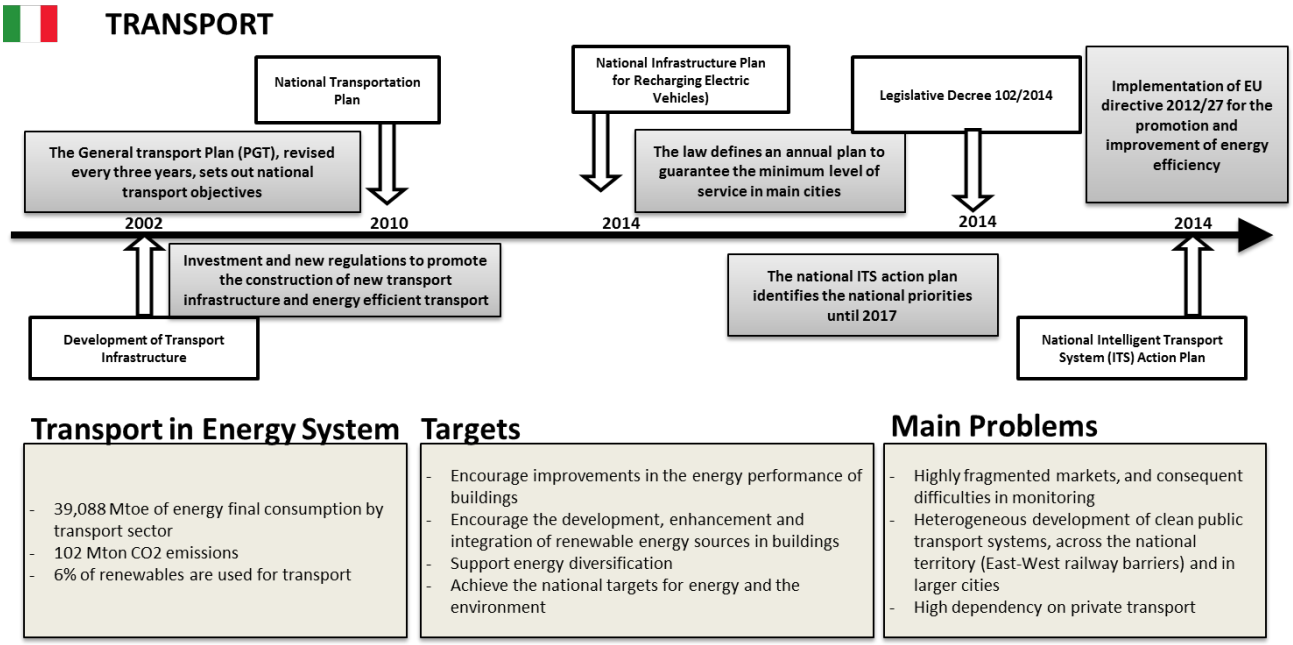


Figure 84: Overview of the transport sector in Italy

7.6 Germany

7.6.1 Energy supply and its related regulation

National overview

In the post-war period, West Germany (BRD) and East Germany (DDR) had different energy strategies. Overall in the DDR, the major source of fossil fuel was brown coal, or lignite, which was burned in large amounts in the post-war period, resulting in huge pollution problems in the following decades. The general dependency on fossil fuels, with subsequent strong greenhouse gases emissions, was reduced by the nuclear programme of the 1960s. In the beginning of the nuclear era, when the long-term availability of coal seemed to be questionable, nuclear power was supported by a consensus of opinion (politics, media, scientists, etc.), because it seemed to represent a science-based solution to the upcoming energy problems of the country. In addition, the oil crisis in the following decade pushed Germany to use nuclear power. At the peak of the nuclear era, Germany drew about 30% of its electricity from nuclear power. Economic and social pressure on the nuclear sector pushed this down to 22% in 2010. After the Fukushima Daiichi nuclear accident, a long debate was launched in Germany and the Government decided to close all nuclear plants in the country by 2022.

Germany's energy mix is undergoing a significant transition due to the political decision to phase-out nuclear energy by 2022 and to achieve decarbonisation of the energy mix on the basis of renewable energies and energy savings (EC, 2015f). All of these changes in energy production are driven by the German government, mainly by means of reforms and new laws produced by the Federal Ministry for Economic Affairs and Energy, which plays the primary role in the decisions about the energy model in Germany, taking consideration of environmental sustainability and economic efficiency.

Also many agencies and associations are collaborating with the government and the energy companies in order to achieve the energy transition towards a renewable-oriented energy model. These entities carry out research and development to find new low-cost ecological energy solutions (e.g. German Heat and Power Association, universities) and technology-knowledge transfer (e.g. Energy Efficiency – Made in Germany and German Federal Association of Energy and Climate Protection Agencies).

Fossil Fuels

Coal

Coal plays an essential role in Germany's current mix of energy sources. Hard coal and lignite together account for almost 25 per cent of primary energy consumption (12.8 and 11.7 per cent respectively in 2013). Regarding electricity production, coal also represents the most important energy source, as around 45 per cent of electricity generation is covered by coal (lignite - 25.5 per cent, hard coal - 19.4 per cent).

Hard coal mining in Germany has witnessed a long process of restructuring; State support has decreased progressively and consequently so has the number of mines and people employed in the sector. Currently more than 80 per cent of the German market's supply of hard coal is imported. Regarding lignite, over 90 per cent is used to generate electricity and district heating in public and industrial power plants. It therefore accounts for 25.5 per cent of electricity generation in Germany.

When Germany decided to shut down eight of its seventeen nuclear plants in 2011 and phase out the rest of them by 2022, there was concern that coal power would increase significantly to fill the gap left by nuclear. However, the country has drafted specific plans in its energy policy strategy documents to reduce the role of coal in its energy mix (Energy Transition, no date).

On July 2015, the Federal Government's coalition parties reached an agreement with regard to the closure of lignite fired power stations, for reducing carbon-emissions further (EC, 2015f).

The following figure represents the coal-related policies and regulations in recent years. Below the timeline, an overview of the different elements that have driven the coal sector in Germany are presented.

