



Energy System Stakeholder Characterisation

Deliverable D2.1

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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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Executive Summary

WP2 undertakes an extensive characterisation of energy system actors. Within this context, this deliverable D2.1, as part of T2.1, is essential as its objectives are to develop an energy actor-network typology and to appreciate the complexity of the factors that can play a role in the transition towards a more sustainable energy era. The T2.1 and its 'stakeholder analysis' is aimed at informing subsequent work packages in terms of mapping the direct and indirect influences on the energy system, and the actors that comprise it. To accomplish this, an extensive data gathering exercise has been conducted to develop insights on the energy models of Ireland, UK, Spain, Italy, France, Germany, and at the EU level. In addition, a number of key energy topics were studied in greater detail, and a range of discourses on the energy transition were mapped. An extended map for each of the six countries was produced.

The extensive data gathering enabled the identification and exploration of areas of interest concerning the energy system, from nuclear phase out and promotion to fuel poverty, renewable energy deployment, energy independence and security, energy economics, political discourses, as well as capturing some influential socio-demographic factors. The multiplicity of fields that interconnect with, and within, the energy system indicates the complexity of the energy system itself, as well as some of the complexities involved in its transition to sustainability.

At an individual Member State level, the fact that all six countries studied have a different overall energy model, even though these may share, or have shared, some similar characteristics, is a further indication of the complexities involved. For example, France and Germany are now following different paths with regard to nuclear energy. In the aftermath of World War II, nuclear power was of strategic importance to both countries to enable them to reconstruct quickly and to develop their economies. However, within the past two decades both countries have diverged drastically with Germany opting to decommission its nuclear power infrastructure, while France continues to invest in, and develop, nuclear energy.

With regard to the energy transition, the position is similarly complex. Although the energy transition process is slow, each country has entered into it. This is demonstrated by the presence of similar discourses on the energy transition across the member states, as well as by the fact that they have all taken some steps towards a low carbon and sustainable energy system. However, it should also be noted that notwithstanding the moves to integrate EU energy markets, at present it seems that national factors may result in member states making their own individual energy transitions, albeit in a co-ordinated fashion. Similarities in experiences should not mask the (still) country-specific responses to energy choices – as exemplified by the divergent paths taken by France and Germany with regard to nuclear power.

It should be noted here that notwithstanding the extensive data gathering and the comprehensive mapping of significant factors that influence the energy system, what are, necessarily, absent are the discourses of communities themselves regarding the energy system, as well as the social factors, including socio-demographic factors, that impact on communities' engagement with the energy system, and ultimately on their consumption of energy. It is the aim of ENTRUST to identify those 'absent' discourses and factors; and to integrate them into our understanding of the energy system. In developing this fuller understanding of the 'human factor' in the energy system, and in consultation with the 'communities of practice', we can enhance their engagement with the sustainable energy transition, and map the way forward.

Acronyms

ACER	Agency for the Cooperation of Energy Regulators	GHG	Greenhouse Gas Emissions
ADEME	French National Energy Agency	GLA	Greater London Authority
ANT	Actor-Network Theory	GNP	Gross National Product
ASN	Autorité de Sûreté Nucléaire	HGV	Heavy good vehicles
BEF	Better Energy Financing	ICT	Information and Communication Technologies
BER	Building Energy Rating	IEA	International Energy Agency
BNetzA	German Federal Network Agency	IEE	Intelligent Energy Europe
BP	British Petroleum	IPCC	Intergovernmental Panel on Climate Change
BRD	West Germany	IRSN	Institut de Radioprotection et Sûreté Nucléaire
CER	Commission for Energy Regulation	ISEE	Indicatore della Situazione Economica Equivalente
CEGB	Central Electricity Generating Board	LEZ	Low Emission Zone
CFD	Contracts for Difference	LNG	Liquefied Natural Gas
CHP	Cogeneration Heat and Power	MEP	Member of Parliament
COP	Conference of the Parties	MLP	Multi-Level Perspective
CPC	Carbon Performance Coefficient	MS	Member States
CTE	Codigo Tecnico Edificacion	NEAP	Non-domestic Energy Assessment Procedure
DAtF	German Atomic Forum	NEEAP	National Energy Efficiency Action Plan
DBEIS	Department for Business, Energy & Industrial Strategy	NGO	Non-Governmental Organisation
DCENR	Department of Communications, Energy and Natural Resources	NIMBY	Not In My Backyard
DDR	East Germany	NZEB	Nearly Zero Energy Buildings
DECC	Department of Energy & Climate Change	OPEC	Organization of the Petroleum Exporting Countries
DoECLG	Department of the Environment Community and Local Government	PAEE	Piano d'Azione per l'Efficienza Energetica
DSO	Distribution System Operator	PER	Plan Energias Renovables
EBPD	Energy Performance Buildings Directive	PFER	Plan Fomento Energias Renovables
EC	European Commission	PV	Photovoltaic
EDF	Electricité de France	RD	Real Decreto
EEG	German Renewable Energy Sources Act	REC	Regional Electricity Companies
EMR	Electricity Market Reform	RES	Renewable Energy System
ENTSO	European Networks for Transmission System Operators – Gas and Electricity	R&D	Research & Development
EPC	Energy Performance Certificate	SEAI	Sustainable Energy Authority of Ireland
ESCO	Energy Service Company	SEN	Strategia Energetica Nazionale
ETS	Emissions Trading System	SME	Small and Medium Enterprise
EU	European Union	TAP	Trans Adriatic Pipeline
EXM	Excess Winter Mortality	Toe	Tonnes of Oil Equivalent
FEASTA	Foundation for the Economics of Sustainability	TSO	Transmission System Operator
FIT	Feed-in-Tariff	TTIP	Transatlantic Trade and Investment Partnership
GDF	Gaz de France	WHO	World Health Organisation
GDFC	Green Deal Finance Company	WP	Work Package
GDP	Gross Domestic Product		

1 Deliverable context

1.1 Overview of Work Package 2

As per the description of action:

“WP2 aims to undertake an extensive characterisation of energy system actors. A basic map of energy systems will be produced consisting of key actors, a description of their key roles, and critical strategic points of interaction, consistent with a practice based approach. Actor-network theories will be applied to develop insight into stakeholder¹ interactions; communities of energy use and the energy supply chain as a cascading, interlinked ecosystem/network of linked and interacting stakeholders. This work package will involve a comparison of energy system profile for diverse energy technologies, including an analysis of how synergies can be found between them regarding evolution, market, policies and uptake/acceptance”.

Work Package 2 (WP2) seeks to inform and outline the scope for subsequent WPs. It aims to provide an initial mapping of significant factors that need to be taken into account when aiming to understand and foster a transition in the energy system. WP2 proposes to map and illustrate the capacity of actors to change the energy system; as well as how the system and its outputs constrain actors’ capacity to act. Actor-Network Theory (ANT) informs the approach taken for T2.1 “Development of actor-network typology”.

1.2 Objectives of Task 2.1

As per the Description of Action:

ENTRUST embraces a holistic system approach [...]. The energy system is part of a broader societal system and therefore there can be more stakeholders and driving forces outside the energy system itself that could be vital for the analyses purposes of the proposed project [...]. Thus, it is vital that this task (T2.1) [...] appreciates the complexity of the factors that could play a role in the transition towards a more sustainable energy era. ANT theories will be applied to analyse how the growth and structure of knowledge are linked to the interactions of actors and networks [...]. This task aims to identify the main stakeholders at European and national level [...].

T2.1 “Development of actor-network typology” starts WP2 with the objective of using Actor-Network theory to achieve:

- An actor-network typology;
- An overview of how the growth and structure of knowledge influences the interactions of actors and networks.

An actor-network can be comprised of actors that are human or non-human, living or non-living. All contribute to shaping the energy system. This approach enables us to account for other external actors that have not always been accounted for in more traditional analyses of the energy system. T2.1, therefore, tries to map these various actors and interlinking actor-networks.

¹ A note on the usage of the terms ‘actor’ and ‘stakeholder’: Both terms – ‘actor’ and ‘stakeholder’ – are used in defining the objectives of Work Package 2, and in the Description of Work. In keeping with Actor Network Theory (ANT) the term ‘actor’ has been preferred throughout this document as, within ANT, the term ‘actor’ encompasses all the disparate elements of a network – both human and non-human – including all stakeholders.

2 Task process, methodology, and methods

2.1 Overview of task process

The aim of T2.1 is to define an actor-network typology for characterising the actors that play a role in the energy system. In order to produce this typology, the relationships between individual entities and groups of entities, both human and non-human, must be identified and characterised. In addition, the task requires that the typology must be based on an extensive mapping of the identifiable forces, drivers and actors with an influence, either direct or indirect, on the energy system. Table 1, below, outlines the research process, including the actions, methods, and rationale for this task.

Table 1: Research process

Action	Content/Aim	Link w/ Description of Action
Literature review	Placing the deliverable in a wider scientific context	
Country overviews	Overall view of individual country's energy model and relations with other societal topics	Understanding each country's energy model
Actor identification	Spreadsheet map of the actors that comprise the energy system	"Identifying the main stakeholders at European and national level"; "Extensive characterisation of energy system actors"
Discourse identification	Identification of discourse of actors, directly or indirectly linked with energy.	"Actor-network theories will be applied"
Case-studies	Case-study on key energy topics, allowing a more detailed understanding using ANT	"Actor-network theories will be applied"
Actors' analyses and discourse characterisation	One page text explaining how actors evolve in the context of the energy transition and their discourses	To provide insights for building the "actor-network typologies"
Extended energy system and discourse maps	<ul style="list-style-type: none"> Map representing the energy system, key actors, their relationships and driving forces that impact the energy system Map representing the identified discourses, categorised. 	<p>"A basic map of energy systems will be produced consisting of key actors, a description of their key roles, and critical points of interactions."</p> <p>Discourse mapping is a part of the ANT: "Actor-network theories will be applied"</p>
Lists and indicative typology of influences and actors mapped during the task.		

It is important to clarify here that the work undertaken in this document details the **known** actors in the Energy System, and their interactions, as well as the surrounding discourses. Therefore, the typology, whilst extensive, is necessarily limited. It can **only partially** position those actors who are energy users/domestic consumers, and their communities, in relation to the rest of the energy system network. Primarily, this is because a multiplicity of social factors impact on the everyday consumption of energy – factors that are significant for energy practices, but which may not ostensibly appear to be connected with the energy system at all. Further, the typology does not, and cannot, map the discourse of ‘ordinary’ communities, and their community members, concerning energy, and the energy system. The reason for this is that their discourse is absent from the wider discourse on energy that prevails in the public sphere.

These missing discourses and human factors in the energy system is the gap that ENTRUST aims to fill.

ENTRUST is engaging with communities in order to identify, analyse, and integrate, their discourses into the broader range of discourses that concern the energy system.

This initial mapping of the actors and discourses, presented in this deliverable and currently extant is intended to inform our community engagement and analyses. These engagement and analyses will enable us to identify the relevant hidden social factors and to incorporate them, map them back, into our understanding of the energy system developed in this deliverable.

Incorporating the knowledge of the pertinent actors through community engagement and the actors typology that has been produced in this document, as well as the gaps that have been identified, will generate the most substantive understanding of the energy system. While, at the end of ENTRUST we will be able to deliver a more comprehensive picture of the network that comprises the energy system than has hitherto been possible, our work will also allow us to better position communities *vis à vis* other actors in the network.

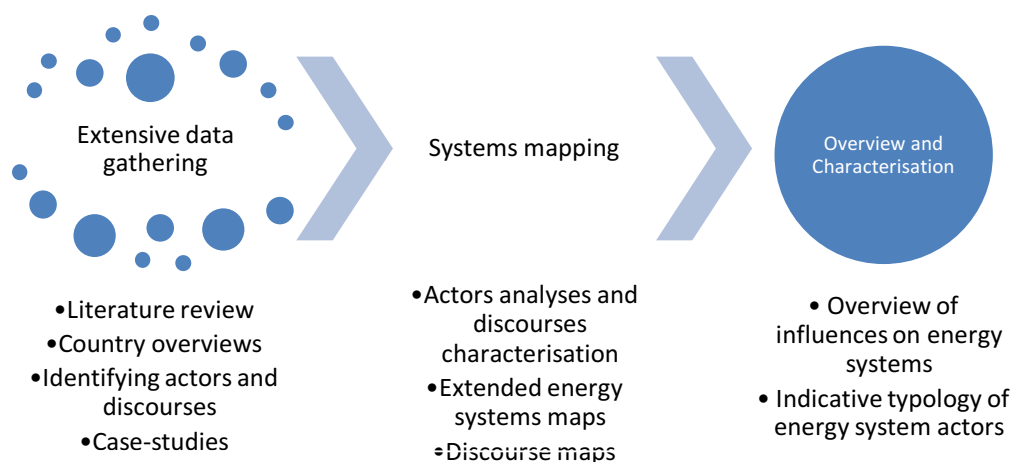


Figure 1: Task process

2.2 Methodology: Actor Network Theory (ANT)

Emerging from the writings of Michel Callon (1986a; 1986b), Bruno Latour (1987; 1988; 1999) and subsequently John Law (1992; 1999), this form of systems analysis incorporates the generalised symmetry principle, whereby human and non-human actors are assigned equal amounts of agency in a given network (Callon, 1986a; 1986b), in an effort to understand the significance of an individual entity in relation to others within that network. Recognising the ‘agency’ of non-human, as well as human actors in a network has the advantage of facilitating the broad mapping of a wide range of elements in a network without the necessity of assigning hierarchies and defining the structuring effects of power.

We use the terms ‘human’ and ‘non-human’ when referring to actors in the Energy System, but, in keeping with ANT, we recognise that no absolute division can be made between the two. All ‘technologies’ have a

human dimension – from the humans that invented and built the technologies, the scientific know-how and theories that allowed the development of the technologies, to the humans who buy and sell, and who use the technologies. And humans in the Energy System, in turn, have a ‘technological’ dimension as human existence is inextricably interwoven with the technologies that are part and parcel of everyday life; the technologies that allow us to eat, cook, clean, work, build homes, have children, develop complex societies – complex societies that allow the development of complex technologies. Our concept of what it means to be human, and how to live as a human, are influenced by the technologies that we have developed; and the technologies that we have developed reflect our concepts of what it means to be and live as humans, and what is important for human development. In keeping with ANT we recognise that all actors in the Energy System cannot be identified with finality, that it is in the nature of complex networks to be dynamic and so, inevitably, prone to change and resistant to concretisation.

Networks are processual, built activities, performed by the actants [actors] out of which they are composed. Each node and link is semiotically derived, making networks local, variable, and contingent. (Ritzer, 2004: 1)

Further to this, there is also the issue of the ‘unknown’ and its effect on the ‘known’. Gross (2007) contends that the ‘unknown’ is not only vital to our developing the ‘known’, but that developing knowledge is actually contingent upon the unknown. Knowledge does not develop in a linear fashion, but instead grows dynamically in feedback loops where ‘new’ knowledge reveals gaps in pre-existing knowledge – it reveals the unknown. In turn, the unknown raises uncertainty about the hitherto ‘known’.

Knowledge production, therefore, is not a linear progression from old knowledge to new knowledge; ignorance to epiphanies, but a dynamic process of going forwards with new discoveries, backwards to old postulations, enrolling new actors while abandoning others, shrinking the domain of uncertainty only to expand the boundaries of the unknown. This process, messy and chaotic as it seems, can be a useful way of reframing questions about energy security; questioning old assumptions about locked-in infrastructure; experimenting with different energy transition scenarios; and finding new ways of (re)organizing energy systems in urban settings. (Wong 2016: 108–109)

As outlined above, the extensive actor mapping in this document details the known actors in the Energy System, and their interactions, as well as the surrounding discourses. Within this mapping, the missing elements are the discourses of communities of energy users and their perceptions of the Energy System, as well as their interconnections with other energy actors. **Building on the extensive characterisation of the ‘known’ actors produced in this document, these are the elements – the unknowns – that ENTRUST intends to record and map back into the energy system. Including these, unknown, elements will inevitably involve a reconfiguration of the network.**

2.3 Method: Country overview

The country overview describes the energy system in each country in order to contextualise the analysis of the actors, and to identify actors external to the country that have an impact on internal actors in an individual country’s energy systems.

The following countries were considered: Ireland, Spain, Italy, the United Kingdom, Germany, and France, with the EU for context. The structure was the same for all countries and the EU, namely:

1. Global overview of the energy sector
 - i. Energy history
 - ii. Local energy sources
 - iii. The energy model

2. Economics of the energy model
3. Political energy framework and agenda
4. Socio-economic influences on the energy transition

A comprehensive list of all the categories that are included under the headline sections, listed above, that structure the analysis for each Member State surveyed is available in **Appendix 1**.

2.4 Method: Actor identification

A mapping (identification) of the actors in the energy system was undertaken for each of the six countries, as well as a more general overview of the EU, in order to provide a degree of context to our findings. The mapping was spreadsheet based, see **Appendix 2**, which shows the categories used to tabulate the actors. From the exercise we identified between 150 and 200 actors per country. Some categories were defined prior to the mapping, while others were added after they were identified during the mapping process.

The desk research that was conducted in order to compose the spreadsheet file encompassed government datasets, media publications, and research papers from the literature. The process had two elements:

- Completing the known categories with examples of actors;
- Using a snowball approach, moving from one document source to another to complete the categories. Each mapping was collated into one spreadsheet document. In addition to the spreadsheet mapping, a one-page document was produced for each of the six countries, and the EU, to present the most relevant actors, new actors and actors' reconfigurations that could be identified, in order to gain an understanding of how the energy transition is emerging.

2.4.1 Activity: Meeting workshop

A brainstorming session was organised to familiarise T2.1 contributors with the task and gather more data on the external actors and driving forces that influence the energy system. The participants were asked to think about what constitutes an actor in the energy system using the precepts of Actor-Network Theory. They were then asked to place their post-it notes on white A3 paper sheets that represented the categories, as identified in Section 2.4 above. The results of the workshop can be seen in **Appendix 3** and have helped the authors to settle on a list of influences and actors pertinent to the ENTRUST project.



Figure 2: Workshop of the 6 month meeting

2.5 Method: Discourse identification

For each country a range of strategic documents, energy actors' websites, and contributions drawn from conferences and events were examined in order to identify a broad range of the available viewpoints and opinions on, or impacting, the energy system. Table 2 present the list of all discourse strands identified across the 6 countries and a brief description of their meaning.