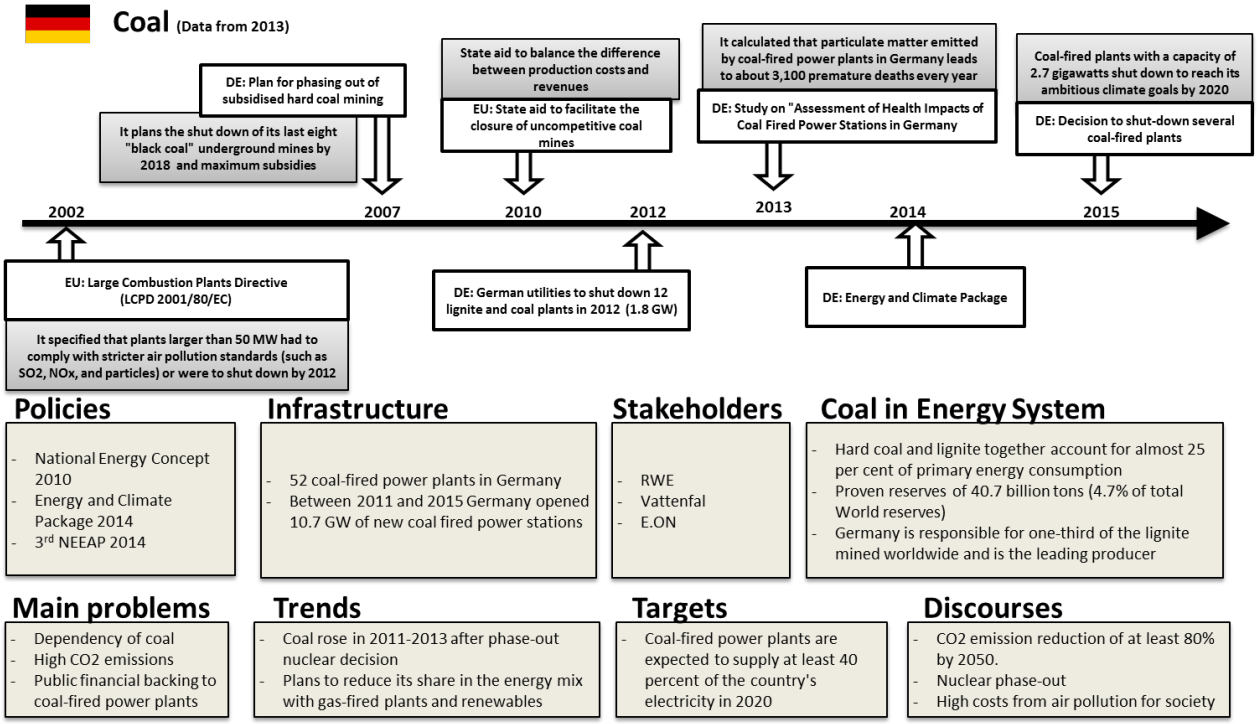


Figure 85: Coal policy overview in Germany

Oil

Traditionally, oil has always accounted for a large share of the energy mix. In the 1970s it represented more than half; in the 1980s the change from oil to natural gas for heating reduced its share to 33-40%; in the 1990s-2000s the increase in transport related activities led to a temporary increase of oil's share up to the current 33.5% of primary energy consumption in 2013.

Germany's crude oil imports amounted to 93.4 million tonnes in 2012, Russia and Norway being the largest suppliers. It is imported into Germany via four transnational crude oil pipelines as well as national ports and distributed from import terminals along its northern coastline to inland refineries.

The following figure represents the oil-related policies and regulations in recent years. Below the timeline, an overview the different elements that have driven the oil sector in Germany is presented.

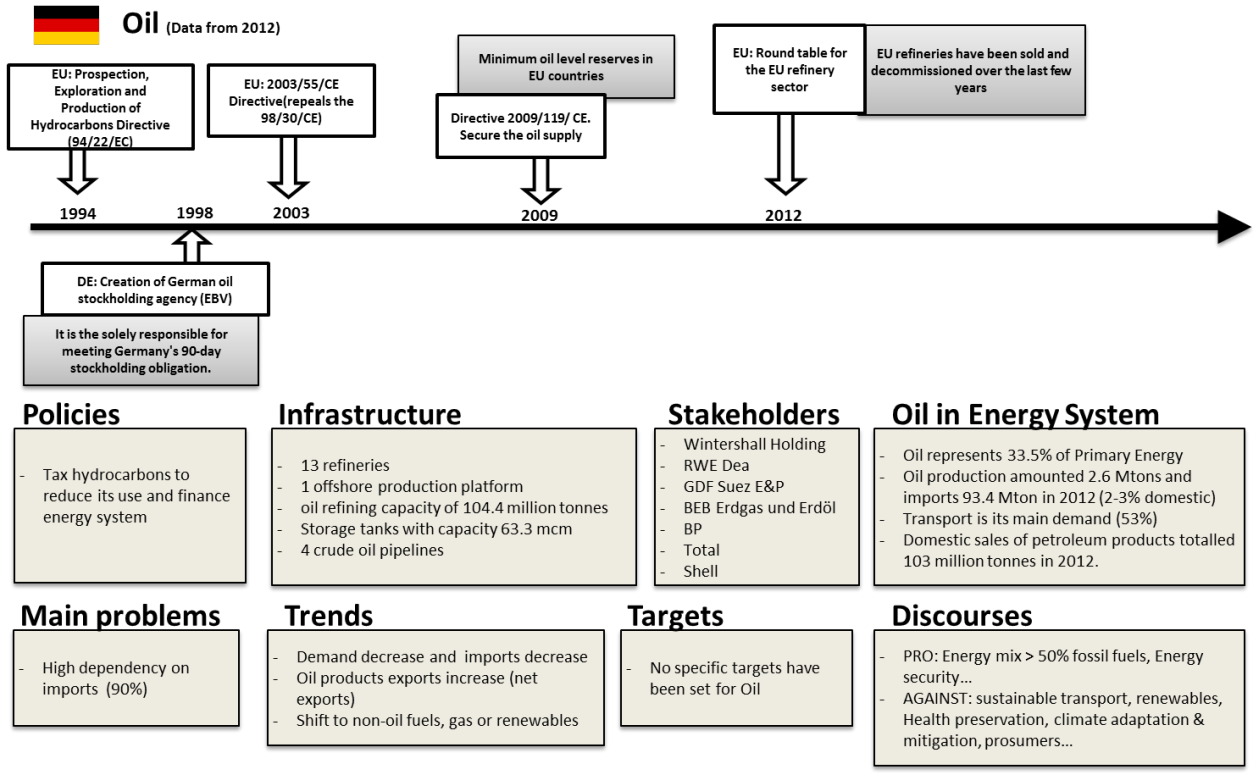


Figure 86: Oil policy overview in Germany

Gas

Natural gas also plays an essential role in the energy system, representing more than 20.5% of primary energy consumption in 2014. Natural gas will continue to make a significant contribution to energy supply in Germany over the coming decades; mostly for heat generation but also for electricity generation as the country shifts from coal-fired stations to gas-fired stations, which are more climate-friendly. Domestic production amounts to 10% of total primary energy consumption, so Germany is highly dependent on imports. The largest importers are Russia (38 per cent of the gas imported in 2014), Norway (22 per cent in 2014), Netherlands (26 percent in 2014). Regarding gas infrastructure, Germany is well interconnected (gas is provided exclusively via pipelines) and has a high degree of diversification of supply routes and sources (EC, 2015f). There are three gas pipeline projects underway to further improve the security of supply of natural gas to Germany (and Europe).