Table 2: Discourse strands identified in the 6 countries

Discourse	Description
Responsible energy use	We should consume responsibly: this covers reducing energy consumption, energy efficiency, clean energy
100% Renewables	Technical discourse saying that 100% of RES is possible.
80% Renewables	Government's aim to reach 80% of energy share from RES by 2050
Necessity of an energy mix	Technical discourse saying that a mix of energy is necessary, that a dependence on one type of energy is impossible
Competitive energy prices	Economic discourse emphasising the need of a competitive national economy so energy prices need to be competitive for industry/business to be competitive
National economic growth	This is a general economic discourse on the necessity for economic growth
Nuclear energy as 'green'	Promotion of nuclear energy as a clean energy
Nuclear energy as a competitive advantage	Promotion of nuclear energy as a competitive sector
Energy mix with more than 50% given to conventional energies	Technical discourse saying that a mix of energy is necessary, that a dependence on one type of energy is impossible.
Energy mix with more than 50% given to RES & alternative energies	Technical discourse saying that a mix of energy is necessary, that a dependence on one type of energy is impossible.
Nuclear energy as prestige	Promotion of nuclear energy as a sector that gives prestige and offers opportunities
Competitive energy sector	Economic discourse emphasising the need of a growth of the energy sector, that it is an important sector for growth GDP, for export etc.
Green jobs creation	Discourse saying that the green sector is an important opportunity for job creation, thus helping the country to reduce unemployment rates
Smart technologies, smart grids & smart cities	Technical discourse emphasising the importance and potential impact of ICT communication as key lever for system optimisation and overall problems solving
Social Moderation	General discourse, quite opposed to consumption discourses, saying that we should limit our needs & desires to reduce our earth impact and act responsibly toward the earth and other people and countries
Capitalism promotion	Economic discourse, promoting capitalism over other economic models
Green growth	Economic and environmental discourse saying that it is possible to run the system with green technologies, processes, products and services reducing our impact on the environment, supporting economic growth.
Opportunistic green growth	Discourse saying that green growth is an opportunity for being competitive and overcoming current economic and environmental problems. It does not promote green growth for the sake of the environment, but rather as a shift that we better take for our own good.
Degrowth	Similar to social moderation but with more protest against The "System, less positive than social moderation
Energy security	Economic discourse saying that energy independence is important from a security of supply point of view
Energy independency	Economic and nationalist discourse saying that we have enough of

Discourse	Description
	alternative energies and RES sources at national level and that it is absurd to continue importing, from economic and nationalistic point of views.
National competitiveness	Economic and nationalistic discourse emphasising the need to be a strong economy to compete at EU and global level
Integration within EU	Political discourse emphasising that we are part of the EU and therefore we support the EU and follow the same direction
Nationalism	Political discourse saying that we must quit the EU and that we should prioritise national interest firsts
Global environmental preservation	Global environmental discourse emphasising the quick degradation of the environment and that we need to fix it.
Nature rights & Deep ecology	Law discourse saying that nature has rights, also covers animal rights
Nuclear social danger	Anti-nuclear discourse – arguing it is unsafe for people
Nuclear environmental danger	Anti-nuclear discourse – arguing it is polluting the earth
Climate adaptation	Technical discourse saying that climate change will happen and that we must adapt to it now.
Climate mitigation	Hopes that we can still fix the climate by political actions and individual commitments
New political governance	Discourses on the need to have new political governance (wide meaning, from total revision of the system to incremental improvement such as participatory democracy)
Innovation governance	Discourse saying that we need to supervise innovation
Environmental governance	Discourse saying that we need to supervise any activity having an impact on the environment
Sustainable development	Discourse promoting a growth respecting the environment, the economy and society.
Circular economy	Economic & environmental discourse saying that we can reduce our environmental impacts while maintaining the economy by taking a ‘closed loop’ approach to production processes.
Functional economy	Economic & environmental discourse saying that we can reduce our environmental impacts while maintaining the economy by reducing products ownership and increasing products lifecycle
Energy efficiency	Technical discourse emphasising the importance of energy efficiency in many fields (economic, social, environmental, competitiveness etc.)
Climate change denial	Discourse denying climate change.
Health preservation	Overall discourse emphasising the negative effects of current energy, transport and food systems on health
Responsible innovation	Discourse saying that innovation is not all good and that we should only promote innovation that have responsible outcomes
Precautionary principle	Discourse saying that we must define rules and processes for ensuring that new products/technologies etc. do not harm.
Progress	Discourse promoting an on-going improvement of society, usually based on technology and science
Biomimeticism, green products	Promotion of solutions based on nature and imitation of natural processes
Individual responsibility	Discourse emphasising individual responsibility, that everyone, both private or public actor is responsible for his/her action
Energy system cost-inefficiencies	Discourse pointing out that the energy system is cost-inefficient
System deficiency	Alternative discourse on criticising current occidental model
Consumption critics	Discourse criticising consumption society
Energy citizenship (<i>market based view</i>) see footnote 4	Discourse giving responsibility to consumer to choose wisely their energy products and services, and enabling this wise choice

Discourse	Description
Active consumers (similar to market based view of energy citizenship)	Discourse promoting interaction and feedback loop from consumers to the production companies in order to co-design products & services and reinforce positive interaction/relationship between firms and consumers, giving a competitive advantage to firms which engage with consumers this way.
Prosumers & technology right	Discourse considering the shift from passive consumer to a consumer that consumes what he/she produces on his/her own. For e.g.: RES, food, Do it yourself & Fablab movements.
Environmental citizenship (Obligation based view)	Discourse emphasising the fact that we are part of our environment and that we must act for the environmental public good.
Energy "rights" see footnote 4	Discourse reflecting on the fact that everyone should have minimal access to heat for comfort and survival, whatever his/her income.
Air, climate, environment as a public good & usage rights	Discourse saying that air, climate and environment are public goods and therefore everyone should have access to it in their "pure" quality, i.e. not polluted. Covers national & international territories.
Corporate responsibility	Sub discourse of responsibility discourses applied to companies
Purchase power	Economic discourse emphasising the need of "cheap" energy prices for supporting purchase power of consumers
Technical intermittencies problem	Technical discourse emphasising the fact that grid intermittencies caused by RES are a problem
Cost of new technologies	Short view discourse rejecting adoption of new technologies for their high price and that they are unlikely to compete with incumbent technologies
Energy transition	Overall discourse emphasising the need to shift to another energy model
3 rd industrial revolution	Political discourse predicting a new alliance between energy production modes and ICT, leading to decentralised energy production, energy exchanges thanks to ICT and an empathic society
State decentralisation	Political and governance discourse promoting decentralisation and/or pointing out inefficiencies of centralisation and bureaucracy
Technology as a saver	Technocratic discourse saying that solution comes from
Global north – south development & responsibilities	Broad discourse, at play during climate & environment global negotiations, differentiating the role of North/South countries in global warming and establishing differentiated responsibilities and the right to development
Questioning developed countries responsibility / reallocating responsibility	Discourse advocating that climate change responsibility is not only from developed countries but shall be shared among all countries globally
Ecospirituality	Religious and environmental discourse connecting ecology and spirituality. Helps people experience the "holy" in the natural world
Greenwashing illusion	Big companies, smoothing the rough edges, playing it green on fashionable issues, but still having a big negative impact on energy and environmental issues
Ecocide	Predicting humans are killing themselves by destroying the environment
Financial problem	Economic discourse emphasising the need for finding new channels of finance for new clean technologies
Economic interventionism, fiscal incentive & polluter pays principle	Political and economic discourse saying that the State must intervene in the economy. With respect to energy this includes for example subventions to RES and fiscal change to reduce negative externalities
Anti- energy oligopoly	Pro competition – wary of energy companies connivance with government
Energy consumer rights	Provide citizens with their consumption data in almost real time
Nuclear energy downside	Economical discourse about the real price of nuclear energy: maintenance plant costs, uranium import, indirect environmental costs, etc.
Nuclear waste disposal	Technical discourse about the unsolved problem of nuclear waste disposal.
Democracy	Political/social discourse which declares that democracy must drive government's decisions
Nuclear phase-out costs	Economical discourse about the costs of scrapping nuclear power plants.

2.6 *Method: Case-studies on key energy topics*

2.6.1 *Overview and justification*

Case studies have been conducted on five energy topics:

- Fuel poverty in Ireland and the United Kingdom;
- Energy independency in Italy;
- Renewable energy sources in Spain;
- Nuclear phase out in Germany;
- Importance of nuclear energy in France.

In keeping with the Description of Action, Actor-Network Theory was applied to these case-studies to develop our analysis: “Actor-network theories will be applied to develop insight into stakeholder interactions; communities of energy use and the energy supply as a cascading, interlinked/network of linked and interacting stakeholders” and “ANT theories will be applied to analyse how the growth and structure of knowledge are linked to the interactions of actors and networks”.

In recognition of the multiplicity of actors, the diversity of discourses, the range and variety of networks, and the complex multi-layered interactions and intersections of all these various elements it was decided to limit the focus to specific topics that are key to developing insights into the energy transition. The case studies were allocated according to their relevance for the individual country chosen.

Comprehensive guidelines were prepared for the preparation of the case studies to facilitate a coherent and consistent approach across all the member states for which case studies were produced. These guidelines are available in **Appendix 4**. The case-studies have been placed in a dedicated section at the end of Section 3 Analysis of the energy system. However, insights from these case-studies inform the extended energy system and discourses maps produced in each country section.

2.7 *Extended energy system and discourse maps*

2.7.1 *Extended energy system maps*

In order to represent the main findings from the Country overviews, actor mapping and case studies, “extended energy system maps” have been realised for the following countries: Ireland, Italy, Spain, the UK, France and Germany. These maps include: A representation of energy flows, from energy sources to human usage; Key figures of the energy system; main actors and their relationships

2.7.2 *Discourse maps*

For each country, once the prevailing discourses were identified, a map of these was produced to represent how they relate with the energy system and the wider socio-technical system.

In order to map out the identified connections between these discourses and their primary areas of influence, these areas have been thematically organised into five groupings. These are: innovation and technology, environment, politics, economy & competitiveness, and, health and comfort. Discourses intersect widely with a range of areas, and actors, in multiple and complex ways. Given this complexity, it is not possible to map them all, however, a pragmatic approach allows a sufficient representation of the most visible intersections of discourses with these identified areas. Where a discourse has an influence in a number of areas, they are represented in between the areas. The colour code has been used as follows:

- Traditional discourses have been represented in grey boxes
- Discourses fostering the energy transition have been represented in green boxes
- Areas of society influenced are represented in deep red circles
- The areas related to the energy system itself (production, the whole system and energy use) are represented in grey circles

Energy production has been defined by source (fossil fuels, nuclear, and renewables or alternative sources), so the discourses related to the source of energy are represented close to its energy source (no matter the impact they have in the other areas). Neither the size of the boxes nor their proximity to their areas of influence is of significance, these simply reflect the limitations of graphical representation. While this exercise aims to be as comprehensive as possible, it has obvious limitations. Primarily, the discourses are limited to those that can be captured from available resources—such as the media, government, and research. What are not captured are the discourses of communities and community members—those actors who form the “human” aspect of the energy system outside of technologies, policy making, and industry.

3 Analysis of the energy system

3.1 Ireland

3.1.1 Country overview

3.1.1.1 Global Overview of the Energy Sector

During the recent downturn, Ireland’s economy contracted by approximately 10% with a corresponding decrease in CO₂ emissions also recorded (SEAI, 2010). Despite this, Ireland’s energy-related CO₂ emissions remain at 17% above 1990 levels. It also continues to have one of the most vulnerable economies in the European Union in terms of energy import dependency, which rose to 89% (at a cost of some €6.7 billion) in 2013 (SEAI, 2014). Ireland’s primary energy mix comprises primarily of oil (47%) and natural gas (29%), with renewable energy sources accounting for 6.8% and coal and peat falling to 10% and 5.4% respectively. Electricity consumption in the state totalled 24TWh (terawatt hours), with the carbon intensity associated with that consumption dropping to 469g CO₂/kWh in 2013.

Energy history in Ireland

Renewable energy, most notably investment in wind energy, has seen strong growth in Ireland in recent years. However, it is by no means a new phenomenon on the island given its historical presence as a source of power. The earliest recorded windmill in Ireland dates from 1281 (Kilscanlon, Co. Wexford) and by 1840 there were 250 windmills (SEAI, 2015a). The Dublin Electric Light Company was established in 1880 and by 1922 there were 130 public electricity schemes, along with several private ones also. Ireland’s first electricity power station began operations on Fleet Street, in Dublin city in 1884. After independence and the foundation of the Irish state in 1922 discussions on national electrification began in earnest. Earlier proposals, in 1844 and again in 1901, to dam the River Shannon were resurrected and seen as a viable means to bring electricity to the larger towns and cities. The Electricity Supply Board Act was passed in 1927 and the Electricity Supply Board, known as the ESB until very recently, was established to control and develop Ireland’s electricity network (ESB, 2015). The country’s first large-scale electricity power station was built by Siemens Ireland at Ardnacrusha in County Clare, powered by hydroelectric turbines. It opened in 1929 and is still in operation today. The process of rural electrification however did not begin until the mid-1950s with the Electricity Supply Act of 1955. (EAI, 2015) By 1965, approximately 80% of rural households were connected, but it was not until the late 1970s that the process reached completion (MacPhilib, 2015).

Coal has traditionally been an important source of fossil fuel for power stations in Ireland. However, peat (colloquially know as turf) has also played a prominent role, and not just on a domestic scale where it was the primary fuel used for heating and cooking until recent decades. In 1963 the world’s largest peat-fired power station was built in County Offaly (Siemens, 2015) to meet the increasing demand for electricity. Lang (1969) describes the Republic of Ireland’s developments in electricity in three stages: the hydro phase from 1928 to 1954, the peat phase from 1950 to 1965 and the oil phase from 1964 onwards. Oil is still the

dominant fuel source today despite increases in the use of renewables and the procurement of Irish sources of gas (Howley et al, 2014). Ireland's first offshore exploration well was drilled in the North Celtic Sea Basin in 1970, and on the third exploration well in 1971 Ireland's first reserve of natural gas, the Kinsale Head Field was discovered with production beginning in 1978 (IOOA, 2015).

Historically, Irish buildings were heated using solid fuels (usually peat, coal or wood) in open fires and stoves. Central heating using either solid fuel or oil or gas, was not common until after the 1980s. Insulation in buildings was also under-utilised during the construction of new buildings until the 1980s, when a growing interest in energy conservation was sparked by a series of oil crises in the 1970s. Energy use for thermal purposes in Ireland currently accounts for 41% of the final energy demand, with the residential sector accounting for 47% of that figure, almost equal to industry, services and agriculture combined. Despite Ireland's strong agricultural sector – agriculture accounts for very little energy use by comparison (Howley et al, 2014). The thermal performance of buildings is now a high priority in Ireland, with many designers espousing the benefits of Passive House (passivhaus) design principles.

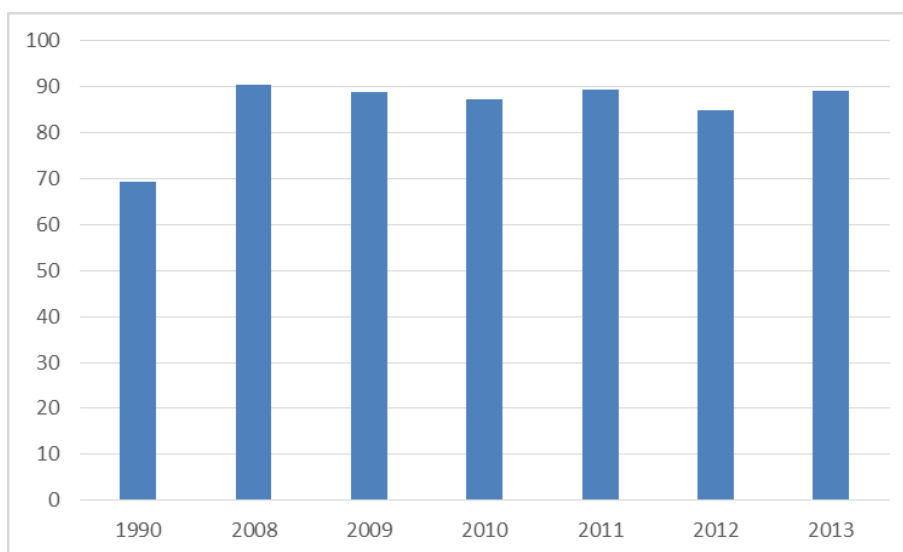


Figure 3: Ireland Import Dependency 1990–2013 (Howley *et al.*, 2014: 20)

Ireland imports 89% of its energy (down from a peak of 95% in 2008, but up from 85% in 2012), mostly from fossil fuel sources (Howley et al, 2014). EU import dependency averaged at 55% in 2008, and Ireland's oil dependency was the 5th highest in the EU in 2009 (SEAI, 2011). There are no nuclear power stations or oil reserves in Ireland, and only modest gas reserves. Offshore gas and oil exploration levels are low, as is the drill success rate in Ireland – one in 25. Due to the geological complexities of the surrounding offshore basins, exploration has proven to be both difficult and expensive. This has led to Irish offshore basins being considered by many to be "lightly explored in comparison to most neighbouring countries" (IOOA, 2014: 4; see also IOOA, 2015). The Irish Offshore Operators' Association (IOOA) also, note in the 2014 report that the number of Irish exploration and appraisal wells being drilled annually has tapered off significantly since the 1970s and 1980s.

Irish people have relatively high levels of home-ownership and in more recent decades, car ownership, combined with low-density living – single rural and suburban dwellings with gardens for example. Therefore, district heating and similar schemes are not generally in use. The geothermal potential in Ireland would be limited to heating only, were it to be utilised more fully, as underground temperatures are not sufficiently high for electricity generation. Ireland's indigenous fossil fuel, peat, will no longer be viable (or ecological desirable) in the future, despite the 'bumper' harvest of peat in 2013 (up over 300% on 2012). Ireland does however have abundant potential in the form of renewable resources, namely, wind and marine based energy generation, and, albeit to a much lesser degree, solar power. Figure 4 shows the

breakdown on indigenous energy production from 1990 to 2013, with a large reduction in gas, and an increase in renewables evident.

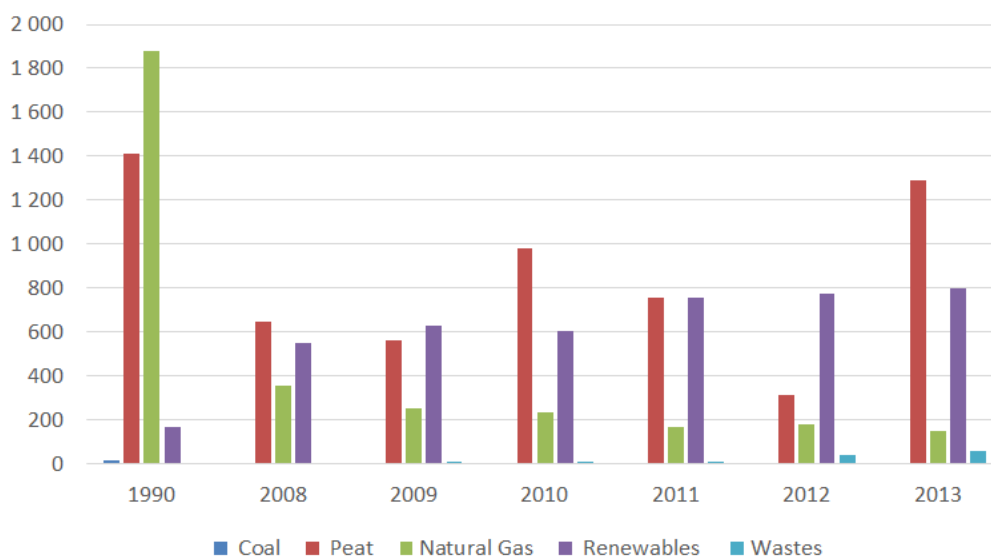


Figure 4: Indigenous Irish Energy Production 1990–2013 (Howley and Dineen, 2014: 21)

The Irish Energy System

Since 2007, Ireland's economy has contracted by 6.7% and, as a consequence, energy demand has fallen by 18% to 1999 levels. The associated CO₂ emissions have fallen by 22% to 1997 levels. While this is good news in terms of Ireland's energy targets, these figures will increase along with any growth in the economy. Ireland's target for electricity generated from renewables by 2020 is 40%, but the current figure is still approximately half that at 20.9%. Electricity imports (net) increased by 413% to 182ktoe in 2013 as a result of the interconnector to the UK coming on stream. On a slightly more positive note, over the same period, 1990 to 2013, while the primary energy per capita increased by 7.3% (up to 34MWh) energy-related CO₂ emissions per capita decreased by 9.4% (down to 7.9 tonnes) which reflects the switch from fossil fuels to renewables. Ireland's total final consumption in 2013 was 10.8Mtoe, 49% above 1990 levels, as shown in Figure 5. Gross final consumption (Directive 2009/28/EC) of renewables in 2013 amounted to 858 ktoe (wind and hydro normalised) and represented 7.8% of gross final consumption (Howley *et al.*, 2014).