Due to extremely cold temperatures in Eastern, Central and Western Europe in 2012, there was a peak of end-user demand for natural gas in Germany (reaching historic maximums in some areas). At the same time, available gas supplies from Russia started dropping. This originated the “cold snap” that put German gas infrastructure under considerable pressure. In 2014, the Federal Network Agency issued the third Gas Network Development Plan (NDP), which lists 51 measures for expanding the national gas infrastructure.

The following figure represents the gas-related policies and regulations in recent years. Below the timeline, an overview the different elements that have driven the gas sector in Germany is presented.

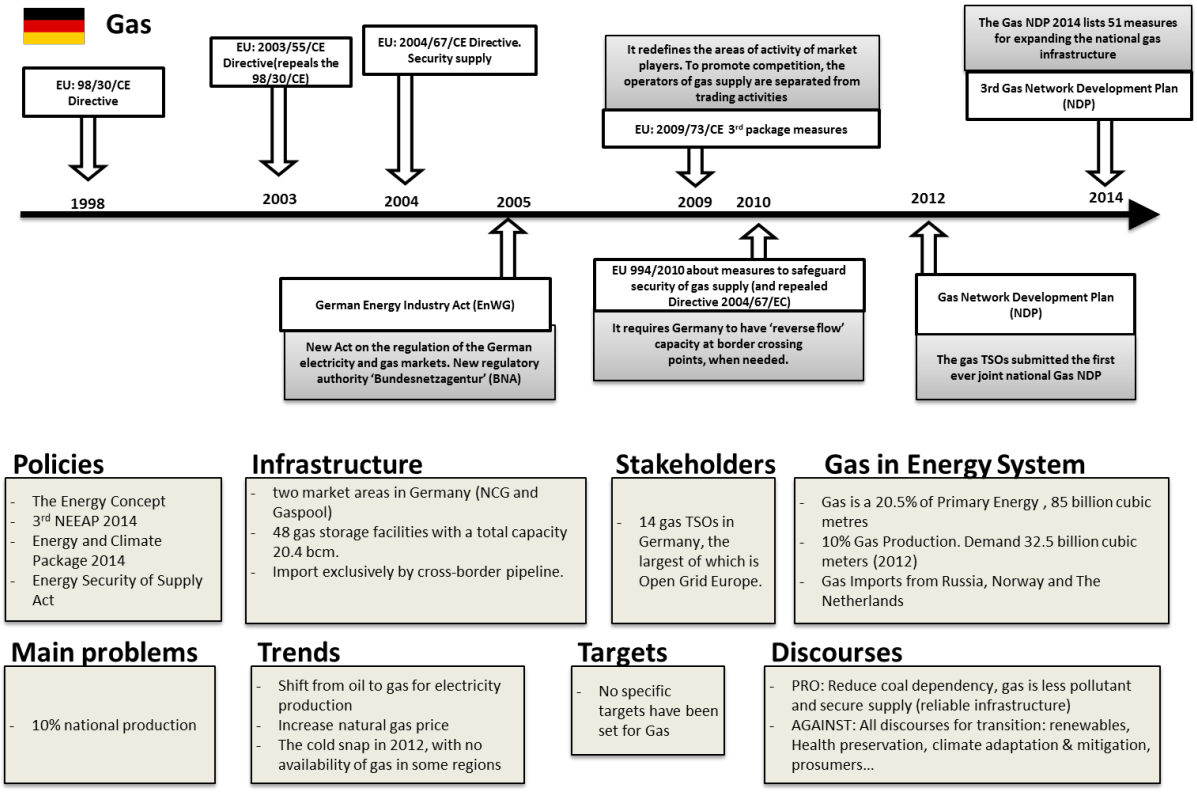


Figure 87: Gas policy overview in Germany

Nuclear energy

A total of 37 nuclear power plants have been built in Germany since 1962 and at the peak of the nuclear era, Germany produced 30% of its electricity from nuclear. Between 1962 and 1980, 24 nuclear power plants were commissioned. Since then and after various nuclear accidents German society started to grow deeply anti-nuclear

In September 2010, German government reached a deal to run the remaining 17 nuclear plants, on average, 12 years longer than planned, with some remaining in operation until the 2030s. Then, following the Fukushima Daiichi nuclear accident, the government reconsidered nuclear power again. Germany's Reactor Safety Commission presented a study of the risks associated with nuclear in Germany. In addition to this, the German government appointed an independent ethics commission, which provided insight on all the issues related to the future supply of energy. The findings of these commissions served as the guidelines for the subsequent energy policy decisions and it was decided in summer 2011 to speed up the energy transition and completely phase out the generation of energy in German nuclear power stations by the end of 2022.

In 2015, there are still 9 nuclear power plants with an electrical output of approximately 12,000 MW in operation. They represented the 15.8% of total electricity supply in 2014.

The nuclear energy phase-out is regulated by two amendments of the Law on nuclear energy and is currently on track. In 2014, already 43% of nuclear generation capacities have been decommissioned (corresponding to 9.4 GW). The further pathway of phasing-out nuclear energy is shown in Figure 88.

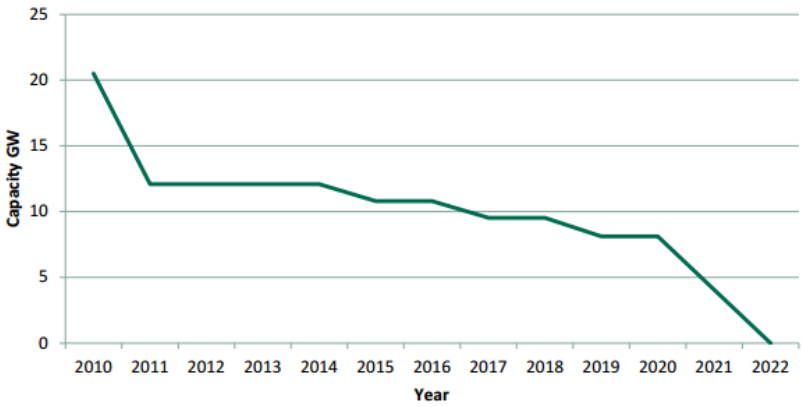


Figure 88 : German nuclear phase-out timeline (BGBL, 2011)

The following figure represents the nuclear energy-related policies and regulations in recent years. Below the timeline, an overview the different elements that have driven the nuclear energy sector in Germany is presented.