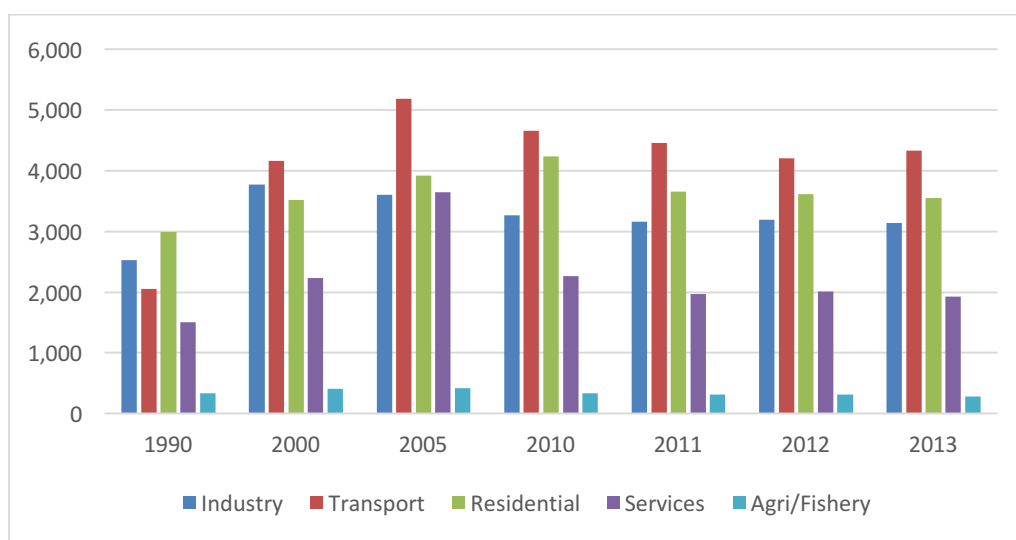


Figure 5: Ireland Total Final Consumption by Sector 1990-2013 (Howley *et al.* 2014: 16)

3.1.1.2 Economics of the Energy Model in Ireland

Due to Ireland's heavy dependence on imported energy, mostly fossil fuel based and subject to Carbon Taxes since 2010, the fluctuations in global oil and gas prices greatly affect national energy prices. This is not just in terms of thermal and transport costs associated with the use of gas and oil, but also in terms of electricity prices as 60% of Ireland's electricity is currently generated from natural gas (SEAI, 2011). Major world oil supply disruptions such as wars, terrorism, and hurricanes, occurring many thousands of miles away, culminate in increases in energy costs in Ireland. As a nation, energy imports cost Ireland 6.7 billion euro in 2013 and represent 89% of total energy consumption (SEAI, 2013). The Statistical Unit of the Sustainable Energy Authority of Ireland compile and maintain Ireland's energy related statistics.

Table 3: Business Electricity Prices, 1st quarter 2014 (SEAI, 2014: 3)

Business Electricity	Band share	Ireland c/kWh	Ireland relative to:		Ranking with 1 most expensive in:		Semester price change:		
			EU	Euro Area	EU	Euro Area	Ireland	EU	Euro
Band IA	11.9%	18.4	96%	89%	10	9	-4.0%	-1.3%	-1.5%
Band IB	32.5%	15.8	106%	99%	7	7	-1.7%	3.9%	5.1%
Band IC	17.1%	13.4	108%	101%	5	5	-2.6%	4.1%	5.3%
Band ID	25.0%	11.6	107%	100%	7	5	-0.7%	1.9%	2.5%
Band IE	7.1%	10.1	107%	103%	8	5	-1.6%	0.0%	-0.4%
Band IF	6.3%	9.2	108%	106%	7	5	-1.1%	1.3%	1.6%

Table 4: Ireland Business Gas Prices, 1st quarter 2014 (SEAI, 2014: 3)

Business Gas	Band share	Ireland c/kWh	Ireland relative to:		Ranking with 1 most expensive in:		Semester price change:		
			EU	Euro Area	EU	Euro Area	Ireland	EU	Euro
Band I1	11.3%	5.3	101%	97%	8	6	-6.7%	-5.2%	-5.7%
Band I2	18.9%	4.4	94%	90%	13	11	-10.5%	-1.9%	-1.6%
Band I3	21.1%	4.1	105%	102%	11	8	-12.9%	-1.8%	-2.2%
Band I4	30.7%	3.4	102%	100%	12	10	-6.7%	-3.8%	-3.7%
Band I5	18.0%	--	--	--	--	--	--	-2.9%	-3.2%

Table 5: Ireland Residential Electricity Prices, 1st quarter 2014 (SEAI, 2014: 3)

Residential Electricity	Band share	Ireland c/kWh	Ireland relative to:		Ranking with 1 most expensive in:		Semester price change:		
			EU	Euro Area	EU	Euro Area	Ireland	EU	Euro
Band DA	1.1%	64.8	206%	185%	1	1	1.0%	3.9%	4.3%
Band DB	9.1%	30.0	137%	130%	3	2	0.3%	1.8%	1.6%
Band DC	33.0%	24.1	118%	111%	4	3	0.1%	1.9%	2.1%
Band DD	48.5%	20.6	106%	98%	6	5	-1.3%	0.7%	1.1%
Band DE	8.3%	18.1	97%	89%	9	8	-0.1%	1.0%	1.6%

Table 6: Ireland Residential Gas Prices, 1st quarter 2014 (SEAI, 2014: 3)

Residential Gas	Band share	Ireland c/kWh	Ireland relative to:		Ranking with 1 most expensive in:		Semester price change:		
			EU	Euro Area	EU	Euro Area	Ireland	EU	Euro
Band D1	5.0%	7.6	79%	70%	16	11	-14.7%	-7.0%	-9.7%
Band D2	93.2%	6.8	102%	94%	9	7	-5.7%	-5.8%	-7.7%
Band D3	1.7%	6.4	104%	94%	8	6	-2.9%	0.0%	-0.1%

3.1.1.3 Political Energy Framework in Ireland

Energy regulation and policy in Ireland, as with other EU member states, is mainly derived from EU Regulation and Directives and their transposition into Irish National Law. Ireland joined the EU in January 1973 and is a member of the Eurozone. EU Directives relating to energy use in Ireland include: Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the international electricity market; Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport; Directive 2003/87/EC establishing a scheme for greenhouse gas emissions trading within the community; Directive 2009/91/EC on the energy performance of buildings; Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market; 2009/28/EC The Renewables Directive, and the 2012/27/EU Energy Efficiency Directive. Examples of Irish regulation which deal with energy include the following:

- The Gas Regulation Act 2013 (The Gas Act 1976), SI No 39/2013
- The Electricity Regulation Act 1999, SI No 23/1999
- Petroleum (Exploration & Extraction) Act 2015, SI No 26/2015
- ESB Act 2014, SI No 5/2014
- Energy (Misc. Provisions) Act 2012, SI No 3/2012
- Electricity (Carbon Revenue Levy) (Amendment) Act 2015, SI No 15/2015
- Planning and Development (Amendment) Act 2010, SI No 30/2010
- The Building Control Acts of 1990 and 2007
- The Building Control Regulations 1997-2015
- The Building Regulations 1997-2014

The nexus of the Irish energy policy domain the Department of Communication, Climate Action and the Environment², which following a recent governmental reorganisation now holds under one roof policy responsibility for energy, climate change and the environment. Other relevant departments include the Department of Housing, Planning, Community and Local Government the Department of Housing, Planning, Community and Local Government³, the Department of Agriculture, Food and the Marine, and the Department of Transport, Tourism and Sport.

Renovating Buildings:

The renovation of Ireland's existing building stock is a source of considerable, yet almost untapped, potential for energy saving, due to the existing amount of poorly insulated building stock in the state. On this point, the missed opportunity presented by the construction boom of the so-called 'Celtic Tiger' era, which generated a third of current available housing stock is noteworthy. During this period the best-practice standards, then extant, weren't always adhered to. While the building regulations concerning new buildings are now demanding much higher levels of energy efficiency – these do not apply to existing buildings. SEAI commissioned an analysis of the potential for energy efficiency improvements (economy-wide) in Ireland to 2020. The study found that "across all sectors studied there remains nearly 35 TWh of technical savings potential to 2020, with more than 26 TWh of this economic. In absolute terms, the technical potential is largest in the residential buildings sector (13.5 TWh), followed by the transport (7.3 TWh), commercial buildings (5.9 TWh), industry (4.8 TWh) and public (3.0 TWh) sectors." (SEAI 2015b: 61). However, it also states that; "actual uptake by 2020 is highly likely to be lower than the technical and economic energy savings potential due to aspects of consumer behaviour and decision-making including low awareness and engagement, a limited decision-making frequency, finite budget limits and payback period requirements." (*Ibid.*) The study recommended action on various energy saving opportunities in each sector, including energy efficiency in buildings (see Table 7 below).

² Formerly the Department of Communications, Energy and Natural Resources – DCENR

³ Formerly the Department of the Environment, Community and Local Government – DoECLG

Table 7: Ireland Proposed Energy Saving Opportunities for all sectors (SEAI, 2015b: 4)

Sector	Key Opportunities	Primary Energy Savings in 2020 (TWh)
Commercial Buildings	Energy efficient lighting with controls	1.1
	Heat pumps	0.8
	Roof insulation	0.7
	Energy efficient glazing	0.7
Public Buildings, Transport and Utilities	Energy efficient lighting with controls	0.5
	Energy efficient glazing	0.5
	More efficient boiler with heating controls	0.4
	Roof insulation	0.2
Residential	LED street lighting	0.2
	More efficient boiler with heating controls	3.8
	Solid wall insulation	1.5
	Roof insulation	1.2
	Energy efficient appliances	0.7
Industry	Reducing room temperature by 1°C	1.1
	Process integration and eat recovery for low temperature processes	1.6
	Combined heat and power	1.1
		0.8
Road Transport (private)	Private cars – EU regulation	2.7
	Private cars – VRT re-balancing	0.8
	Eco-driving	0.8
	Modal shift	1.5

Developing green transportation

Transport (of people) within Ireland relies heavily on privately owned cars due to the limited availability, and relative expense, of existing public transport. Many rural areas do not have access to bus services, and where they do, the frequency of buses is not conducive to commuting by bus for work purposes. Trains only operate between some of the cities; hundreds of miles of rural lines were closed down in the middle of the last century due to a decline in profitability and the rise in popularity of the car. In addition to this, the travel time by car from Cork to Dublin is nearly as fast as to travel by train. However, depending on the car and fuel prices at the time (AA, 2015) the cost of a car journey is at least half of the price of the train and cheaper again if there is more than one person in the car. The transport of goods/freight also tends to be predominantly road-based via heavy good vehicles (HGVs). Again, the questions of access and the cost of train services are relevant here (DTTS, 2008).

With regard to the development of green transportation in Ireland, there is potential for significant gains to be made. These can be achieved in two ways: In the long term improving public transport in order to entice people away from car use; and in the short term (and until such a changeover is possible) by the promotion of the use of greener cars and car-sharing initiatives. The electric car and its associated infrastructure (including charging points and servicing) have already been introduced into Ireland. However, electric cars are not commonplace as of yet. Increases in housing density, restricting large out of town retail centres, incorporating cycling and walking policies into local area development plans, capping the level of parking spaces allowed for certain developments, and the promotion of brownfield development, have also long been proposed as solutions towards improving transport efficiencies (DTTS, 2008).

The relevant government department in this area is the Department of Transport, Tourism and Sport. The Department has its own dedicated travel section and website <http://www.smartertravel.ie>, which published its Transport Policy document for 2009-2020. The State Agencies under the department's aegis, in relation to public transport, are: Córas Iompar Éireann – CIÉ (Holding Company for Bus Éireann, Dublin

Bus and Iarnród Éireann / Irish Rail); the Railway Procurement Agency; the National Transport Authority; the Railway Safety Commission

Promoting renewable energy:

Ireland's policy on promoting renewable energy is encompassed in its National Energy Efficiency Action Plan (NEEAP). The current policy is the third revision to the policy and remains committed to a 20% energy savings target for 2020 (DCENR, 2014). Table 8 shows the estimated energy consumption of Ireland in 2020.

Table 8: Ireland Estimated Energy Consumption 2020 (DCENR, 2014)

Estimated Energy Consumption in Ireland, 2020	GWh
Electricity transformation input (thermal power generation)	40,415
Electricity transformation output (thermal power generation)	18,661
Electricity generation output (renewables)	11,603
Energy distribution losses (all fuels)	2,764
Total final energy consumption	129,805
Final energy consumption – Industry	27,177
Final energy consumption – Transport	59,976
Final energy consumption – Households	25,295
Final energy consumption – Services	13,472
Final energy consumption – Agriculture	3,920
Total primary energy consumption in 2020	157,110

Policy measures created in order to achieve those outcomes in 2020 include the following:

- Domestic Supports – consumer awareness programmes, advertising, information provision and financial grant aid. Examples of grant aid include The Better Energy Programme, Better Energy Homes, Better Energy Warmer Homes, and Better Energy Areas and Community Schemes.
- Industry Supports – SME advice and mentoring, small business training, EnergyMAP training, and financial grant aid such the Accelerated Capital Allowance and the Triple E (Energy Efficient Equipment) register.
- Building Energy Rating (BER) – is the Irish accreditation system whereby a building is rated on a scale of A to G (A1 being the most efficient) in terms of energy use based on the building fabric and services in line with the requirements of the 2002 EU EPBD Directive (Energy Performance in Buildings Directive). There are currently 823 registered domestic energy assessors and a further 177 registered non-domestic assessors. There are currently over 421,600 domestic published BERs and just over 19,500 non-domestic published BERs (DCENR, 2014).
- Build Up Skills Ireland (BUSI) – was an 18-month project, commenced in November 2011, and funded under the Intelligent Energy Europe (IEE) programme. The project was focused on the continuing education and training of craftsmen and construction workers in the fields of energy efficiency and renewable energy sources in buildings (DCENR, 2014).
- National Energy Services Framework – set up by the Department of Communications, Energy and Natural Resources to help develop the energy-efficiency market in the non-domestic sector.
- Better Energy Financing (BEF) – a pilot Pay-As-You-Save scheme for retro-fitting existing buildings.
- Energy Efficiency Fund – was established in March 2014 with the objective of providing appropriately priced finance for energy efficiency projects in the public and private sectors.
- Transport – charging more tax on less efficient vehicles, and less tax on more efficient ones (on an emissions based system) and deployment of electric vehicles. As of the end of January 2014, 819 public and 694 domestic/commercial charging points have been installed.
- REFIT 3 – is the current instalment of Feed in Tariffs for CHP Plants since its introduction in 2009.
- Progressing with the next phase of the Smart Metering programme.
- GRID 25 – EirGrid's strategic grid development plan designed to deliver an efficient and cost effective transmission network for Ireland.

Improvements to the building regulations, in particular Part L in relation to the conservation of energy in buildings and the move towards nearly zero energy buildings (NZEB) are also part of government policy towards energy efficiency in Ireland. Renewable energy contributes to 7.8% of Gross Final Energy Consumption. Renewable electricity accounted for 58%, renewable heat 30% and renewable transport fuels 12%. The vast majority of renewable energy came from wind (47%) and bioenergy (42%) with the remainder coming from hydro, geothermal and solar. The share of electricity generated from renewable energy sources increased fourfold between 1990 and 2013, while the renewable heat share has doubled since 1990 (SEAI, 2015c).

Ensuring Energy Independence and Security:

Energy independence is not necessarily the same as energy security – a country does not have to be self-sufficient in order to be relatively secure so long as there is a good energy mix. Ample reserves and other buffers against global insecurities such as consistently priced and available imports help, but self-sufficiency and independency are obviously the best way to ensure this. Considering Ireland's high level of energy import dependence, energy security is currently not within the state's grasp now or in the near future. Ireland's potential to produce energy from wind and marine sources could change this situation, but not without large amounts of stakeholder engagement, continued research, investment and development in the sector.

3.1.1.4 Societal influences on the energy transition

Climate Change and Environment:

In December 2015 following a commitment in the programme for government, the Oireachtas (Irish Parliament) passed the Climate Action and Low Carbon Development Act 2015. The purpose of the act is to provide for the approval of plans by the Government in relation to climate change for the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy' (Government of Ireland, 2015). The act provides unequivocal commitment (Section 2) to existing obligations under international agreements including Directive 2003/87/EC relating to EU's Emissions Trading Scheme and Decision No 406/2009/EC, the so-called Effort Sharing Decision of 2009 (DoECLG, 2015). Section 4 of the act requires the relevant minister to prepare a National Low Carbon Transition and Mitigation Plan within 18 months (section 4) and to prepare a National Climate Change Adaptation Framework with 24 months (Section 5) for approval and adoption by the government. The Act provides for the establishment of a Climate Change Advisory Council – interestingly among the *ex officio* membership is the Director of Teagasc - The Agriculture and Food Development Authority highlighting the significance of agriculture related greenhouse gas emissions and the importance of the agricultural lobby in Ireland.

Nuclear Energy in Irish Society:

Ireland has no nuclear power stations. However, since 2012 the East-West Interconnector to the United Kingdom has been in operation. This brings electricity directly into the Irish energy market from British nuclear power plants like the Wyfla and Trawsfynydd nuclear power stations in north Wales. The electricity networks in Ireland and Northern Ireland are linked, at present, by three interconnectors, with the main 275kV interconnector between Tandragee and Louth supported by two 110kV stand-by interconnectors at Enniskillen/Corraclassy and Strabane/Letterkenny. EirGrid (the electric power transmission operator in Ireland) and SONI (the System Operator for Northern Ireland) are proposing a new 400kV interconnection development to allow the two independent operators act as one mutually beneficial system. Northern Ireland is connected to the Scottish electricity grid through the Moyle Interconnector. Public opinion in the Ireland has traditionally been hostile to nuclear energy being produced on the island. In 1968 there was a proposal for a nuclear power plant at Carnsore Point, County Wexford. Plans included building four nuclear reactors on the site, but these were eventually dropped in 1981 after national protests led by various anti-

nuclear lobby groups drained political support away from the project. The proposed generating capacity that this project would have provided was subsequently taken up by other energy sources.

Green Mobility:

The population of Ireland has become increasingly urbanised in recent decades. Ireland is attempting to limit urban sprawl through the use of Green Belts, and promoting development on Brown Field sites. However, urban and suburban sprawl has been significant. For example, the 2011 census shows that the South Dublin town of Saggart more than doubled in population in six years. The area under artificial surfaces increased by approx. 15% since 2000 to 2% of national land cover (EPA, 2013). Urban density in Dublin is 3,498 per square km, while in Cork, Limerick, Galway, and Waterford it is only 1,311. Irish people also have a tendency to live in their birth county (CSO, 2012). Many improvements in mobility for the residents of Dublin have been made in recent years with the introduction of the LUAS tram system, (in addition to the [light rail] DART lines) the Port Tunnel, the removal of the toll barriers on the M50, as well as the development of a range of bus lanes and road improvement schemes. The development of motorways and by-passes on primary routes linking Dublin, Cork, Limerick, Clare, Galway has significantly decreased travel times between the larger cities and towns of Ireland also. Park-and-Ride bus services, Private Car-Sharing Companies, The Dublin and Cork Bike Schemes, Private bus companies and the roll-out of electric vehicle infrastructure across the country are also assisting with the greening of mobility.

The Irish Building Sector and its Sustainable Energy Transition:

The first (1991) building regulations in Ireland came into force in 1992. These were then superseded in 1997, along with numerous updates since then. Until the 1990s building regulation mainly consisted of local authority building codes, and planning and development byelaws. Building regulations apply to new buildings, extensions and material alterations to existing buildings. The building regulations are divided into sections, in a similar fashion to those in the UK, from Parts A through to M. Parts F, J, and L are the most relevant to energy. Buildings are assessed under the requirements of the EPBD Directive using the Dwellings Energy Assessment Procedure (DEAP) and the Non-Domestic Energy Assessment Procedure (NEAP). Reference buildings such as bungalow, semi-detached house, apartment etc. are used in order to comply with the provisions in the regulations. These are also useful design tools to meet a particular building energy rating (BER) and design in energy efficiencies at the early stages in the process. Improvements in the building regulations have led to significant improvements in the energy efficiency levels of new buildings. Figure 6 shows the levels of kWh/m²/annum for dwellings from 1972 to 2020 along with the current building regulations level from 2011.