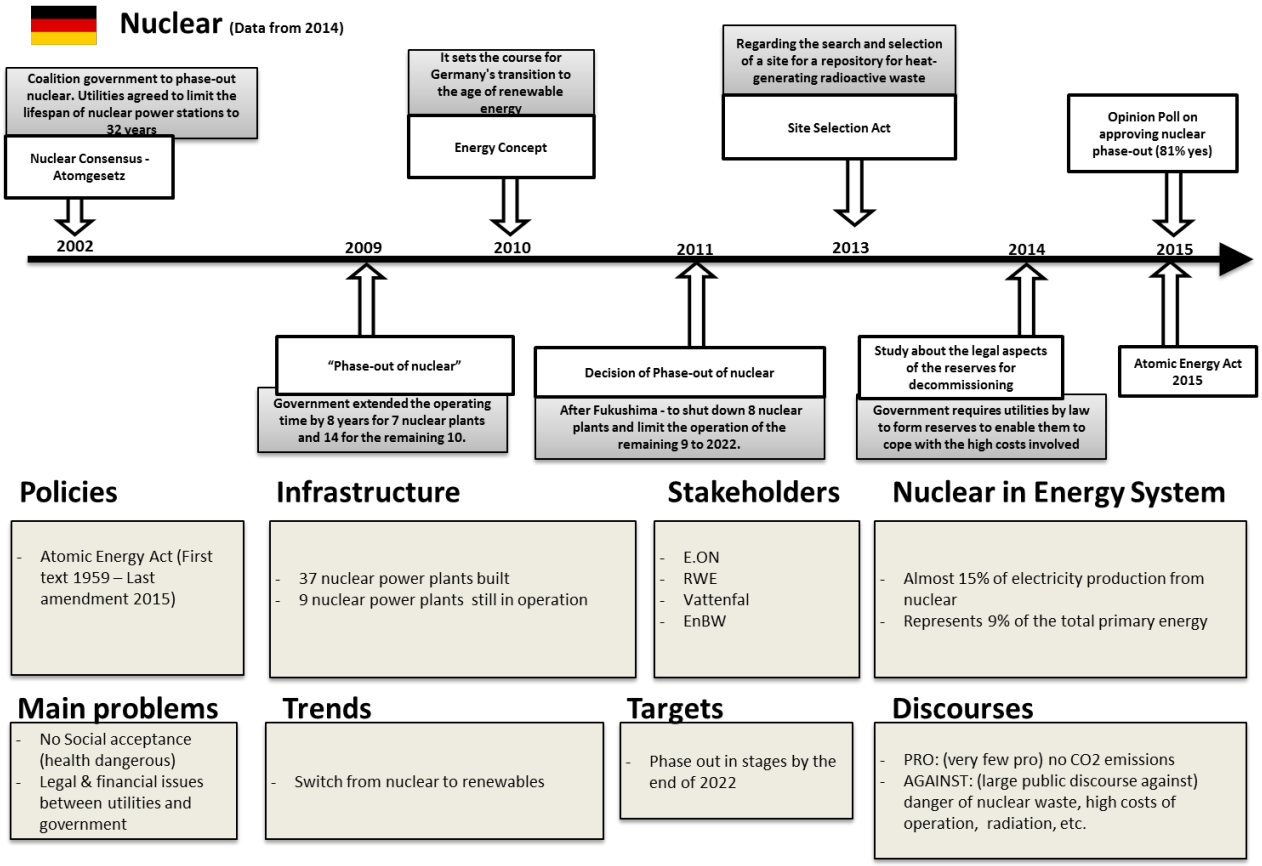


Figure 89: Nuclear policy overview in Germany

Renewable Sources

Renewable energies represent the cornerstone of Germany's energy transition. In 2012 renewable energies were already the second most important source of electricity generation and in 2013 a new record of

25.3% of renewables in electricity generation (AGBE, 2014, p.29) was achieved. Germany is on track to reach its 18% of renewable energy share (gross final energy consumption) for 2020 (EC, 2015f).

To achieve this, a successful instrument to promote green electricity was conceived: the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, or EEG), which entered into force in 2000 and which has been last reviewed in 2014. This law had the aim of enabling young technologies such as wind and solar energy to enter the market with support provided by fixed tariffs, a purchase guarantee and priority feeding-in of renewable electricity into the grid. The final purpose is to achieve a power generation cost from renewable energies (wind off-shore and photovoltaics) similar to the one from the German power mix, which is estimated by the Energiewende by 2030 (Energy Transition, no date).

The Renewable Energy Sources Act meant a clear transformation of the German energy system and since 2000, the proportion of power generation accounted for by renewable energy has risen from 6% to 32.5% in the first half of 2015 (Federal Ministry for Economic Affairs and Energy, no date). It is also worth mention that net installed capacity from wind and solar overtakes the ones from coal, gas or nuclear already in 2014. However the related power generation is considerably smaller due to the intermittency and lesser efficiency than traditional energy sources (Energy Transition, no date).

Renewables related regulation

The Renewable Energy Sources Act was amended in 2004, 2009, 2011, 2012 and finally 2014. Its main points are (IEA, 2013):

- Priority access for renewable energy (RE) to the power grid
- Priority transmission and distribution
- Fixed price for every kilowatt hour produced for 20 years for many technologies
- Tariffs are set technology-specific and specific with regard to further provisions (such as site, system services, etc.)
- Reduction of the tariffs as a result of technical and market development
- Equalisation of additional costs for electricity from renewable energy between all grid operators and electricity suppliers
- Independence from public budget
- Regular monitoring and evaluation process, comprehensive accompanying research and analysis

This policy intensive period pushed the German government, industry and society to strongly concentrate on renewable energy sources such as wind, hydraulic energy, biomass, biofuels, photovoltaic, solar thermal etc. The rapid expansion also resulted in a rise in the surcharge imposed under the Renewable Energy Sources Act ("EEG surcharge"). Furthermore, it posed a growing challenge for the stability of the electricity grids and the security of our energy supply (Federal Ministry for Economic Affairs and Energy, no date b).

The Act was reviewed in 2014 to ensure the continued growth of renewable energies in Germany. It aimed at protecting the investments of renewable energy producers, by holding energy prices stable, avoiding any rise in costs and thus making renewables more and more competitive compared to traditional sources. It promotes market integration of renewables consistent with EU State aid rules (EC, 2015f). In addition, it imposes an over surcharge on the non-renewable energies.

Another key German policy is the Energiewende (2010), the new programme on the themes of renewable sources and energy efficiency, by which it proposes to reduce greenhouse gas emissions by 80-95%, to consume 60% of energy from renewable sources and to improve the electricity efficiency by 50% by 2050 (EC, 2015f).

Wind

Germany is the third-largest market for wind in the world. In 2012, the country installed 2,415 MW of wind capacity, which made its cumulative total 31,308 MW. According to the National Renewable Energy Action Plan, the percentage of energy from renewable sources in the gross final energy consumption will rise from 6.5% in 2005 to 18% in 2020. By 2020, renewable energy will represent at least 35% of the gross electricity consumption of Germany.