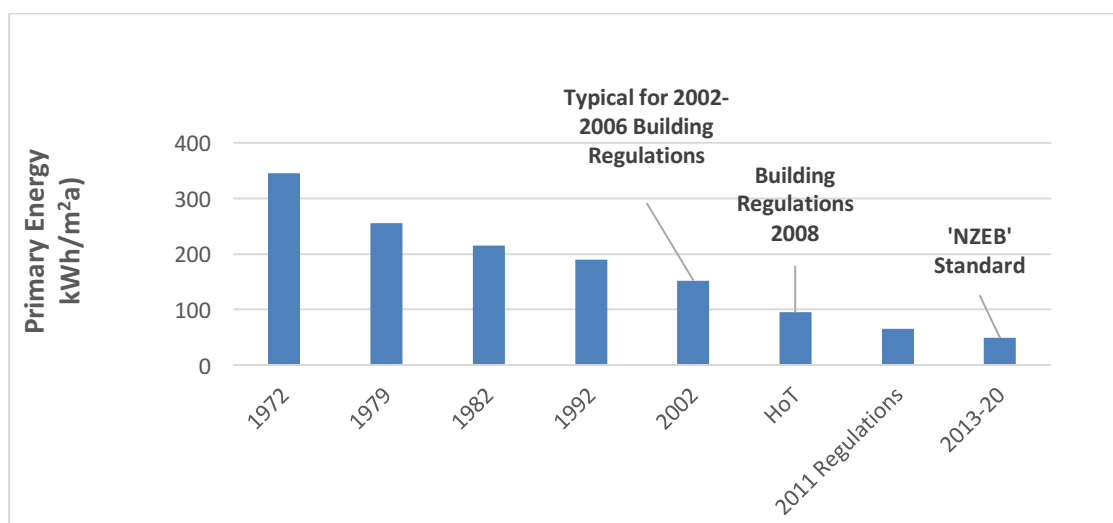


Figure 6: Ireland Indicative trends in energy rating of housing 1972-2002 & 2008-30 (SEI, 2009 & DoELCG, 2012: 6)

The Department also published their policy on NZEB buildings in November 2012, titled “Towards Nearly Zero Energy Buildings in Ireland – Planning for 2020 and beyond”. Data in respect of CO₂ emissions estimated that a total of 12.6 million tonnes of CO₂ equivalent was generated by the building sector in Ireland in 2010. This accounted for 28.8% of the non-ETS emissions allocation for 2010. Fossil fuel combustion for heating in residential dwellings accounted for approximately 7.8 million tonnes, while a further 2.4 million tonnes comprised of heating in non-residential buildings. Housing in Ireland traditionally falls into three categories bungalows/detached (40% of national stock) semi-detached/terraced (40%) and flats/apartments (20%). There are over 2 million buildings in Ireland, and nearly half of them were constructed before the introduction of building regulations. The residential sector accounts for 27.1% of Ireland’s overall energy use (DoECLG, 2012). The requirement for energy performance certification has been in place since 2008 for dwellings, and 2009 for other buildings. By 2020 all new dwellings in Ireland are expected to have an Energy Performance Coefficient and a Carbon Performance Coefficient (CPC) of 0.302 and 0.305 in accordance with the common general framework set out in Annex I of Directive 2010/31/EU on the energy performance of buildings (recast). This is equivalent to a minimum BER of A3 (DoECLG, 2012).

3.1.2 *Energy system actors and discourses: characterisation and maps*

Over the past number of years, discussions of an energy transition in Ireland have, for the most part, been confined to academic debates and policy positions from environmental NGOs that emerged after the oil shock crises of the 1970s. Ireland’s near total dependence on imported fossil fuels during the boom economy of the late 1990s to the mid-2000s saw technocratic narratives supporting greater intensity in the incumbent energy system dominate discussions in the national media. At present, and despite the economic downturn, Ireland still needs to import 90% of its energy requirements. More recently, these debates have begun to reflect wider international discussions concerning peak oil, climate change and a push towards greater diversification in energy supply. State bodies responsible for the development of the national electricity network, Eirgrid, the Commission for Energy Regulation (CER) and to lesser extent Electric Ireland, have all promoted the upgrading of the national grid with heavy-duty 420kv transmission lines, in part to accommodate the diversification into wind energy. In fact, at an official level, policy has (in the main) emphasised large-scale investment in wind energy and the construction of transnational interconnectors between Ireland and the United Kingdom. This nearly exclusive focus on wind turbines and the proposed rolling out of electricity pylons to accommodate the new 420kv transmission line has led to numerous, spontaneous local opposition groups emerging to try and block such developments at the planning stages of development.

In terms of new energy actors forming in the Irish market, these have largely been confined to new wind farm developers with access to significant financial resources. Unlike other member states in the EU, Ireland has followed the Anglo-American model with no meaningful government support being given to foster community-led wind farms. This has led to distrust among some communities where wind turbines have been proposed. One notable plan, with full government support, was to allow electricity to be traded between Ireland and the UK via a privately constructed interconnector from wind farms to be constructed in the Irish midland counties of Westmeath, Offaly, Laois, Meath and Kildare. A memorandum of understanding was agreed between the Irish and British governments, which if realised would have meant that Ireland would become a wind energy exporter. All the electricity produced was to be consumed in the UK. This plan was met with strong local opposition and the political support for the project soon began to ebb away with the project finally shelved in 2014.

The Irish government remains committed to an energy transition to a low carbon economy and have suggested that the forthcoming energy White Paper will outline in detail its plans to 2030 and beyond. While much of its focus remains on procuring secure fossil fuel supplies it is also committed to contributing

to the Integrated Single Electricity Market project, promoting greater energy efficiency standards with its National Energy Efficiency Action Plan and meeting the binding 16% target for renewables by 2020. In June 2015, the Minister for Communications Energy and Natural Resources acknowledged that the government wished to move away from “the often insensitive approach to community concerns that has been seen in the past” (White, 2015) and wished to see stakeholders now as “energy citizens”⁴. One of the commitments he made in this speech will be to remove the barriers currently preventing investment into small-scale renewable projects. It will remain to be seen if this is simply political rhetoric, or if it will be backed up with policy and financial supports.

This reluctance to reduce such barriers has meant that Ireland has seen relatively few new actors emerge to champion the energy transition, particularly in terms of small-scale renewable electricity generation. Also, bad planning and poor building practices coupled with weak regulation during the building boom has meant that much of the newer housing stock has lower energy efficiency standards than should be expected. Best practice standards such as district heating systems or building closer to existing transport/energy infrastructure were not adhered to. Ireland still does not have any district heating systems in operation. Despite this, environmental NGOs, community groups, and a number of state agencies have tried to push debates forward. Organisations such as the Foundation for the Economics of Sustainability (FEASTA), government agencies like the Sustainable Energy Authority of Ireland (SEAI) and environmental NGOs like Friends of the Earth Ireland have contributed to national discussions. A small number of voluntary community initiatives like *Transition Town Kinsale*, county Cork, emerged during the mid-2000s and sought to organise the food, energy, transport, education and health systems that contribute to the town in an effort to make the energy transition to a low-carbon future. Another notable initiative to emerge in recent years is the Cloughjordan ecovillage in county Tipperary. This new community has built 50 low energy houses and work units near a rail link and community farm, along with a solar and wood-powered community heating system and a green enterprise centre. Another eco development in West Cork, The Hollies, also exists. An interesting development from the ecovillage movement, and which may have some significance to energy transition in Ireland in the future, is the GET Local initiative. GET Local is social franchise that tries to develop community-supported enterprises that ultimately feed any wealth they generate back into the local economy. It also promotes local food and energy solutions in its business model. Despite such developments, they prove (for now) to be the exception rather than the rule when it comes to new actors focused on the energy transition in Ireland. The extended energy system map of Ireland is represented in Figure 7 and the overview of the different available discourses is represented in Figure 8.

⁴ Energy citizenship is a concept which seeks to move beyond the narrow view of energy as a commodity and seeks to integrate the public as active and legitimate stakeholders in the energy system – the term remains contested and its further development is a key objective of ENTRUST

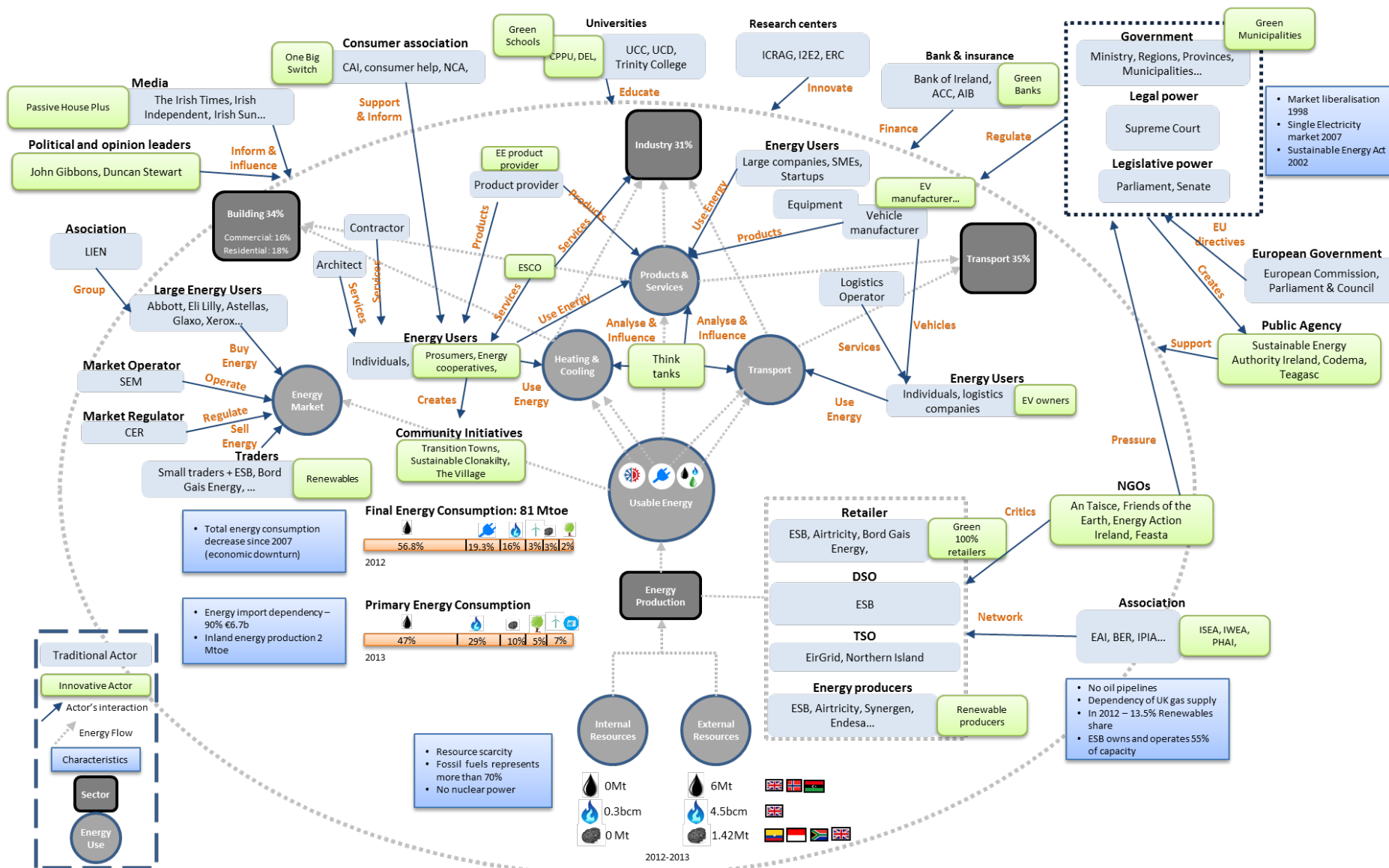


Figure 7: Ireland extended energy system map

Energy System Stakeholder Characterisation

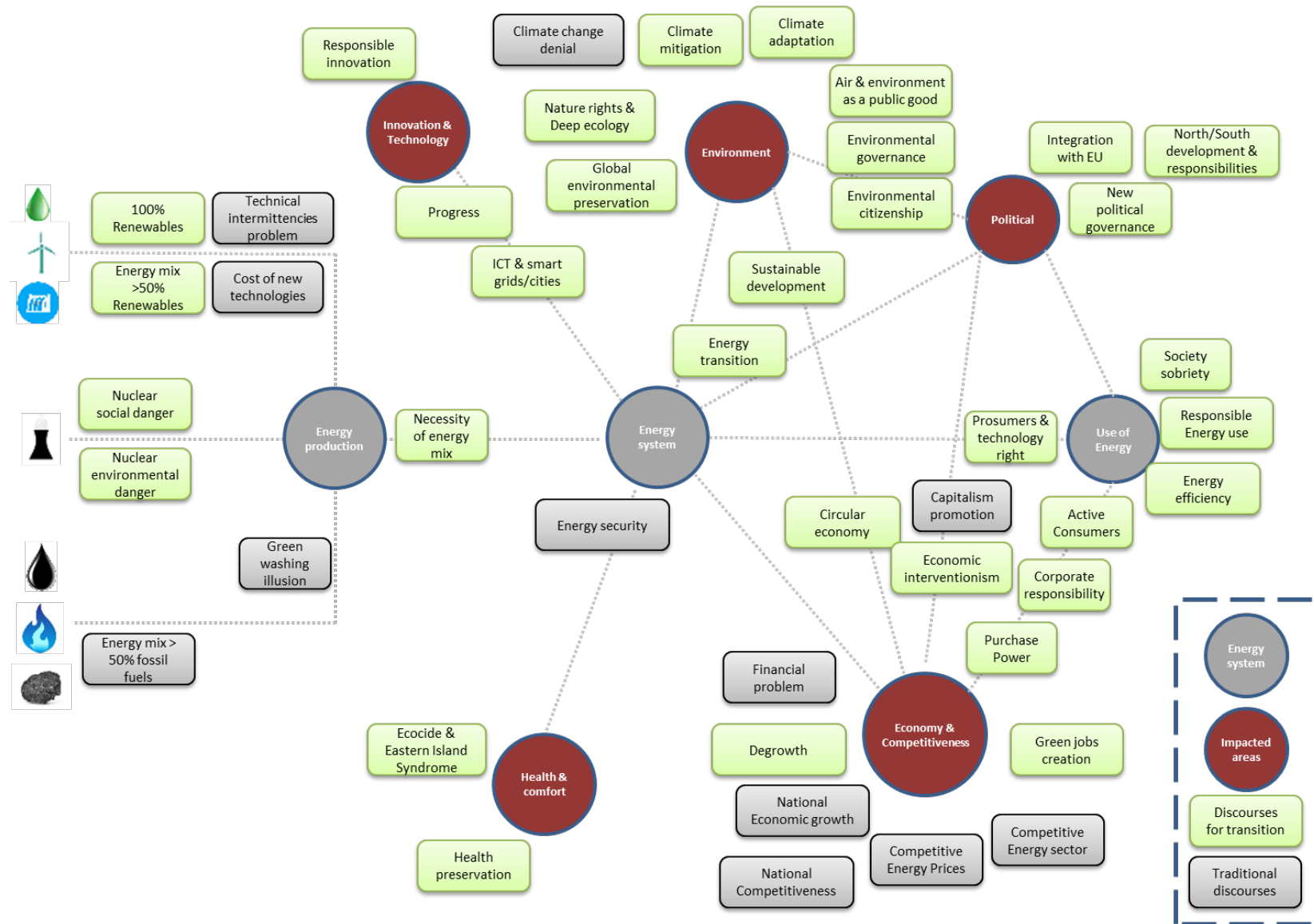


Figure 8: Ireland energy discourses – overview

3.2 United Kingdom

3.2.1 Country overview

3.2.1.1 Global overview of the energy sector

At present, the energy industries in the United Kingdom employ nearly 162,000 people directly, with an estimated 207,000 employed indirectly, contributing to nearly 3% of GDP. Investment in the energy industries, both in renewables and more controversially in new technologies in shale gas known as ‘fracking’, has continued to grow since 2004. The UK has faced a number of challenges to its domestic energy production, given the closure of its once numerous coal mines and the depletion of its North Sea oil and gas stocks. This document will explore some of these challenges and provide an overview of the UK energy model more generally.

Energy history

Gas and Coal in the UK

Wood and charcoal was the most commonly used fuel in the UK until the early 1700s. Coalmining began on a small scale during the Middle Ages as a result of a firewood supply crisis in the mid-1500s. With the invention of the steam engine, and the beginning of the Industrial Revolution in the 16th and 17th centuries, coal eventually became the preferred source of fuel. Investment in the inland waterway network to transport coal drove down freight rates for coal by 50%. In the late 1700s Boulton and Watt started to build small gas works (for gas from coal burning) for their factories, and in 1807 gas began to be used for street lighting in London.

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, with naphta or propane produced gas at higher pressures than was possible with coal gasification was rolled out. This meant that 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. When we look at domestic energy demand since 1970 (particularly in terms of heating) we see a 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 (DECC, 2015b: 9)

In 1970, the industrial sector accounted for 40% of the total UK energy consumption, with the domestic sector accounting for 24%, transport 18% and others (mainly agriculture and public administration) at 12%. By 1990 this scenario had changed with industrial consumption falling to 24% and transport rising to 31%.

By 2014 industrial consumption continued to fall to 17%, while transport consumption increased to 38% and domestic use accounted for 27% of overall energy consumption statistics (DECC, 2015b).

Electricity in the UK

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). 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 interconnectors that are used to import or export electricity when it is most economical.

Local energy sources

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.

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) and oil from Norway, Russia and the OPEC countries (DECC, 2014b). The UK is a net importer of oil since 2005. 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 (Crichtlow, 2014). British Natural Gas companies include: British Gas, Npower, Powergen, Scottish Power, Scottish & Southern Energy Plc, and EDF Energy.

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 (WNA, 2015). The UK's nuclear plant capacity increased up to 1998 but has since declined with the closure of old stations.

The energy model

According to the DUKES publications by the Department of Energy and Climate Change, the energy sources that comprise the UK's electricity mix are (approximately) as follows: Gas and Coal 30% each, Renewables

and Nuclear 19% each, and Oil and others at 3% (DECC, 2014). It should be noted that there are some fluctuations between quarterly measurements; in some quarters coal is a little higher than gas and renewables a little higher than nuclear.

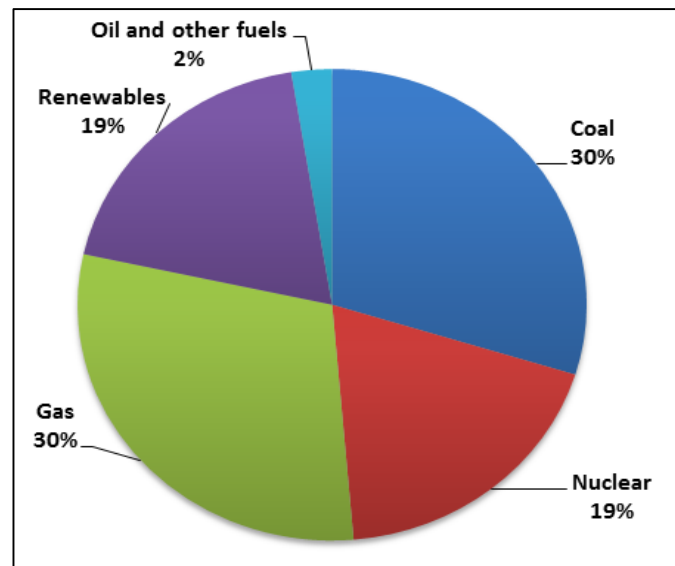


Figure 9: UK Electricity by energy source (DECC, 2015c: 119)

The proportion of renewables has steadily increased since 1990 in accordance with EU energy directive requirements, from over 2% in the 1990s up to 15% in 2013. Over half the renewables capacity is now comprised of wind, which first exceeded hydro capacity in 2005 (DECC, 2014b).

The demand for electricity in the UK grew by about 2.4% p.a. between 1970 and 2005. There was a decline following the recession, but the trends are now on the increase again. Household electricity consumption has risen significantly in this time period due to the proliferation of electrical appliances in the home. Industry is one area where consumption of energy in general has decreased due to deindustrialisation, the recession, and energy efficiency improvements (Platchkov & Pollitt, 2011).

3.2.1.2 Economics of the energy model

In 2013 UK gas industrial prices for medium consumers were the third lowest in the EU and the UK gas prices for small consumers were the fourth lowest. The average industrial prices for medium consumers of electricity were 11% above the median for the EU28 countries, while average industrial price for extra-large industry was 44% above the EU28 median. For small consumers it was 4% above. In the same year UK unleaded petrol prices were the eight highest in the EU, while diesel prices were the second highest. Since 2003, gas prices for domestic users have more than doubled, while electricity prices are up by 73% (DECC, 2014b).

In the earlier part of the 20th Century over a million people worked in the coal industry. By the 1980s there were still 169 mines employing some 220,000 people (Pearson & Watson, 2012). Now, there are less than ten thousand employed in this industry. At present, around 375,000 people are employed in the oil and gas industry across the UK, with the majority of these jobs in Scotland. This industry is on the decline, however. Last year more money was spent than earned from production and more job losses are expected in the future (Carrell, 2015). The nuclear industry employs more than 60,000 people, and the renewables industry another 112,026 people, with employment in this sector continuing to rise (REA, 2015). Overall, the contribution of the energy industries to GDP fell sharply in the 1980s and continues on a downward trend, albeit at a much slower rate. Employment in the energy sector in the same period has also fallen (DECC, 2014b). Investment in the energy industries has risen significantly since 2004.