The 2014 reform of the Renewable Energy Sources Act entailed that a mandatory direct marketing of green electricity be introduced. According to this law, operators of larger wind turbines must sell their electricity production on the electricity market. In addition to the wholesale price they receive a floating market premium, which is based on the average market value of all wind power in Germany. The mandatory direct marketing affects both the costs incurred, as well as the revenues earned, by the plant operator (Grau, *et al.*, 2015).

The current leading position of Germany in the global wind market can primarily be attributed to decades of progressive and targeted legislation. By the early 1980s, a growing environmental movement influenced the energy debate in the German Parliament and the energy policy of the federal government (IRENA, 2013).

The following figure represents the wind energy-related policies and regulations in recent years. Below the timeline, an overview the different elements that have driven the wind energy sector in Germany are presented.

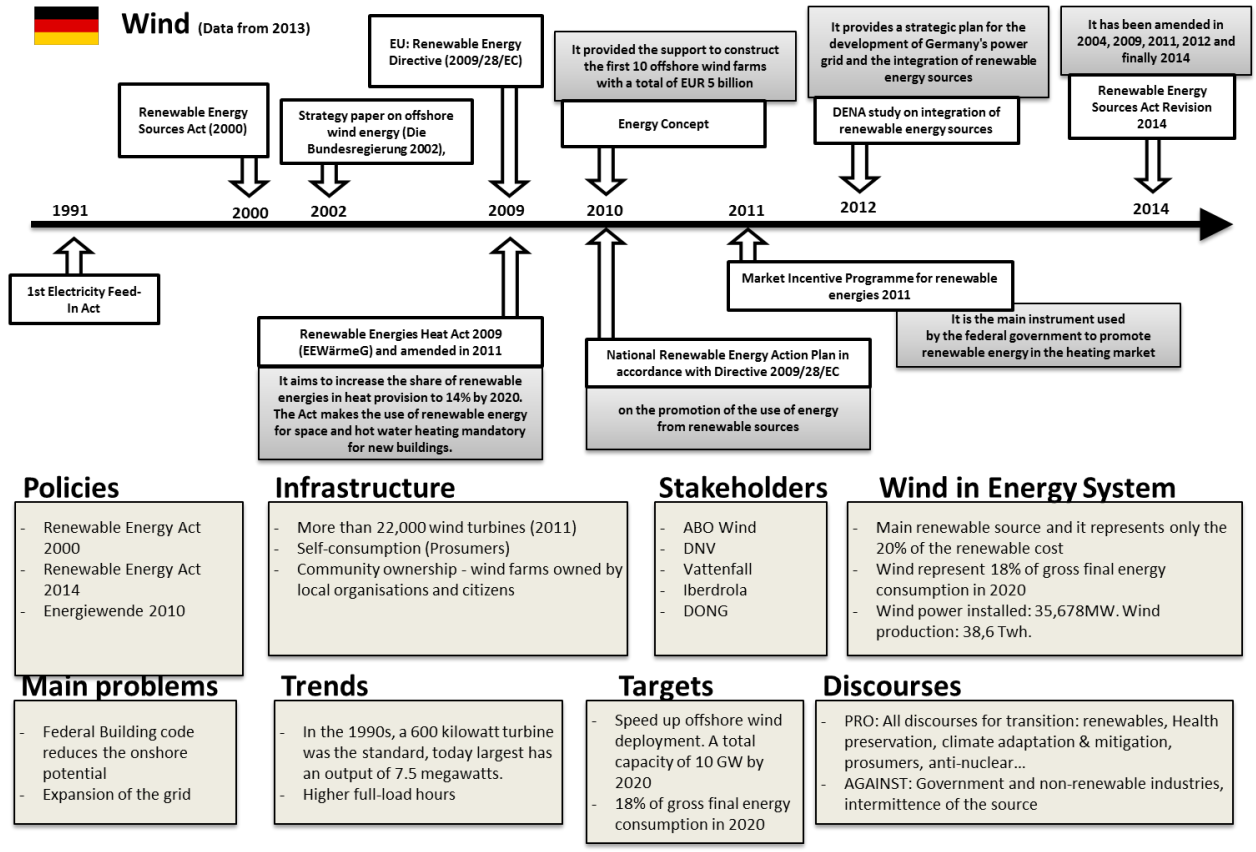


Figure 90: Wind energy policy overview in Germany

Solar

In 2013 Germany had installed 35.7 GW of solar PV capacity and this represented almost a third of world's installed capacity, making Germany the country with the largest installed solar PV capacity in the world. By 2014, almost 1.5 million photovoltaic installations of different sizes were installed in Germany. The majority of them were built by private households, which turned into decentralised energy suppliers (prosumers). One of the main challenges of the sector remains the cost of the solar panels, more and more Chinese manufacturers are entering this market which is a highly political market subject to significant government interventions.

On the other hand, authorities have recognised that recent growth in solar PV was too rapid, moving out of line with both the 2020 NREAP indicative target of 52 GW and overall energy system planning. FITs were not adjusted as fast as falling system prices, leading to excess returns on solar investments and deployment. In June 2012, an amendment to the EEG – the "June PV Amendment" – made it clear that FITs for PV systems will expire when the overall target of 52 GW is reached (IEA, 2013).

As the share of renewable energy has grown, the cost of supporting the total amount of renewable resources has also grown, and the achieved levels of renewable energy penetration begin to raise questions about future market design and renewable energy support.

The following figure represents the solar energy-related policies and regulations in recent years. Below the timeline, an overview the different elements that have driven the solar energy sector in Germany are presented.

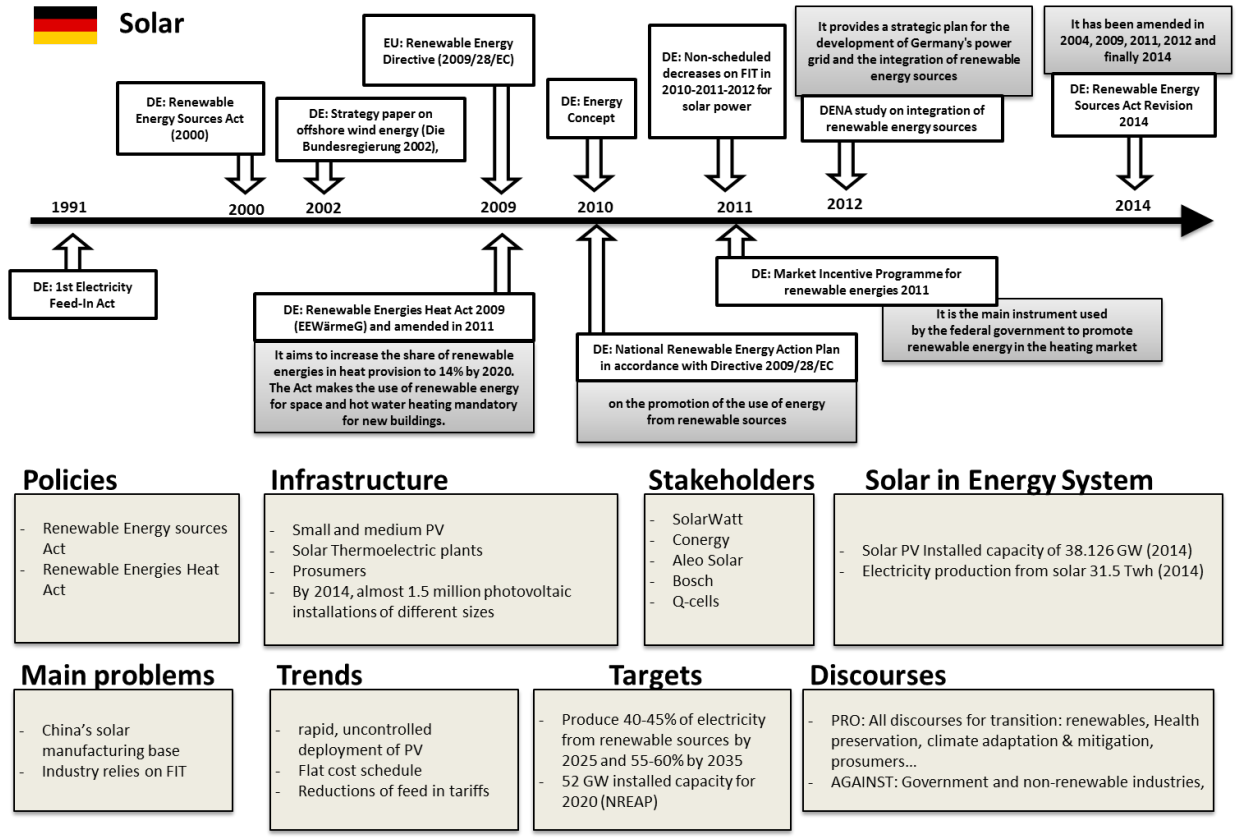


Figure 91: Solar energy policy overview in Germany

Biomass, biogas and waste

Biomass represented the 33.3% of electricity generation from renewables in 2011, which made the country the second-largest share of electricity generation from renewable energy sources. Of the 132.3 TWh of electricity generated from renewable energy resources in 2011, approximately 44 TWh came from biomass, of which 19,425 GWh was biogas (IEA, 2013). Biomass includes solid and liquid biomass, biogas, landfill gas, sewage gas, and the biogenic share of waste. In 2009, the Federal Ministry for Food, Agriculture and Consumer Protection (BMELV) and Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) created a National Biomass Action Plan for Germany, Biomass and Sustainable Energy Supply (the Biomass Action Plan) (IEA, 2013). The purpose of the Biomass Action Plan was to establish the potential for the use of biomass in Germany and identify available reserves. The Biomass Action Plan was later integrated into the NREAP in 2010. Similar to the case of wind farms, many biomass facilities have been built in communal or local collective ownership.

Hydropower and tidal

Hydropower represents a relatively small percentage of the renewable electricity generation (less than 15%) compared to other EU countries. The current capacity installed in Germany was 5,619 GW in 2014 to produce 14.7 TWh, compared to the 17.3 TWh generated in 2011 (Energy Transition, no date).

Electricity

In 2014, there were generating facilities with a net rating totalling around 188 GW. Of this total, renewable energy sources account for about 43 percent, of which about 20 percent is from solar and about 18 percent from wind power. In 2013 Gross domestic power consumption was 598.3 TWh and total gross electric production was around 632 TWh. Despite an increasing contribution from the renewable energies, the share of lignite and hard coal in the energy sources mix in the German power supply remains high (Federal Ministry for Economic Affairs and Energy, no date c).

On the retail side, the electricity market is reasonably competitive with the four largest companies having a market share of 45.5%. Electricity retail prices for households are among the highest in Europe due to high taxes and levies. The reform of the 2014 Renewable Energy Sources Act (EEG) is expected to stabilise costs for the renewable surcharge (EC, 2015f).

The interconnection level for electricity was of 10% in 2014. Nevertheless, for a fully integrated energy market, there is a need to further increase interconnections with neighbouring countries (according to the European Energy Security Strategy, objective 10% in 2020, 15% in 2030). The Federal Government's coalition parties reached an agreement with regard to further measures to enhance the necessary grid expansion. More than 50 grid expansion projects are currently to be implemented (EC, 2015f) included in the National Grid Expansion Acceleration Act (NABEG).

In 2014, the Federal Ministry for Economic Affairs and Energy published the Green Paper "An Electricity Market for Germany's Energy Transition", which launched a structured debate on the future design of the electricity market. It constituted an open and participatory process of four months and some 700 comments were received (Federal Ministry for Economic Affairs and Energy, no date c). This fed directly into the White Paper 2015 and the decision to develop an electricity market 2.0.

The White Paper with the same title published in 2015 is the outcome of an open and transparent dialogue process on how to organise the electricity market. The Ministry clearly advocates a further development of the electricity market to become an electricity market 2.0, and argues against the introduction of a capacity market. In the electricity market 2.0, the necessary capacities can be remunerated via existing market

mechanisms. The White Paper contains the principles for 20 measures implementing the electricity market 2.0, such as:

- Guaranteeing free price formation: the principle of free pricing in electricity trading is to be anchored in the Energy Industry Act. Prices send important information to the market players. They are the only way to show how scarce electricity is at any time.
- Monitoring security of supply: an ongoing monitoring process will use the latest methods to see whether the supply actually is secure.
- Introducing a capacity reserve: this will safeguard the electricity supply against unforeseeable events.
- Developing the balancing capacity markets further: in order to keep the system stable at all times and to offset erroneous forecasts, the transmission system operators use balancing capacity. More providers are now to receive access to the balancing capacity markets. This increases competition on these markets and thus reduces costs.

(Federal Ministry for Economic Affairs and Energy, no date c)

7.6.2 Energy Efficiency

Energy efficiency is the second pillar of the German energy transition (renewable energy being the first). In 2010, Germany had, in the frame of the Energiewende Concept, set itself the target of reducing primary energy consumption by 20% by 2020 compared to 2008. If the trend in primary and final energy consumption observed in the period 2005-2013 will continue up to 2020, Germany will not meet its national target (EC, 2015f).

In order to achieve this target, the German Federal Government established the Energy Efficiency Platform to entail dialogue and develop joint solutions together with main stakeholders from the private and public sector. The Platform was involved in the development of a comprehensive strategy on December 2014: the National Action Plan on Energy Efficiency (NAPE). All the measures under NAPE adhere to a common principle: Supply information - Provide support - Demand action. In the German Climate and Energy Policy, energy efficiency is the key. The plan is to having their primary energy consumption by 2050. The following measures planned are (Sach, 2011):

- Further development of energy services
- Expansion of energy management in industry
- New energy efficiency fund (up to 300 million €/year)
- Expansion of funding programmes for buildings
- Expansion of National Climate Initiative.