The governments in the UK have put in place a policy of Electricity Market Reform (EMR) to promote investment in secure and low carbon electricity generation, while improving affordability for consumers. There are to key mechanisms to provide incentives for the investment required:

- Contracts for Difference (CFDs) provide long-term price stabilisation to low carbon plant, allowing investment to come forward at a lower cost of capital and therefore at a lower cost to consumers.
- The Capacity Market provides a regular retainer payment to reliable forms of capacity (both demand and supply side), in return for such capacity being available when the system is tight.

(DECC, 2014c: 9)

3.2.1.3 Political energy framework and agenda

Similar to other European Union member states, the United Kingdom is bound by the terms set out in EU regulation, particularly with directives being interpreted and fitted into national legal frameworks. It should also be noted 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. These white papers set out government strategy for delivering its four key long-term goals:

- to put ourselves on a path to cutting the UK's carbon dioxide emissions - the main contributor to global warming - by some 60% by about 2050, with real progress by 2020;
- to maintain the reliability of energy supplies;
- to promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity; and
- to ensure that every home is adequately and affordably heated

(UK Government, 2007: 10)

The key government department with a mandate in energy is the Department of Energy and Climate Change, which was formed in 2008 to meet the two main challenges that inform policy:

- tackling climate change by reducing carbon dioxide emissions both within the UK and abroad; and
- ensuring secure, clean and affordable energy as we become increasingly dependent on imported fuel

(UK Government, 2007)

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.

Renovating British Buildings

An important policy document in relation to UK policy energy and buildings is the *2010 to 2015 government policy: energy efficiency in buildings* paper. Updated in May 2015, this paper suggests that 2009 buildings accounted for about 43% of all the UK's carbon emissions, with poor waste management designs and insufficient use of resources attributing too much of these emissions. Therefore, as set out in the National Planning Policy Framework reducing carbon emissions from buildings will involve the following:

- ensuring local planning authorities to make sure that new developments are energy efficient

- ensuring all new homes are zero carbon from 2016 onwards, and looking at extending for all other buildings from 2019
- introduced the green deal (now discontinued) to enable people to pay for home improvements over time using savings on their regular energy bills
- improved the Energy Performance Certificates so that they are more informative and user-friendly

(UK Government, 2015)

Though not available in Northern Ireland, the Green Deal Home Improvement Fund was made available to homeowners in England and Wales through the Energy Savings Advice Service, while those in Scotland can access it through Home Energy Scotland. Claimants can receive up to £1,250 for

- insulation, including solid wall, cavity wall or loft insulation
- heating
- draught-proofing
- double glazing
- renewable energy generation, including solar panels or heat pumps

However, it has now been discontinued with the UK Government making the decision to stop funding the Green Deal Finance Company (GDFC), which was set up to lend money to Green Deal providers. It is uncertain what the government intends to do with regards to home improvements into the near future.

Developing green transportation

The government has operated a cycle to work scheme, since 2001. It incentivises employees to cycle to work and enables employers to loan bicycles and cyclists' safety equipment to employees as a tax-free benefit.

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 CO₂, NO_x 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 on Route 312, between Croydon and Norwood Junction. Benefits envisaged include reductions in GHGs and noise pollution levels.
- Plans are also afoot 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 per cent discount for the vehicles that emit less than 75 g/CO₂ 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 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. While in Edinburgh transport authority there has begun rolling out a hybrid bus fleet of its own, with 15 hybrid buses set to produce 30% less carbon emissions than the equivalent diesel buses used in the rest of its fleet.

Promoting renewable energy

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.

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.

Ensuring Energy Independence and Security

During the 1980s and 1990s the UK was a net exporter of energy, given its North Sea oilfields. At present, the UK is again an energy importer with nearly 50% of its energy needs coming from abroad. Issues around energy independence and security of supply are again strong policy agendas for government. There has been criticism in some quarters that efforts to meet these challenges have been diminished by the tendency to link energy independence and energy security together. Some commentators have suggested that the major energy crises of the past forty years in the UK were created by disruptions to the domestic energy supply rather than the international situation.

Therefore, a more comprehensive framework of diversification and risk reduction measures are seen as being needed more so than having any national self-reliance target. It was also acknowledged in a 2011 report, produced by the House of Commons Energy and Climate Change Committee that relying on energy imports into the future is all but inevitable. However, they suggest that this can be mitigated somewhat by diversifying the UK's energy portfolio and minimising the reliance on a single fuel source or supplier. This outlook has helped to generate considerable interest in developing a shale gas industry akin to that of the United States of America, which has led to considerable controversy in the media and from local populations.

3.2.1.4 Societal influences on the energy transition

Climate Change and Environment: As with most developed countries UK government policy has adopted a dual response to the challenges of climate change, adaptation and mitigation. Adaptation strategies involve lessening the adverse effects of climate change through a wide-range of systemic changes including conservation, infrastructural and energy-reduction measures. Mitigation operates in conjunction with adaptation and encompasses actions that limit any human contribution to climate change, especially by reducing emissions of GHGs and enhancing natural carbon sinks. The government has published a series of policy documents in this regard. In 2008 the House of Commons passed the Climate Change Act, which set up a cross-party Committee on Climate Change. This committee is responsible for producing a series of reports that will ultimately inform policy. They include:

- The Climate Change Risk Assessment (CCRA), with the first report published in 2012 and the second to be made available in 2017
- The National Adaptation Programme (NAP)

- And the Adaptation Reporting Power (ARP) report

Key government ministries, responsible for implementing policy in this regard, include the Department for Business, Energy & Industrial Strategy (DBEIS)⁵ and the Department for Environment, Food and Rural Affairs (Defra). Legislation on climate change is also particularly active in the devolved administrations in Scotland, Wales and Northern Ireland. The Climate Change (Scotland) Act was passed in 2009, committing Scotland to a 42% reduction in emissions by 2020. The devolved administrations in Wales and Northern Ireland are also developing similar legislation.

Nuclear Energy in British Society: Nuclear power in the United Kingdom has played a significant role in post-war British energy policy up to the present day. It has also had a rather chequered position in terms of public acceptance, with only the prospect of wide-scale shale gas drilling (fracking) being nearly as controversial. Having said that, public confidence continues to remain relatively high. At present, and not including the 2GW on interconnector capacity coming from France, nuclear power contributes approximately 20% to the UK's energy mix. Given this figure it continues to be strategically important in terms of policy on energy security and climate change. Also, it should be noted that despite shocks such as the 2011 Fukushima disaster in Japan, the UK has decided to continue using nuclear energy and even recently proposed updating many of its aging reactors. Indeed, it was these policy positions (energy security and climate change) that were used to justify the current government's decision to fast-track the rolling out of new nuclear power plants.

Green Mobility: In keeping with trends seen elsewhere, the UK has witnessed significant urban sprawl in the post-war years. An estimated 50% of the landscape in England is now categorised as disturbed (to some degree) by noise, light and visual pollution from urban areas and major infrastructural projects. Centralised planning systems and the use of "green belts" are credited with helping to contain urban expansion in the UK. The weighting towards developing brownfield sites has also helped. Policies in this regard have had mixed success. Some 77% of new homes constructed in England in 2008 were constructed on brownfield sites, a figure up from 57% in 1996 (EU, 2015). There has also been a noticeable shift in policy, particularly in urban centres, away from a reliance on privately-owned cars for mass transport and towards public transport alternatives. A number of initiatives discussed in the Part III, Section b, are examples of this change.

The British Building Sector and its Sustainable Energy Transition: 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).

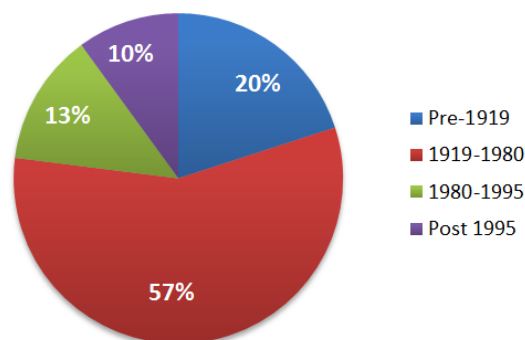


Figure 10: UK age profile of Housing (DECC 2014d: 59)

⁵ Responsibility formerly rested with the defunct Department of Energy and Climate Change (DECC)

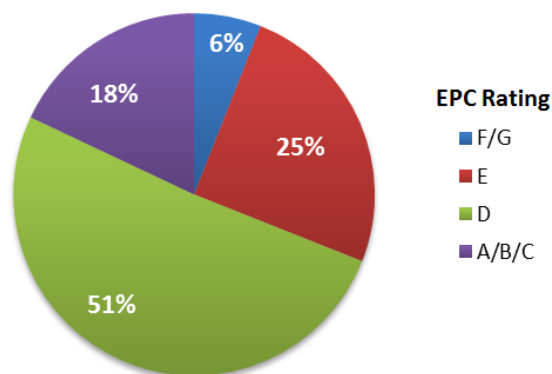


Figure 11: UK housing in terms of energy efficiency (Energy Performance Certificate ratings) (DECC 2014d: 59)

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 installation, draught proofing, improved heating controls, double-glazing, and renewable energy technologies (DECC, 2014d). The Carbon Trust was originally set up by the government (and now a self-financing company) to promote energy efficiency and carbon reduction. Invest NI offers free energy and resource efficiency audits for businesses in Northern Ireland. The Department of Social Development also facilitates energy efficiency through their advice line. The Resource Efficient Scotland programme offers comprehensive information, advice and support to businesses and public sector organisations. A smart metering programme has also been established, which aims to roll out domestic (gas and electric) smart meters across the UK by 2020. The non-domestic Renewable Heat Incentive (RHI) is a subsidy to promote the uptake of renewable heating technologies (DECC, 2014d).

Policies and programmes to tackle energy:

- Bryson Energy Advice Line & “Energywise” (NI)
- Warm Homes Scheme (NI)
- Boiler Replacement Scheme (NI)
- Northern Ireland Sustainable Energy Programme (NI)
- Northern Ireland Renewable Heat Premium Payment (NI)
- The UK Green Investment Bank
- Salix Finance Ltd
- RE:FIT programme pioneered by the Greater London Authority
- The Energy Saving Advice Service
- The Green Economy Awards
- Big Energy Saving Week
- The Open Homes Network
- The Green Deal Finance Company
- Home Energy Scotland Advice Centres (SC)
- Resource Efficiency Scotland & Resource Efficient SME Loans (SC)
- The Home Renewables Loan Scheme (SC)
- The Climate Challenge Fund (SC)
- The Welsh Integrated Resource Efficiency Support Service (W)
- Nest Fuel Poverty Scheme (W)
- Arbed Area Based Community Scheme (W)
- Sustainable Living Grant Scheme (W)
- Build Up Skills UK

Consumption and British Society: Feed-in-tariffs (FITs) became operational in the UK in 2010 to anyone with a renewable electricity system, paying up to 41.3p/kWh, depending on the type and size of the

system, and for up to 20 or 25 years. The larger energy operators are required by law to offer FIT's, while the smaller are not. Smaller operators may do so voluntarily, however. The Energy Performance Certificate (EPC) of the building must be higher than a D-rating, otherwise energy efficiency improvements will need to be carried out before the best rate over the life of the building can be estimated. There are now so many tariff options in the energy sector, and so many different suppliers in the UK that it is difficult for customers to shop around and ensure they are getting the best value by switching supplier. It is speculated that Internet demand in the UK is growing such that the nation's optical fibres are reaching now "capacity crunch". Internet transmission already accounts for 8 to 16% of Britain's power. Major telecoms operators' alone account for the equivalent of three nuclear power stations of power (Withnall, 2015).

Household residential energy consumption accounts for about 20-25% of overall household CO₂ emissions. Therefore, a reduction in energy consumption at the household level would greatly help to reduce the UK's carbon footprint (Longhi, 2014). Results of recent surveys also show that while socio-economic characteristics (such as the income, presence of elderly, or ill persons) have an impact on energy use, the most important characteristic is actually the size of the household whereby one additional individual decreased per-capita expenditures on average by 32-38% (Longhi, 2014). In 2010, 4.8 million UK households (approx. 19% of all UK households) were in fuel poverty (ONS, 2012).

The future of the UK's energy landscape remains hard to predict. It faces a number of challenges going forward, including the political considerations associated with further devolution and its aging fleet of nuclear reactors. While Electricity Market Reform (EMR) will help support low-carbon energy technologies in the short to medium term the long term outcomes are less certain. Also the issues around fracking are yet to be resolved and will remain politically contentious given the "economy versus environment" paradigm it engenders. Gas fracking in United States has seen a boom in that sector of the economy in recent years, but the environmental costs have been substantial particularly in terms of air and water pollution and the despoliation of the landscape.

3.2.2 *Energy system actors and discourses: characterisation and maps*

The United Kingdom, unlike Ireland, has not been significantly exposed to the risks associated with importing its energy sources from abroad. Large deposits of coal remain intact and for much of the 1980s and 1990s the UK was a net exporter of energy, given its oil and natural gas reserves in the North Sea. As those reserves have begun to diminish, however, the UK has again found itself to be a significant energy importer. Nearly 50% of its current energy needs come from abroad. Consequently, this has revived debates from numerous quarters on the twin issues of energy independence and security of supply. Both concerns continue to strongly influence the energy agendas of the national and regional governments. Criticism has also been levelled at government energy policy from some analysts who suggest that these efforts have been hampered by the tendency to link energy independence and energy security together. Such critics have argued that financial instruments from the markets can largely insulate the UK from the risks associated with security of supply. Others remain less convinced of such arguments. Either way, coal, oil and gas will continue to dominate the UK energy mix for the next 30 years or more.

The energy transition narrative in the UK is intrinsically linked to the 2008 Climate Change Act, which seeks to reduce carbon emissions to approximately 20% of the 1990 baseline levels by 2030. To do this the UK proposes to rely primarily on offshore wind, Electricity Market Reform (EMR) and Feed-in-Tariff (FIT) supports for any low carbon plant development. In light of these efforts, numerous community energy projects have emerged to meet the challenges of dwindling fossil fuel supplies and government efforts to switch to a low-carbon economy (Seyfang et al., 2014). These new types of energy transition actors are highly informed and the energy policy "trilemma" of affordability, decarbonisation and energy security are all key influencing factors for active local communities looking to embark on long term transition pathways to low carbon energy systems (Bolton and Foxon, 2015). Many of these energy co-ops and community

power schemes have grown in popularity due to government support schemes like the Rural Community Energy Fund (RCEF). This £15 million is jointly funded by the Department for Environment, Food and Rural Affairs (Defra) and the Department for Business, Energy & Industrial Strategy (DBEIS), and helps rural communities in England to develop viable renewable energy projects. Elsewhere in the UK, the Scottish consortium Local Energy Scotland provides supports to rural communities there to access funding and financial instruments for renewable energy schemes. In conjunction with these efforts nuclear power in the UK remains a strong contributor to the energy mix. Government plans to replace its existing aging nuclear infrastructure with at least twelve new nuclear reactors at five sites across the UK continue apace. The extended energy system map of United Kingdom is represented in Figure 12 and the overview of the different available discourses is represented in Figure 13 .

Energy System Stakeholder Characterisation

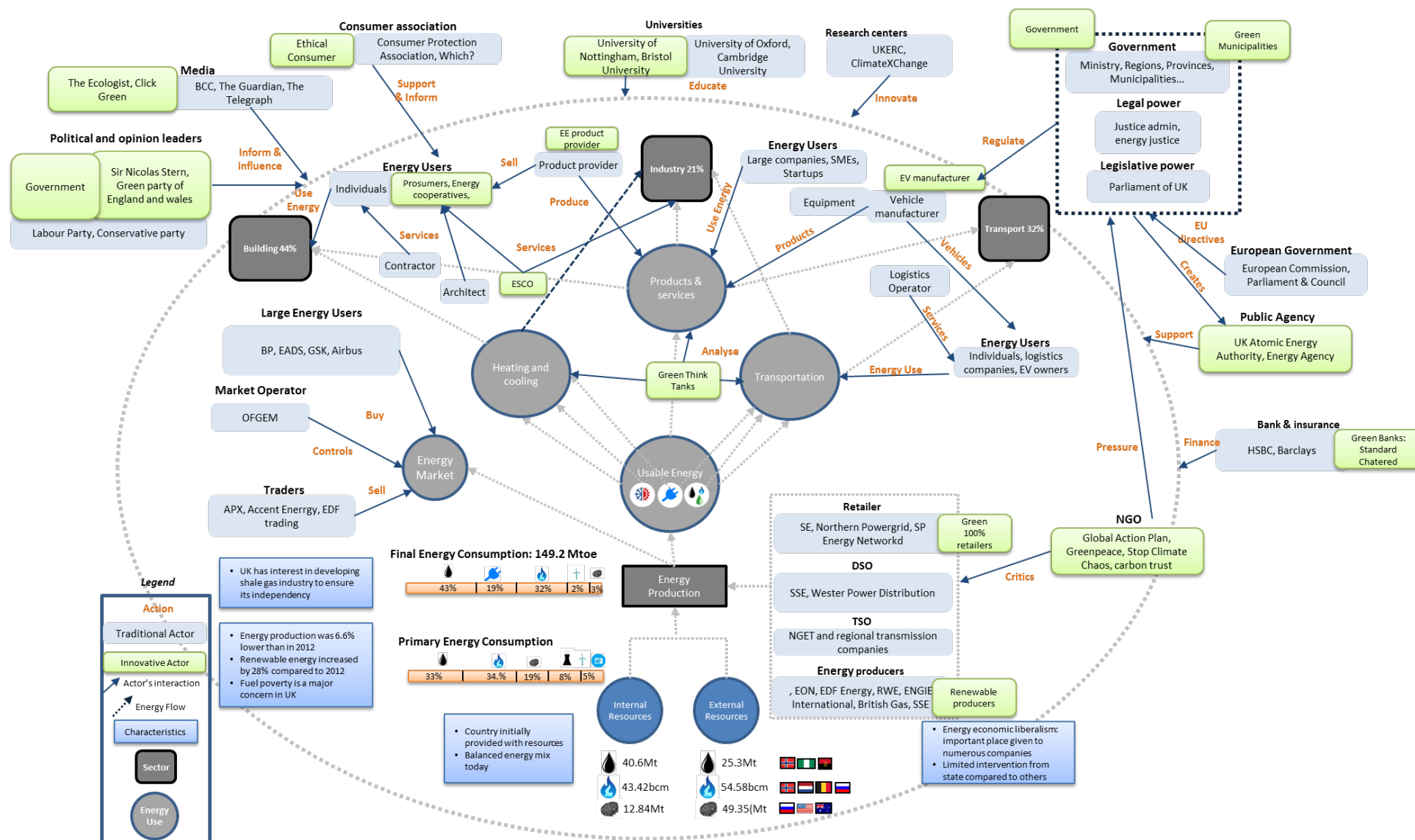


Figure 12: UK extended energy system map

Energy System Stakeholder Characterisation

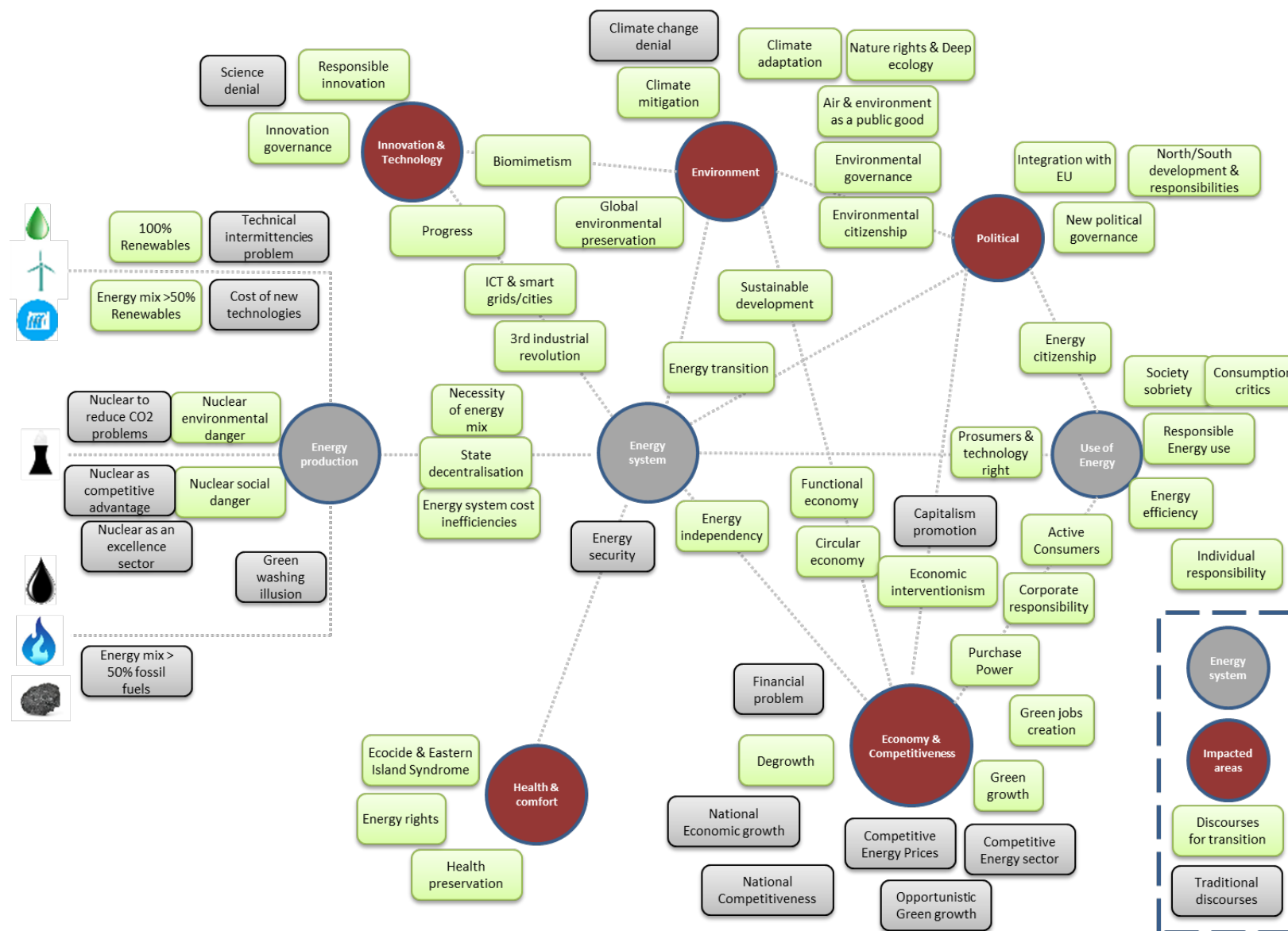


Figure 13: UK energy discourses – overview

3.3 France

3.3.1 Country overview

3.3.1.1 Global overview of the energy sector

Energy history

Benefiting from the energy resources of its colonies, France was “secure” in terms of oil dependency until the First World War. During the war, deprived of its resources, France turned toward the USA to ensure its energy supply. Concerned for its energy security, the country created in 1924 “*la Compagnie Française des Pétroles*” in charge of building up strategic oil stocks. At the end of the WWII, the French scientific community, inspired by the Manhattan project, convinced Charles de Gaulle to create the “*Comité à l’Energie Atomique*” which aimed to conduct technical and scientific research on nuclear energy. At the same time, the government in office founded two national companies, “*Electricité de France*” (EDF) and “*Gaz de France*” (GDF) and modernised mining facilities to accelerate the country’s reconstruction. Making use of the results from the military atomic bomb programme, EDF built its first nuclear power plant in 1963. France’s energy security was also covered by the exploitation of the natural gas from its ground in 1957. To cope with coal mining decline and oil shocks, France chose the path of nuclear energy. Symbolised by the slogan “*En France, on n’a pas de pétrole, mais on a des idées*”, [meaning “In France, we do not have oil but ideas”], French energy choices are the result of economic (energy costs and industrial developments) and political (energy security and technical expertise) considerations. The different nuclear accidents (including Chernobyl and Fukushima) have not, so far, modified the energy pathway of the country, but the development of renewable energy could change the situation.

Local energy sources

Although France had been able to guarantee a part of its energy independence via fossil fuels resources (oil, gas and coal) directly extracted from its grounds, the current national production is near zero. According to the most recent data, fossil fuels produced in France (Commissariat Général au Développement Durable, 2014) come down to:

- 0.3 MT of coal, representing 1.4% of national needs,
- 0.8 MT of oil. The 11,6 MT of oil resources are expected to be depleted in 14 years,
- The national gas production ceased in 2014 after the last closure at the Lacq field.
- France would benefit from its significant shale gas potential according to the International Energy Agency.
- End of national uranium exploitation at Jouac-Bernadan mine in May 2001.

Considering alternative energies, France is the second largest producer of renewable energy, after Germany, in Europe thanks to its large hydro, wind and geothermal potentials. The French coastline, as well as its submarine territories, represents important onshore and offshore wind capacities. The country benefits also from an interesting biomass potential since it has the fourth largest forest area in Europe and large solar gains especially around the Mediterranean coastline (Duluc and Geni, 2007). The potential contribution of renewable energy in France was around 700 GW in 2014 (ADEME, 2014).

The energy model

The primary energy production in France is mainly in the form of electricity form due to the importance of nuclear energy in the French mix. In 2014, the local primary energy amount produced was on the order of 139.1 Mtoe including 121.6 Mtoe of electricity, mainly from nuclear power (113.7 Mtoe) (Commissariat Général au développement durable, 2015:34).

The remaining electricity production comes mainly from hydro and thermal power plants (Figure 14).

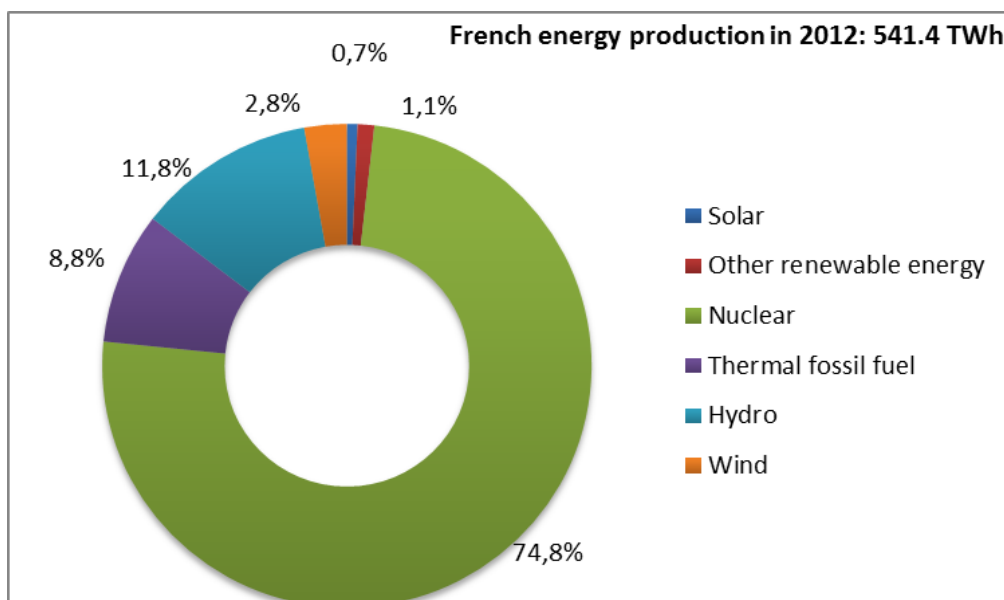


Figure 14: France Electricity mix 2012 (RTE, 2012)

Whereas the 58 nuclear power plants deployments are homogeneously distributed over the territory, France has taken advantage of its environmental resources to implement geographically-based renewable energy production installations:

- Solar energy around the Mediterranean Arc,
- Wind energy in north of the country and along the coasts,
- Hydro facilities among the Alps mainly.

According to data from Eurostat, France is the primary energy producer in Europe, the second energy consumer behind Germany, and the second renewable energy producer behind Germany. On the consumption side, after a peak in 2006 and 2008, the energy consumption started to decline slowly, which can be explained by low economic growth and some energy efficiency gains. In 2013, the total amount of final energy delivered to users, 154 Mtoe, was divided as follows: Oil products: 40.5%; Electricity: 24.5%; Gas: 20.8%; Thermic renewable energy: 10.5%; Coal: 3.7%. Energy consumption is divided among 5 sectors as shown in Figure 15.

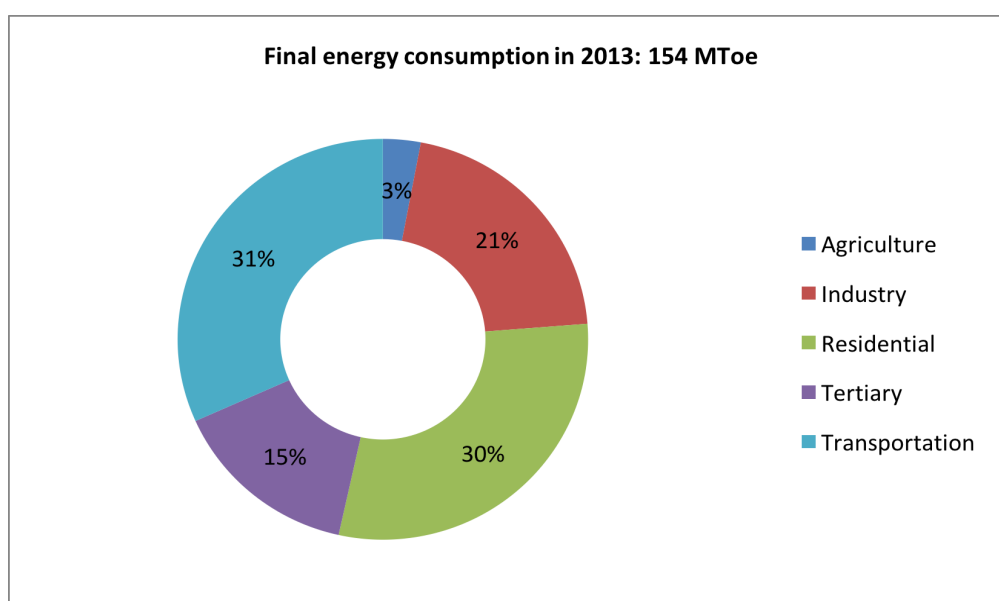


Figure 15: France Energy consumption by sectors 2013 (Observatoire de l'énergie électrique, 2012)

Due to political considerations, the French energy model has long been dominated by large national companies like EDF or GDF, which were monopolies for a long time. Although the energy market is becoming more open, the energy model can still be considered vertically integrated. Under pressure from the EU, the energy network had to be fragmented to let new actors like RTE or ERDF operate but past monopolies and established players still keep their advantageous positions.

Highlight on the role of EDF and GDF:

As already presented above, EDF and GDF have played a role of utmost importance in structuring the market. In the 70s electric heating started to spread in France, especially due to the production of nuclear electricity. The government promoted electric heating, as it worked together with nuclear energy. Energy services companies were therefore of two types: those of the water heating sector (plumbers, heating engineers, etc.) and those of the electric sector (electricians etc.). At that time, EDF and GDF used to work together. EDF and GDF organised the sectors downstream. For example, EDF promoted electric heating and used to cooperate with industry so that they would manufacture products adapted to electricity. They used to cooperate with installers also, so that they would know how to install electric equipment. GDF used to follow the same process to sell gas.

EDF was a little more ahead, and minimal competition and close relationships used to exist between small energy companies and EDF and GDF. In the 1980s, air conditioning developed, which brought the two competences closer: water heating and electricity. With the opening of the market, this relationship ended. As EDF and GDF lost market share to the profit of new market entrants like RTE and ERDF, they developed new activities to enter the market of small energy companies. From a cooperation logic, they went to a logic of vertical integration and started to buy installers, electricians, and plumbers companies. This restructuring led to the creation of new brands: Dolce Vita for GDF and Bleu Ciel for EDF. This is to show that the EDF and GDF (and their new companies) play a structural role in the French market and that they are able to destabilise smaller actors to increase their market share through vertical integration.

Another example comes from the white certificate system established by POPE's law. In the first period of French white certificates (2006-2007), EDF and GDF were the only first ones to really understand how this new system worked. So they used their knowledge to benefit from the situation. They managed to obtain white certificates without actually implementing energy savings. To do so, the process was simple. Energy services suppliers such as installers implemented energy savings for their clients. These transactions were recorded as usual under invoices. Installers could have actually used these invoices to obtain white certificates. However, they were not so informed about these. So it was easy for EDF and GDF to implement a lucrative deal. They exchanged these invoices against access to their clients' databases for €15. So an installer would receive €15 and access to EDF and GDF client database but would lose their white certificate, which could be worth way more than these €15.

3.3.1.2 Economics of the energy model

To understand the French energy market (Commissariat Général au Développement Durable, 2015), it is important to bear in mind a clear distinction between the wholesale market operated by providers who buy energy from the producers at an hourly price, and the usual energy market between providers and users (particulars, companies) where prices are nearly always fixed (RTE, 2011).

The opening of the energy market has created two kinds of pricing for final consumers:

- The regulated tariff fixed by government which differs regarding the kind of users (particulars and companies). It is usually operated by historical electricity producer (EDF)
- Market prices that are freely fixed by historical and alternative providers depending on the kind of energy delivered. These prices are more volatile.

The French energy model, mainly based on electricity produced by nuclear facilities, offers a certain price stability since uranium is less volatile than oil or gas on the energy market. Consequently, the energy price

is globally lower when compared to the average price operated in EU, but there is much debate on whether the apparently “cheap” electricity price is worth other hidden costs such as investment in nuclear plants and decommissioning, diplomatic and political costs *etc.* From 2004 to 2013 most energy prices (propane gas in tank, electricity, domestic oil, natural gas, wood pellet in bag, wood pellet in bulk) have, on average, increased; electricity being one of the most expensive energy types (Propellet, 2015).

Considering its local resources, its production capacity, and its consumption energy level, the French energy balance is negative. In 2014, the country needed to import 145.7 Mtoe, chiefly crude oil, oil products (Africa, Middle East and Russia) and gas (Norway, Netherland, Russia and Algeria) to cover national demand. The only energy exports correspond to the nuclear energy surplus sold to its European neighbours, reducing the import balance to 113.5 Mtoe. The amount of imported energy has decreased by almost 8% over recent years raising, at the same time, the rate of energy independence at 55.8%. However, this official figure (55.8%) includes energy that is produced by French companies, but in other countries (such as Niger, Mali). If only production from the national territories is accounted for, the real figure is around 8% of energy independence.

The energy industry has an important place in the economy since this sector in 2013 represents 1.7% of GDP, representing 140,000 jobs and 25% of industries investments. Although the national energy bill has declined compared to last year, it accounted for 54.6 billion euro in 2014. This drop can be explained by the price energy fall observed on the oil market and the energy efficiency gains, which establishes the country's final energy intensity at 73 Ktoe per billion GDP. Besides, the energy transition in train, initiated by the government, represents an important source of employment. In the next three years, the Ministry of Environment expects to generate 100,000 new jobs mainly in the energy efficient retrofitted buildings sector, wood industry, green transportation, renewable energy, and green chemistry.

After several aborted laws, the current government has set up a carbon tax under the form of carbon offsetting proportional to fossil fuels based CO₂ emissions. This fee, initially fixed at €7 per tonne should encourage users (companies and individuals) to adopt greener behaviours. The fee should reach €22 in 2016. Besides, significant resources are used to support the development of renewable energy. The choice was made to consider all potentialities, in order to position France as a major player in all production technologies such as marine energy or biogas. For instance, in the heating sector, a special fund was provisioned (220 million euro per year) to finance projects up to 5.5 Mtoe.

In the transport sector, the main tools to support renewable energy are the general tax on polluting activities that can encourage the incorporation and distribution of biofuels. The development of renewable energy benefits from two other complementary systems: specific purchase rates and national tenders to support investment in renewable energy projects. Finally at the European level, French companies considered as “*les obligés*” are involved in EU ETS mechanism.

3.3.1.3 Political energy framework and agenda

As a member of the European Union, France is bound by EU regulation. Recently, in phase with the upgraded European Union climate and energy packages, the 2030 objectives to reduce greenhouse gases by 40% compared to 1990, the improvement of energy efficiency by 27%, and the increase of the share of renewable energy by 27% were the main threads of the French energy project law. Entitled “Loi de Transition Énergétique”. This law, personally supported by the French environment minister Ségolène Royal, aims to prepare for the post-oil period and to establish sector by sector, a more robust and a more sustainable French energy model in line with current global challenges (climate change, security, *etc.*).

The lack of a clear, unified and unbiased political direction:

As already said, in France, energy decision-making is limited to the State, national administrations, and emissaries of big energy companies. As such, there is no clear political direction as the State is divided between its role of shareholder (major shareholder in EDF and 36% shares in GDF) in the big energy

companies and its role of social protector. For example, despite the opening of the market, there have already been some contentious cases between the big operators and the new market entrants, to the benefit of the former. In addition, a report from the National Competitiveness Authority declares that the opening of the market has not been fully successful; the big operators are keeping their dominant position, with little benefit for the consumers. This shows that the French political model is still influenced by the past. There is little will to actually change the energy paradigm. Evolutions are only incremental.

In addition, some discourses are biased. For example, one key argument of the transition debate was that it was not possible to raise energy prices and therefore decrease nuclear energy production, for that would have hampered the country's competitiveness. However, those who fought to keep the prices at their current levels were the energy intensive industries such as the steel industry, chemistry, paper, metallurgy *etc.* While their sensitivity to energy prices is high, they only represent less than 2% of the total turnover in the economy. That means that all the other sectors could support an energy prices increase. The competitiveness argument therefore only applies to a small percentage of the economy and an energy price increase would not have had consequences as bad as were argued by some.

Renovating the French buildings

To reduce the significant energy consumption of the building sector, the roadmap forecasts renovating 500,000 housings yearly, focusing first on low-income households. Improving the energy performance of new buildings also, is a priority for the government which ambitions to make the French low-energy consumption label "BBC" a standard for every new building in 2050. To carry out such an energy revolution, the government has decided to involve individuals, local communities and companies through:

- Eco-loan zero and credit tax to finance energy renovation,
- The creation of a logbook and maintenance of housing,
- Setting up energy and renovation platforms at the community level to advise and inform consumers.

Developing green transportation

To reduce the occurrence of air pollution around cities, the legislation is intended to accelerate the replacement of fossil fuel based transportation fleets with low-emission vehicles. This measure will be coupled with the setup of electric loading stations in order to reduce the dependence on hydrocarbon. Subventions will be provided to ensure mobility through a rural mobility plan as well as the conversion of downtown into traffic-restricted areas.

Promoting renewable energy

The current government is committed to double the share of renewable energy, meaning 32% of green power by 2030. Efforts and subventions are also expected to support local renewable energy resources and their better integration into the electric grid. This action plan includes the involvement of inhabitants for them to financially support green companies and the setup of "sectors of excellence" to develop renewable energies. Besides, a new support mechanism, an additional premium, will be created in order to make renewable energy economically more attractive.

Ensuring energy independence and security

Developing renewable energy as well as reducing energy consumption are strategic levers to guarantee the energy independence of France. The prospect of no nuclear power plants closure could be part of the same strategy. Aware of the issues associated with terrorism and the frequent Greenpeace intrusions, the current government has strengthened security measures on nuclear facilities.

3.3.1.4 Societal influences on the energy transition

French people are not well aware of energy. This may be attributed to the centralisation and concentration of strategic energy decision-making, which leaves little room for trustworthy debates and clear direction setting. For example, French citizens still have difficulty understanding the difference between EDF and GDF and are not able to tell what their new brands (such as Dolce Vita, Bleu Ciel) actually refer to. While citizen initiatives for an energy transition exist, the majority are still quite misinformed because of the lack of clear political direction, which was clearly illustrated during the National Debate on the Energy Transition. While this debate lasted for around eight months, few citizens knew about it and no public media programme was even organised. In addition to a feeling of helplessness, an individual's desire to engage with the transition is diminished by prejudices which associate environmental concerns with green party affiliation. Another problem that actually diminishes the power of energy transition initiatives is the opportunism of many companies. Indeed, opportunistic companies flourish in markets that are subsidised. For example, green washing companies would develop solely to benefit from governmental support, such as support to energy efficiency retrofit *etc.* These companies are called “eco-delinquent”, for they disturb a market with low quality offers and leave the market when governmental support stops.

Climate change and environment: Whilst the city of Paris prepares to host the next COP 21, French awareness of climate change and its consequences remains tenuous. The last poll realised on a sample of 1056 individuals in March concludes that the climate is a “distant and uncertain concern” to French people. Only 13% of respondents consider tackling climate change as a priority, while the majority is more concerned with unemployment or terrorism issues. If numerous French people are pessimistic about the result of the COP 21, 62% of them are ready to take actions at their level to reduce their greenhouse gases emissions. “Solutions exist to tackle climate change” is the message carried by committed French personalities like Nicolas Hulot, Yann Arthus Bertrand, and Maud Fontenoy. Their respective associations and foundations pledge for citizen actions, and promote a positive vision of the environment. Hence, they may appear as game changers in the French society and some of them are even politically involved like Nicolas Hulot who was appointed “special ambassador for the climate” by the French president.