Instruments and programmes in the building sector contribute to a considerable extent (more than 60%) to the saving outlined in the 2nd NEEAP. The German Federal Government has set some ambitious targets for the building sector, towards which progress is at present being made primarily through the EnEV 2012 policy instrument. Three main instruments are here presented:

CO_2 Building Rehabilitation Programme - CBRP

Germany's CO_2 Building Rehabilitation Programme, CBRP (the CO_2 *Gebäudesanierungsprogramm*) is a well-known programme that receives much attention internationally and because of it, Germany is often labelled a 'front runner' in energy efficient building refurbishment (Rosenow & Galvin, 2013). The CBRP has developed through a number of phases since its inception in 2001. Federal subsidies are channelled to

home refurbishment and new build projects via the German Development Bank (KfW - *Kreditanstalt für Wiederaufbau*) as interest rate reductions and in some years also as grants (Rosenow & Galvin, 2013).

EnEV 2012

EnEV sets out detailed guidelines of how to calculate the annual primary energy demand per square metre and rules concerning the heat transfer coefficient of different parts of the housing envelope (Rosenow, 2012). In September 2009, the EnEV standard for comprehensive thermal renovations was tightened, from an average of 150 kWh/m^2 year to an average of 100 kWh/m^2 year. The actual standards vary according to the size and geometry of the building, with these figures in the mid-range. However, the average (calculated) heating energy consumption of German homes is most likely around 225 kWh/m^{2}year, with only a minority of buildings over 300 kWh/m^{2}year and very few over 400 kWh/m^{2}year (Galvin, *et al.,* 2013). The targets of EnEV 2012, with a base year of 2008, are respectively (McKenna, *et al.,* 2013):

- a reduction of the heat demand by 20% by 2020
- a reduction of the primary energy demand by 80% by 2050 with the remainder met mainly or wholly by renewables, hence
- a net zero-energy building stock
- a doubling of the renovation rate for buildings from 1 to 2%

The KfW Promotional Programme for Energy Efficient Refurbishments/New Buildings

The German *KfW Bankengruppe* is a publicly owned bank (80% owned by the German federal government and 20% by Länder/States) that acts as an implementing institute for various governmental financial programmes by offering preferential loans, grants, and other forms of support (Amecke, H. & Neuhoff, K., 2011). Financial incentives have been implemented since the 1990s through the German state-owned KfW bank, to support specified renewable energy projects such as the Photovoltaic program (the so-called 100,000 roof program) with low interest loans.

Germany's current legislative approach encourages smart metering roll-out for the following cases: (i) consumers with annual electricity consumption over 6.000kWh, (ii) major generation facilities pursuant to the national EEG and the Combined Heat and Power Act, and (iii) final consumers in new and renovated buildings (EC, 2015f).

7.6.3 Sectoral and horizontal analyses

The adoption of the German Energy and Climate Package in December 2014 has driven the measures for buildings, in industry and in transport which will help in closing the energy efficiency and CO_2 reduction gaps (EC, 2015f).

Construction

During the 1970s and 1980s, the regulation of energy efficiency in the building sector significantly improved in Europe, but particularly in Germany. Germany continued to amend its building codes in the late 1980s and early 1990s, yielding an average energy reduction for new buildings over the past 30 years of over 75%. About 90% of the building stock in Germany consists of buildings constructed before 1990, which therefore have substantially lower energy efficiency standards for building shell and heating system in comparison to the current standards in the context of the German Energy Saving Regulation (EnEV) 2012.

In September 2010, the German Government adopted a new Energy Concept aiming at an overall strategy for the period up to 2050. With regard to energy efficiency, the Energy Concept includes ambitious targets both for a reduction of total primary energy consumption and for reductions at individual sector level. Energy efficiency was highlighted as a key issue.

In addition, the German Energy Agency (DENA) was established in 2000 as a profit-oriented company with a mission to operate at the interface between politics and business; shareholders include the Federal Republic of Germany, *KfW Bankengruppe*, Allianz SE, Deutsche Bank AG and DZ BANK AG. In 2010 total revenue of DENA was €20.6 million. Between 2005 and 2010, 50% of average revenue came from public grants and 50% from cooperation with private partners

The German Federal Government has set some ambitious targets for the building sector, towards which progress is at present being made primarily through the EnEV 2012 policy instrument. The targets of EnEV 2012, with a base year of 2008, are respectively (McKenna 2013):

- a reduction of the heat demand by 20% by 2020
- a reduction of the primary energy demand by 80% by 2050 with the remainder met mainly or wholly by renewables, hence
- a net zero-energy building stock
- a doubling of the renovation rate for buildings from 1 to 2%

The following figure represents the policies and regulations that have influenced the construction sector, particularly its energy efficiency in the last years. Below the timeline, an overview the different elements that have driven the energy consumption in the construction sector in Germany are presented.