Nuclear energy in the French society: Although the French president has kept his promise to reduce the share of nuclear energy by 25% in 2025, the “Loi sur la transition énergétique” does not mention any requirement to completely stop nuclear energy generation. According to the last IFOP survey released in 2014, nuclear energy in France is a divisive or even taboo topic since 66% of the respondents deplore the lack of transparency and information in relation to nuclear energy. A BVA poll carried out in 2013 indicated that 67% of French people support nuclear energy even if there are strong disparities among the population depending on sex, age, social category and political orientations. Nonetheless, 53% of French people back the idea of a progressive exit from nuclear energy. This eventuality depends on its economic consequences since the top priority for many French people is “the reduction of energy cost” even before “the security of power plant”. A recent scenario from the French agency of energy (ADEME, 2014), stating that a 100% green energy mix in 2050 at an unchanged energy level price is possible, could reopen the dialogue on the place of the nuclear energy within the energy mix.

Green mobility: French society has undergone many changes regarding its mobility through the development of many urban services. Almost all the cities have developed green mobility, providing either bicycles, or electric car rental services. Municipalities have converted town and city centres into traffic-restricted areas connected by metro and other urban transport. Moreover, citizens, preferring usage to possession, are increasingly turning to car rental services. Uber and Blablacar are the most striking example of this transformation across French society.

Car manufacturers have taken part in the green evolution in mobility. Renault, for instance, has built its strategy on the launching of a 100% electric car. To catalyse this transition and boost the industry, the

current government has increased the environmental bonus to support the renewal of the car stock. Two challenges remain to be met in order to successfully convert the mobility sector in France:

- Ensuring continuity between urban and rural zones,
- Integrating electric loading stations to the transport network.

The French building sector and its sustainable transition: The building sector in France is characterised by two phenomena slowing its transition to sustainability. Firstly, there is a shortage of affordable housing that is coupled with a slow pace of construction in some regions. For instance, the level of building construction in Île de France was low, and it focused on private high-priced buildings. In these conditions, the question of the energy performance of new buildings is not the priority for authorities. Secondly, the fuel poverty phenomenon is affecting approximately 9 million people in the country. These households devote more than 10% of their income to energy spending, and they benefit from a specific status and subventions from local authorities. Public-private associations like CAPEB and ANAH have developed local programmes to help people, and to finance renovation.

Consumption and French society: The topic of the circular economy experienced a recent boom in French society to the extent that a section was dedicated to it in the recent French legislation. The roadmap focuses on a better management of waste sorting and their valorisation. Composting projects emerge in several cities like Paris and give evidence of the awareness of some parts of the population.

3.3.2 *Energy system actors and discourses: characterisation and maps*

France is characterised by a centralised government. The State and big energy companies remain the main actors in the energy system. It is to be noted that there was a national debate on the energy transition in 2013. The expression “energy transition” has therefore been adopted at the political level. This debate was preceded by two ‘*Grenelle de l’environnement*’, in 2007 and 2008, which gathered political actors, decision-makers, and civil society organisations to discuss and adopt new laws to protect the environment.

At the national level, new public organisations, new governmental working groups, and new funds have been created to enforce the energy transition and to comply with the outputs of the Grenelle. At the local level, local administrations have gained new capabilities to enforce the energy transition, and the results of the Grenelle. Many regions have taken initiatives to foster the transition – such as energy efficiency retrofitting of public buildings, fostering a 3rd industrial revolution running on renewable and smart energy technologies, etc. The numbers of national level actors working on the topic of energy and environment is relatively high, showing that there is a will to see an energy transition. However, the concretisation of political announcements remains dubious.

At the business level, big energy companies are diversifying their portfolio in order to maintain their market share. This diversification encompasses investment in innovative and renewable energy sources, smart technology and energy services, and developing their use of the internet and big data. Innovative energy companies, such as renewable energy producers, and natural gas and hydrogen energy producers, have started to strengthen their position and to develop their lobbying, research, and innovation networks.

Large companies, not necessarily active in the energy sector, are also developing working groups to communicate their position on the energy and sustainability topics, and are proposing new initiatives to redirect their business sectors to more environmental and energy efficient practices. On a smaller scale, many start-ups are developing with an energy efficient and environmentally aware drive. The movement of social and environmentally friendly entrepreneurship is now quite strongly represented. Although it seems that French society is rather passive on the subject of the energy transition, many citizen and business initiatives have developed, especially represented by the younger generations, around 18-30 which have developed many movements to fight poverty, environmental degradation, and climate change.

Many protest actions and movements exist too, which are often very critical of the status quo, such as NGO movements against capitalism, environmental degradation, and market predation. Some examples are the movements against the new airport in Notre Dame des Landes, as well as anti-nuclear movements. Still very critical, but more pragmatic, and less driven by passion is the Negawatt association, which has developed a 100% RES plan for 2050 that is economically, environmentally, and socially sustainable. Overall, the creation of new actors and the re-shaping of existing ones show that France may be undergoing change, even though the result is still difficult to predict, and the time frame remains vague. The French extended energy map is represented in Figure 16 and the overview of the different available discourses is represented in Figure 17.

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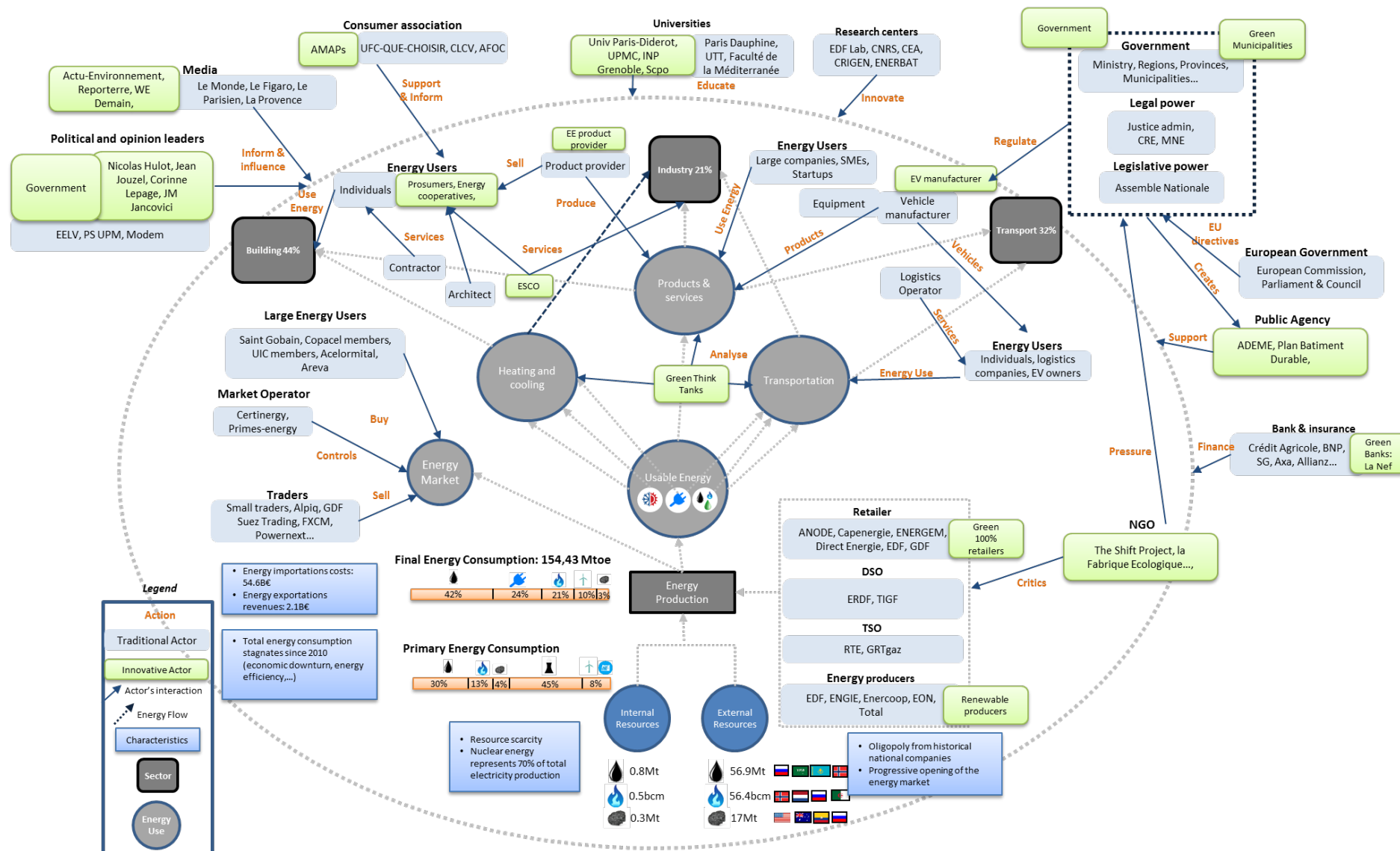


Figure 16: France extended energy system map

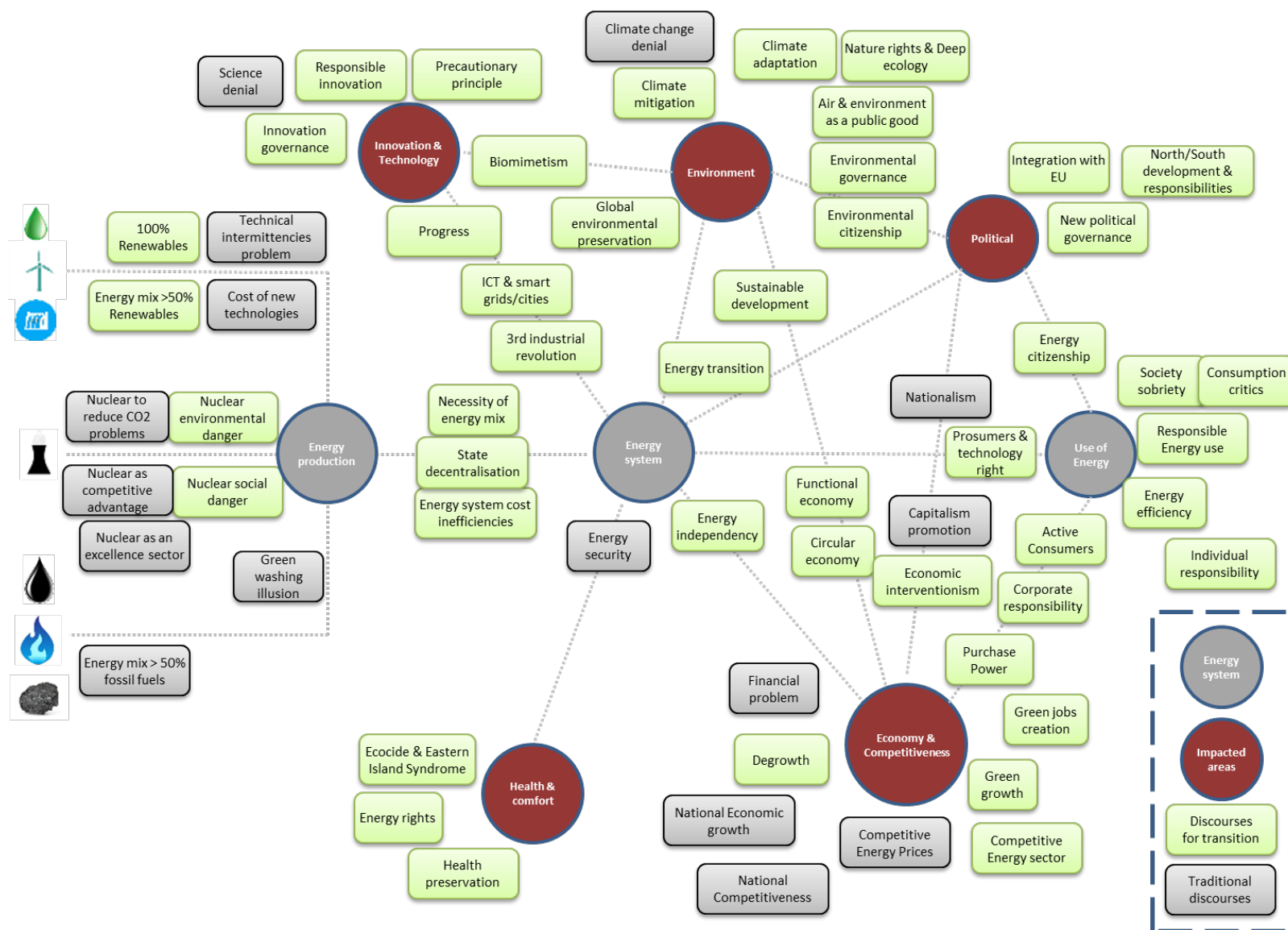


Figure 17: France energy discourse overview

3.4 Spain

3.4.1 Country overview

3.4.1.1 Global overview of the energy sector

Energy history

For the last 40 years, Spain was not able to define a clear long-term energy strategy. The orientation of Spanish national energy plans has been constantly changing, differing from decade to decade.

In the late 1970s, Spain decided that Nuclear Energy would be the solution to reduce its oil dependency. A plan to build 25 new nuclear plants was drafted, but in the end only 10 plants were constructed. In 1982, with the end of the dictatorship, there was a clear commitment to promote national coal production but incentives for coal production were restricted. In the 1990s, in the effort to increase security of supply, natural gas imports were doubled, mainly due to the improvement of the connection with North Africa, and many hydrocarbon and gas treatment plants were constructed. At the beginning of the current century, two technologies emerged, first the gas combined-cycle plants and later on the renewable energies. The boom in renewable energies became a reality, mainly wind and solar, supported by offering substantial incentives using a feed-in-tariffs schema that allowed these technologies to expand. However, in 2008, there was a reduction of incentives for renewables and the RES deployment slowed down.

The total primary energy supply in Spain has steady increased from the 60Mtoe in the 1980 reaching its peak of 140Mtoe in 2008. Afterwards, the effect of the economic crisis brought a decrease in primary energy consumption down to 120Mtoe (International Energy Agency, 2015).

Spain's energy dependency has been constantly reduced during the last decade, from its peak of 82% in 2006 until 70% in 2013; but this value is still very high compared to the EU average. A similar downstream trend has been followed by energy intensity with a peak on 2004 of 162 Toe/M€ of primary energy (117.6Toe/M€ of final energy) reduced down to 131.3 Toe/M€ (92.6 Toe/M€ of final energy) by 2013.

Local energy sources

Spain has a strong dependency on oil, natural gas and coal imports, overall these account for around 70% of total consumption. According to the latest IEA report (International Energy Agency, 2014b), the fossil fuels production figures in Spain are:

- Crude oil production is 0.3 Mt, compared to the 59.1 Mt imported. These imports come mainly from Mexico (15%), Nigeria (14%), Russia (14%) and Saudi Arabia (13%).
- Gas production is nearly negligible, 0.1bcm, against the 29.7bcm imported from Algeria (41.7%), Nigeria (15.5%), Norway (11.7%), Qatar (11.6%) and Peru (7%).
- Coal production is accounted by 3.9Mt, and the coal net imports are 15.1Mt.

Regarding the production of oil products, Spain has a large oil infrastructure devoted to refining and gas treatment, which allows the country to produce 60.8 Mt and to export 2.7Mt of oil products.

On the other hand, Spain has a high renewable potential for generating energy from sources such as wind, solar and hydropower. In 2013, the renewables' share (including wind, solar, biomass, geothermal, biofuels and waste) achieved the 14.1% of the whole primary energy mix (121Mtoe). Specifically, the electricity production reached a 40% of the total electricity production (282TWh). By 2013, wind power capacity was 23 GW, hydropower capacity was 18.5 GW and solar power (photovoltaic + thermoelectric) installed was 4.5 GW (Minetur, 2013, p. 187).

The energy model

The Spanish energy model is based on fossil fuel sources (oil, gas and coal), although almost all of them are imported as there are no local sources. Figure 18 is built based on data from the Spanish Ministry of

Tourism, Education and Energy (Minetur, 2013, p. 37), this figure describes, in percentages, the shares of each primary energy source, counting both national production and imports.

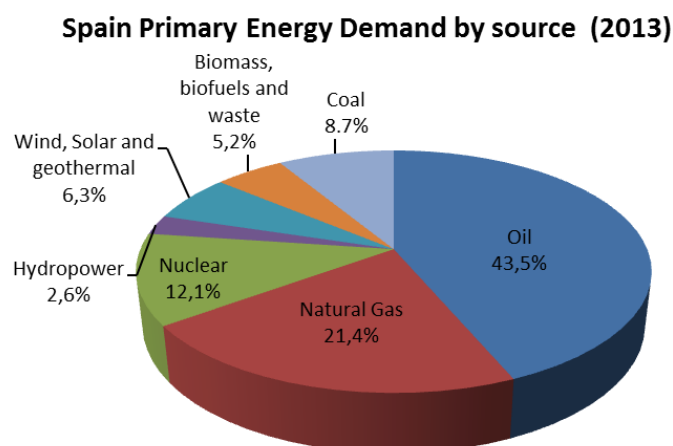


Figure 18: Spain Primary Energy Demand by type of source in 2013 (Spanish Ministry of Tourism, Education and Energy, 2013)

The level of low carbon sources in Spanish electricity production is high when compared to the total primary energy demand. Figure 19, was configured based on data from Red Eléctrica de España: this figure breaks down the shares of each source and technology in 2013, showing that wind, nuclear and hydro power are the three largest technologies generating electricity.

Even though the electricity production share, Spanish electric system has power overcapacity, implying that there are several power plants that are currently working at low capacity or are totally stopped. The case of combined-cycle plants is a clear example. From 2002 to 2011 there were 67 combined cycles plants installed (25,353 MW) with an investment of 13,161M€. However currently turbines are working at only 10% of their capacity; and the electricity produced dropped from 95,000GWh in 2008 to 25,919GWh in 2014 (reduction by 75%). A total of 6GW plants installed are waiting to be dismantled (Roca, 2014).

Spain Electricity Coverage mix (2013)

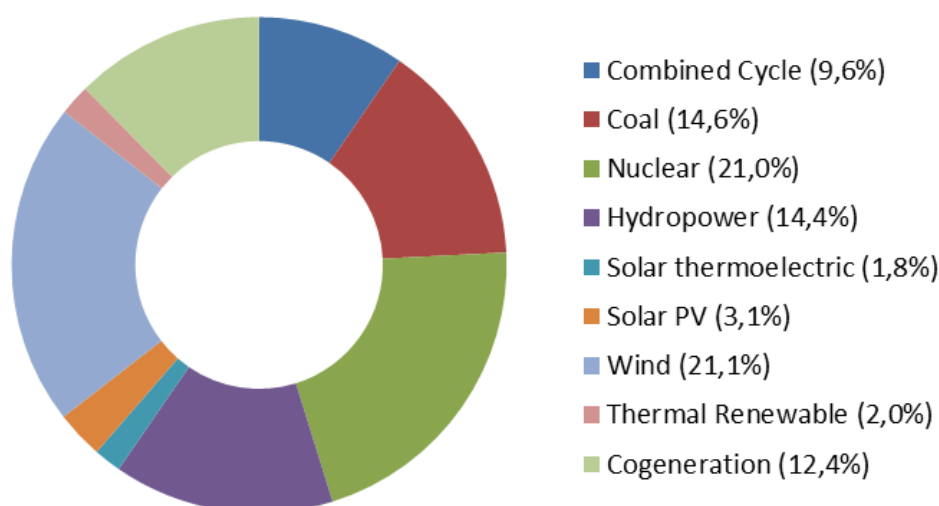


Figure 19: Spain mix for electricity demand in 2013 (Red Eléctrica de España, 2013)

On the consumption side, the final energy consumption in Spain was around 81 Mtoe in 2013, the consumption allocation by source is as follows; oil products represent half of the final energy consumption (50.8%), electricity is almost a quarter (23.4%), then gas with a 17.7% share, renewable energies is 6.2%, and finally coal and coal derived gases, at 1.6% and 0.9% respectively. The large share of the oil products

can be better understood by looking at the consumption by sector, Figure 20, as transportation represent more than a third of the total final consumption (35%) followed by the industry with a 31%.