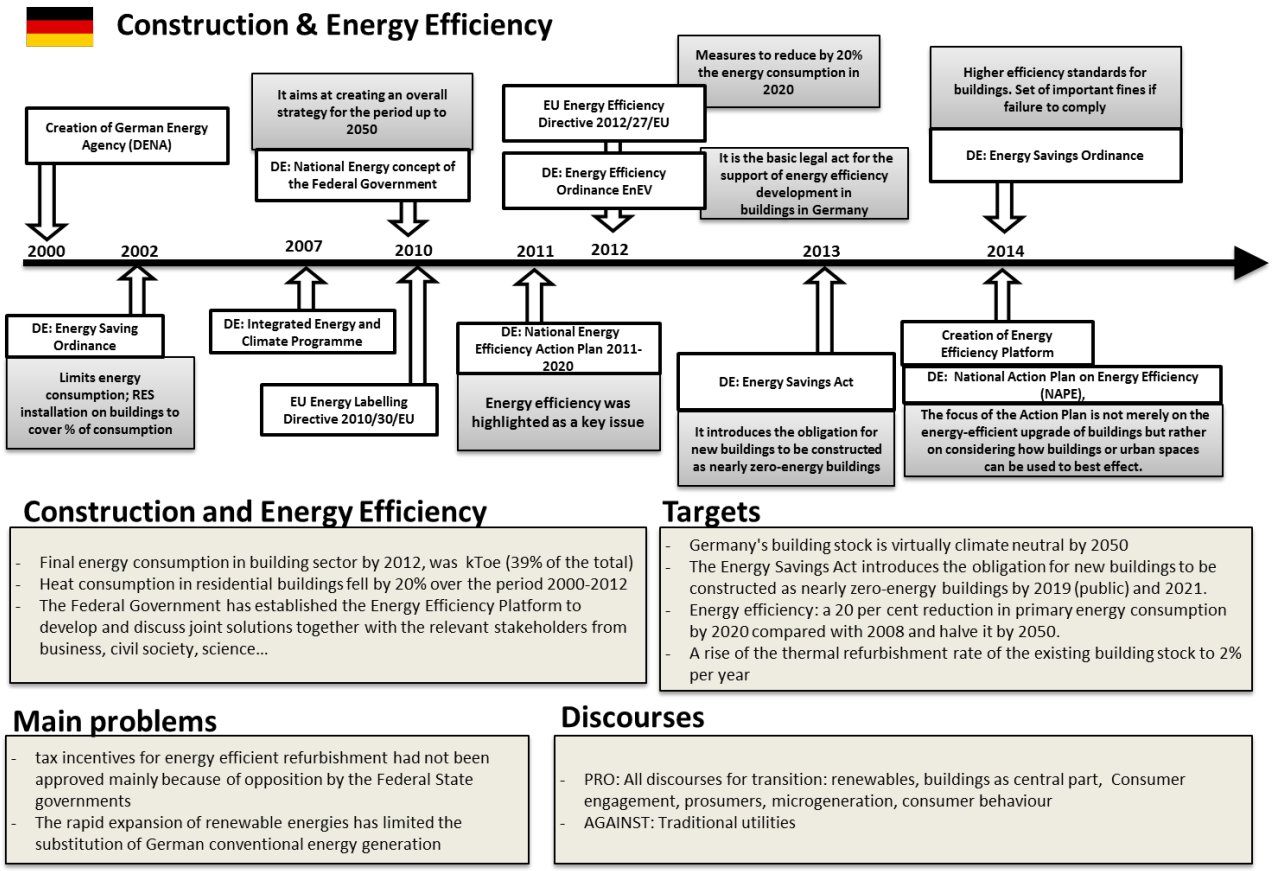


Figure 92: Overview of the construction sector in Germany

Transport

With the Germany's Energiewende the transport sector has witnessed very ambitious goals since 2011, such as cutting final energy consumption by 10% by 2020 and 40% by 2050, compared to 2005 levels. In a relatively short period of time Germany has launched various initiatives seeking more sustainable transport. In 2011, the country launched the Fuel Efficiency Labelling of Passenger Cars Regulations (known as "Pkw-EnVKV"), which require new cars to be equipped with fuel economy labels that describe the vehicle's CO_2 emissions for consumers (similarly to energy-related products and dwellings). In 2012, the German parliament enacted various EV-related taxes:

- the tax exemption of (pure) electric vehicles licensed before December 31, 2015 is extended to 10 years (previously it was 5 years)
- this exemption is extended to all battery electric vehicle classes
- (pure) electric vehicles licensed between January 1, 2016 and December 31, 2020 will be granted 5 years of tax exemption.

Without providing tax reductions for other alternatives such as hybrid electric, biofuels or natural gas vehicles, Germany has selected electric vehicles as the major technology to be developed to achieve its ambitious goals. In 2013, the Federal German Government launched the "Mobility and Fuels Strategy", which is the key platform for sustainable mobility. The strategy is an important instrument for the implementation of the Energiewende in the transport sector as it identifies the fuel options, the corresponding drivetrain technologies as well as the necessary infrastructures, which are most likely to contribute to an increase in efficiency and a reduction of CO_2 emissions (EC, 2015f). The following figure represents the policies and regulations that have influenced the transport sector in recent years. Below the timeline, an overview of different elements that allow a better understanding of policy making in the transport sector in Germany is presented.

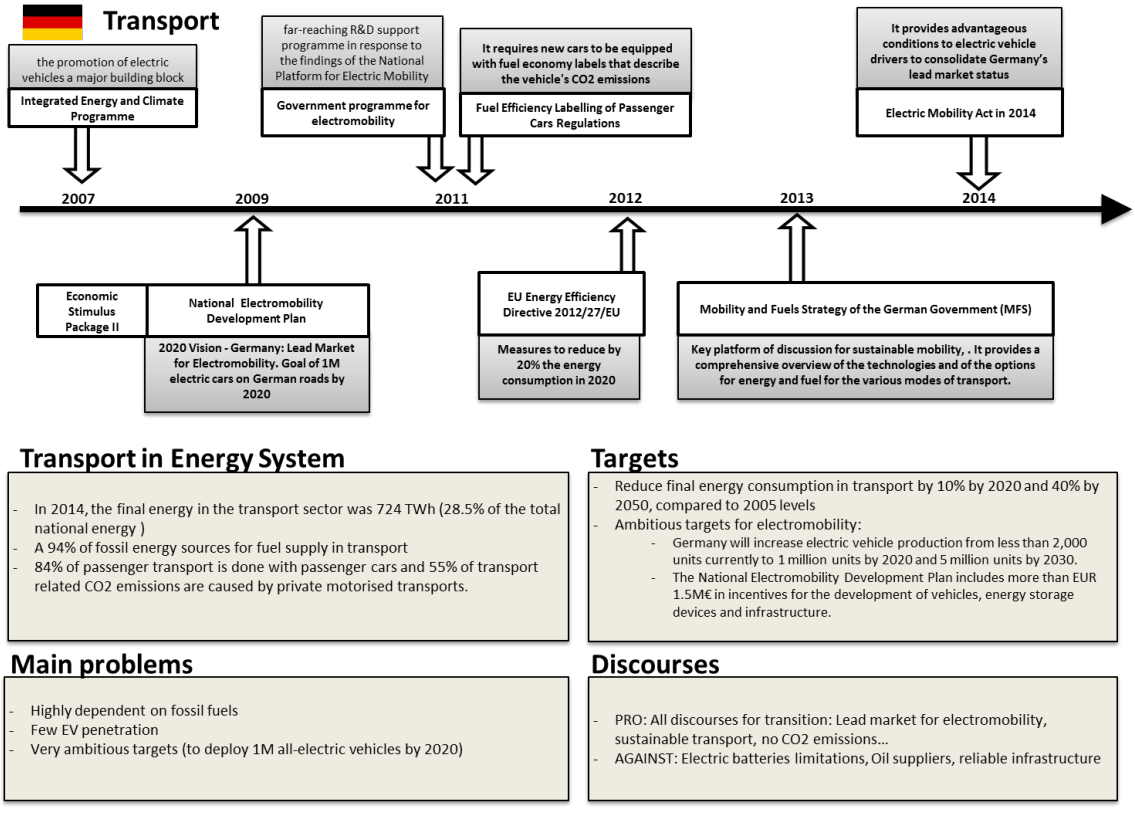


Figure 93: Overview of the transport sector in Germany

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