Total final Consumption by sector, 2013
81 Mtoe

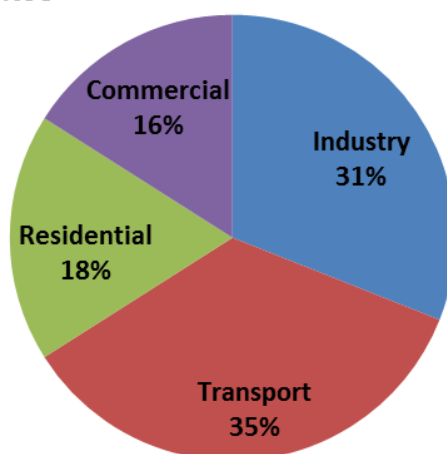


Figure 20: Spain Energy consumption by sector in 2013 (International Energy Agency, 2015)

In comparison to other EU countries' consumption, Spain is the fifth larger consumer with a 7.4% share over all the EU-28 countries in absolute terms, after Germany, France, UK and Italy (Eurostat, 2015). In relative terms, considering the last data available (2009), Spain has final energy consumption per capita of 1.9 Toes/hab, placed below the EU average of 2.2 Toes/hab (European Environment Agency, 2013).

Energy value chain and main actors:

The Spanish energy sector has the following actors: producers, transporters, distributors, traders and consumers; together with the market and system operators (Figure 21). However, from the linearization of energy markets by the end of 1990s, the energy sector in Spain has behaved as an oligopoly, where only a few big companies have the larger share of market, on electric, gas and oil markets. The big five companies on the electricity and gas markets are: Endesa, Gas natural, Iberdrola, Viesgo, EDP. In the oil market a few companies have a large share of the market, those are Repsol, Cepsa, BP, Galp.

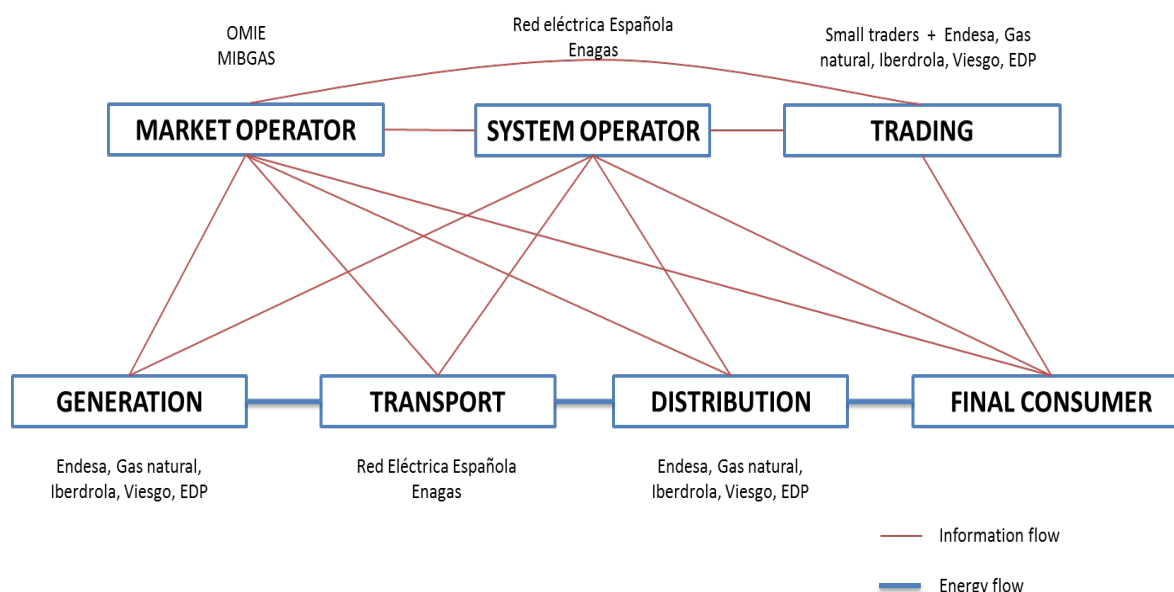


Figure 21: Spain Energy value chain

3.4.1.2 Economics of the energy model

The evolution of the prices of electricity and gas for both industrial and residential consumers over the last 10 years are shown in Figure 22, where the drastic increase in the price of residential electricity can be seen.

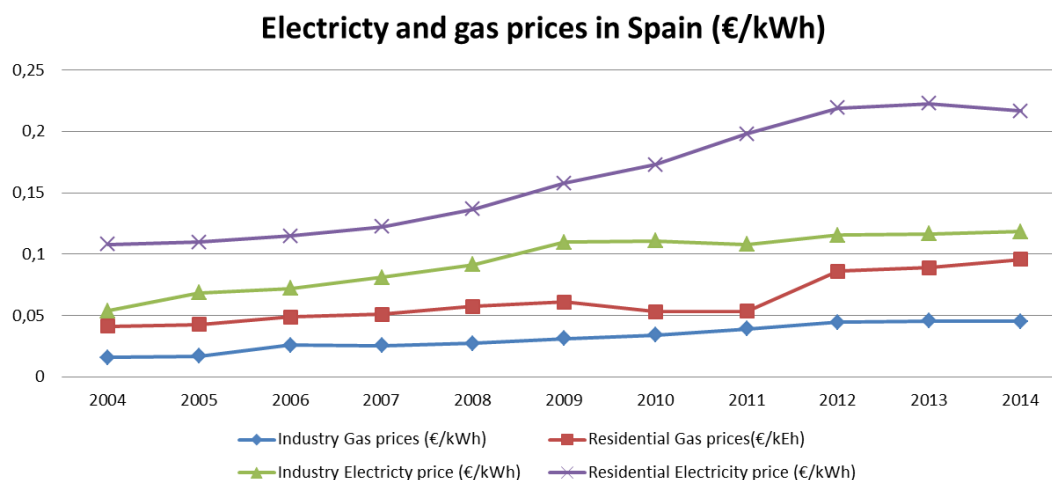


Figure 22: Spain Evolution of gas and electricity prices 2004-14 (European Commission, 2014a)

The energy bills in both electricity and natural gas are divided into three parts:

- Cost of energy production and supply, price per kWh consumed
- Regulated costs, which include network connection costs (transport and distribution) and some other fixed costs, in the case of electricity, the compensation for the renewable energy incentives and the contribution to reduce the deficit-of-tariff (see description below).
- Taxes and levies: The VAT, which is 21% for residential consumers. Other levies, like the regulated electricity tax of 5.11%, are also included in the electricity bill.

The increase on the gas and electric bills in this period is mainly due to the rise in regulated costs, taxes and levies. Comparing the residential electricity and gas bills from 2008 to 2012 (European Commission, 2015, pp. 210-211), the regulated costs and taxes have doubled in this period, becoming more than 50% of the bill. Therefore, is not a coincidence that Spain has one of the highest electricity and gas prices in Europe.

The context for the increase in the regulated costs and taxes on electricity is that the Spanish electric system has a huge accumulated debt, estimated at 25,056M€ in December 2015. The deficit-of-tariff relates to the accumulated difference between the cost of electricity production, recognised by regulatory standards, and the fee paid by consumers. The term, deficit-of-tariff, has been and it is very controversial, as there is no official data available regarding the real cost of electricity generation per technology in Spain since 2008. This lack of data and transparency doesn't help the evaluation of the energy model and the commitment to new and more efficient generation technologies.

In addition to the deficit-of-tariff, the economic energy balance has been increasing over the few last years, reaching a negative balance of 45,696M€ by 2012 which represents 4.4% of Spain's GDP for the same year; this percentage is 1,300 times higher than the EU average. In 2013, Spain's overall commercial balance closed with a 16b€ deficit, without energy costs this balance would be 25b€ positive. This energy dependency on imports puts Spain in a weak position, as any change in the oil or gas price will have an immediate effect on Spain energy provision costs, and will also influence the national GDP (Salas, 2015).

The energy sector in Spain has a direct influence on the national GDP of approximately 3% (assuming 60\$ for the cost of the Brent Oil and almost parity euro-dollar), in absolute terms this accounts for 32,000 M€, generating 75,000 direct jobs. When accounting for the indirect influence on the GDP, this rises up to 5.3 % and total jobs are 420,000 (Club Español de la Energía, 2014, p. 203). The new energy plan, from 2010-2020, focused on energy efficiency and is expected to represent the creation of approximately 360,000 new

jobs by 2020 – in renewable energies, green transport, energy efficiency, the building and construction sector, and waste management (Sustainlabour, 2012, p. 23).

3.4.1.3 Political energy framework and agenda

As an EU Member State, Spain is subject to EU Energy regulations and directives. The actions that need to be taken in Spain should be aligned to the European Energy strategy roadmap: Energy Efficiency Directive 2012/27/EU, the Renewable Energy Directive 2009/28/EC and to the Energy Security strategy and infrastructures. The objectives for 2020 are to reduce greenhouse gas [GHG] emissions by 20%, to improve energy efficiency by 20%, and to increase the share of renewables by 20%, compared to 1990. These objectives are more ambitious for 2030, and involves a 40% reduction of GHG emissions, an improvement of 27% in energy efficiency, and a 27% increase in the share of renewables, compared to 1990.

Nowadays, Spain accounts for two main national action plans on renewable energies and energy efficiency up to 2020:

- The Renewable Energy Plan 2011-2020 (Minetur, 2011): is a less ambitious plan, restricted by the economic incentives given in the previous Renewable Energy Plan 2005-2010.
- The NEEAP 2014-2020 (Minetur, 2014), adapts to the 2012/22/EU Directive, establishes the reduction by 22.5% of primary energy consumption, and by 18.6% regarding final energy consumption, during the period from 2007 to 2020. It is mainly focused on reducing energy consumption and emissions in the transport and building sectors.

Buildings renovation

Improving the performance of buildings is essential in order to reduce their energy needs. Spain has a large amount of old building stock, that is responsible for high energy consumption, which needs to be renovated and upgraded. In that sense the Action Plan for Energy Efficiency 2014-2020 devotes 59.4% of their total 45,985M€ budget to Building and Equipment in programmes such as, Programme for the Energy Renovation of Existing Buildings (PAREER) and RENOVE plan for electrical appliances, boilers, air conditioning, windows, façades and roofs.

The current building regulation, *Código Técnico Edificación* (CTE), establishes that each and every new building has to be designed and built to accomplish a specific energy performance, and a more ambitious target is set by 2020 in which new buildings should be Net Zero Energy Building (NZEB). The *Thermal Installations in Buildings Regulation RITE* was modified by Royal Decree 238/2013, approved on April 5th 2013, which transposes Directive 2010/31/EU in Articles 8, 14 and 15 regulating the heat/cold installations in buildings. The Energy Efficiency Directive transposition in Spain also includes Energy efficiency certification, by the approval of the Royal Decree 235/2013, on April 5th. it was implemented so that each new and old building should have an energy performance certification, mandatory energy audits, and gas and electricity smart meter installation.

Transport

The above mentioned NEEAP 2014-2020 proposes strategic measures to achieve the GHG emission target and reduce oil consumption in transportation. Spain must replace the old transport fleets with low or zero emission vehicles, and also improve its transportation infrastructure, promoting the railway ahead of road transportation. At the public level, initiatives are mainly devoted to improving urban mobility within the Smart Cities framework. To reach the private and particular sectors, some incentive programmes were launched in that direction:

- The Incentive programme for Efficient Vehicle PIVE plan seeks to incentivise low emission cars use, by renovation the current old vehicles fleet.
- The MOVELE plan promotes the acquisition of electric vehicles to reduce both oil dependence and CO₂ emissions in transport.

- “PIMA aire” plan that incentives efficient commercial vehicles, gas powered vehicles and electric bikes.

Energy transition, renewable energies and energy efficiency

The Renewable Energy Plan PER 2005-2010 and the feed-in-tariffs schema produced a boom in the renewable energies sector: solar from 2005 until 2008, and wind between 2007-2011. This favourable environment helped Spain to advance on its renewable energy objectives. However, the high economic impact of the renewable energies incentives during this period ensured that the current Renewable Energy Plan 2011-2020 cut incentives for new installations of renewable energies. Moreover, some other regulations (RD 1/2012, RD 15/2012) were more focused on balancing the energy system economically than on promoting the renewable energies, adding a 7% tax on renewable production, as well as taxing the self-consumption connection to the grid (RD 900/2015).

Energy independence, security and associated risks

Spain’s energy dependency was around 70% in 2013 – a level that is much higher than the EU average. This level of dependency has been reduced over the last decade because the local renewable energy production has increased, and the total energy consumption has decreased. Spain behaves as an “Energy Island” due to the lack of connection with other countries; only a 3% interconnection was achieved by 2015, which is far from EU targets of at least 10% of the installed electricity production capacity by 2020. The Spanish efforts are devoted to improving its electrical interconnection with France, and therefore to Europe, and to being a key actor in the European gas sector, as its connection with north Africa gas could help to diversify the European gas imports. The absence of proper interconnection was reflected in 2012, when Spain produced more electricity than needed and it had to be wasted as it couldn’t be transported to other countries.

3.4.1.4 Societal influences on the energy transition

Spanish society, in general, does not have a good perception of the energy sector as a whole and the actors in it. The energy sector has behaved as an oligopoly, this meant that society was reluctant to participate in the sector, due to the abusive position of the traditional energy companies. As a consequence, in 2014 Spain had the 2nd lowest score on trust in providers, and the 3rd lowest place on overall consumer satisfaction, while it is the Member State with the 2nd highest incidences of problems in the EU (European Commission, 2014, p. 211).

This negative impression was strengthened by the close relationship between the energy companies and the government, as retired politicians generally enter into the administrative councils of large energy producers – this is known as the “revolving door”. Also the high prices and the millionaires’ benefits of the large utilities contrasts with the increase in fuel poverty affecting 10% of the population – more than 1.8 million families in 2013.

In addition to that, the recent lack of support for renewable energies and the liberalisation of the energy market means that the society has a cautious attitude towards the energy sector. The new energy retailers in the market, such as Factor Energia, Holaluz, and Som Energia, are not only offering a 100% renewable energy supply, they also have the task of explaining and fostering the energy transition. They are growing fast, however their market share is still small compared to the traditional energy companies. Also, there is the growth of the Organisation of Consumers and Users (OCU), which supports consumers and their rights, the work of NGOs such as GreenPeace, Energia Justa and WWF, and the existence of the “Plataforma para un Nuevo Modelo Energético” which are having an impact in Spanish society; as well as the numerous renewable energy associations, for instance, Association of Renewable Energy Producers – APPA, which explain the actual situation of renewable energy in Spain.

3.4.2 *Energy system actors and discourses: characterisation and maps*

The main actors in the Spanish energy sector are the Spanish government and the traditional large energy companies, they have been ruling the sector almost at their convenience. However, these last years due to the adaptation to the EU directives, the Spanish Government is more strictly supervised and controlled on the regulation and legislation by an independent entity, the National Commission of Markets and Competence (CNMC). Also, the large traditional energy companies have lost some of their privileges, due to the market liberalization and separation of activities; but they are still powerful as they own the conventional power plants and the distribution network, and they still preserve a large market share. Indeed, Spanish oligopoly can be assimilated to a geographic monopoly, as large companies have geographic areas of influence in the distribution network.

The liberalisation of the energy retail market permitted the appearance of new actors, such as new small and medium RES producers and new energy retailers, which could compete with large utilities by offering more competitive prices and selling energy from renewable sources, and providing some innovative products and services.

The energy transition will require the participation of many actors⁶: the new energy retailers, usually small or medium companies, prosumers and ICT companies with an important role in the energy sector. But the involvement and active participation of the principal actors of the system (government and large traditional energy companies) are the key to triggering this transition. As a remark, the actors in the building and transport sector are called on to actively participate in the energy transition; focusing on green construction (new and refurbishment) to reduce the energy demand, and to integrate RES sources on the buildings. Also, in transport, moving towards low emissions transport, private companies producing electric vehicles, and public authorities, mainly in the large urban areas, promoting green mobility.

Public movements, associations, and NGOs are getting better organised, more adept, and reaching more people – for example, demanding energy poverty support for those families that cannot pay the energy bills; movements or opinion leaders arguing for a new energy model for energy independency based on renewables; RES associations challenging the government policies in the renewable sector.

The extended energy map of Spain is represented in Figure 23 and the overview of the different available discourses is represented in Figure 24.

⁶ Of course the involvement of civil society is key to the energy transitions and one of the key objectives ENTRUST is to expand the idea of the energy system such that individual citizens and communities are recognised as stakeholders and acknowledged as legitimate contributors to the energy domain

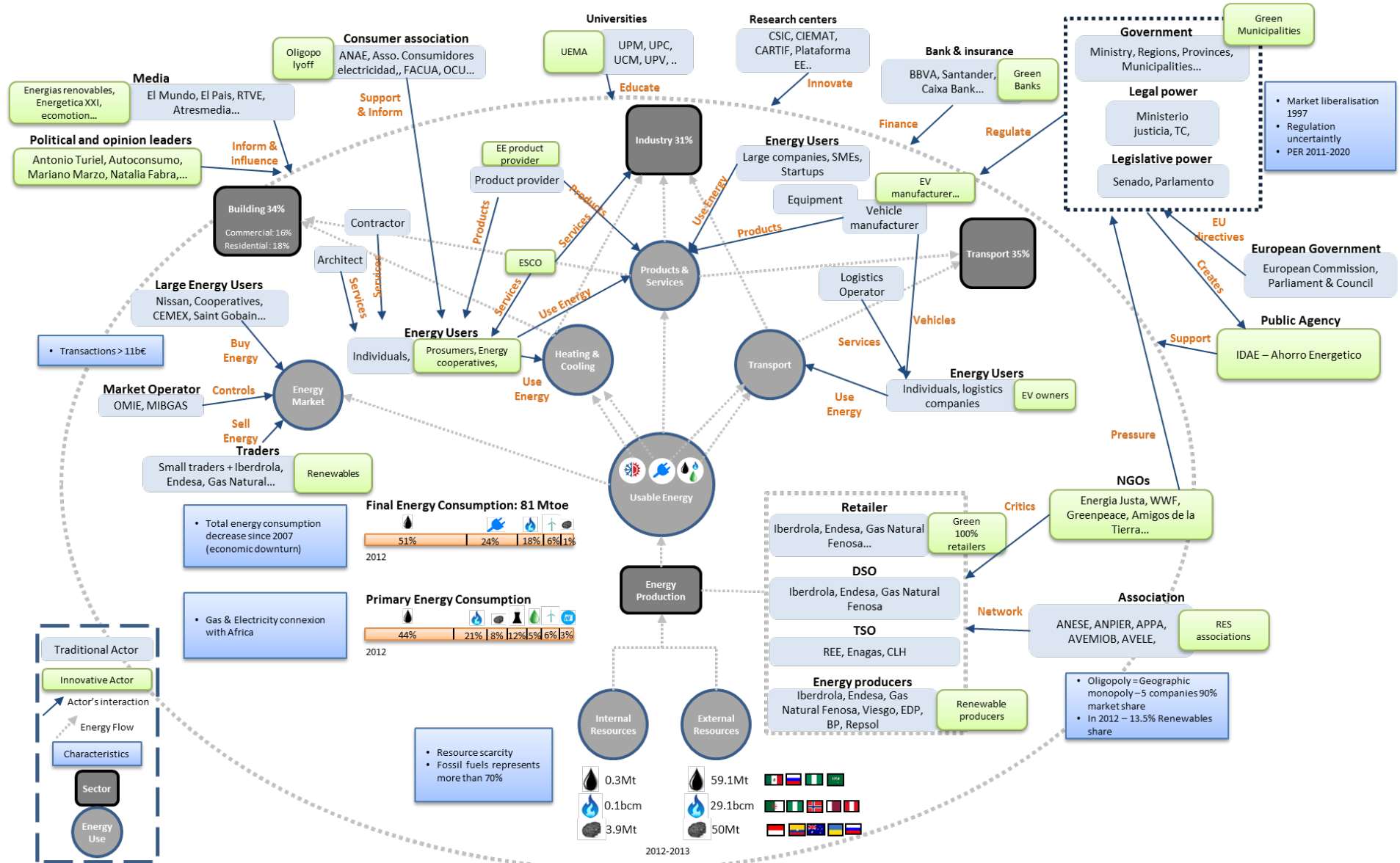


Figure 23: Spain Extended energy system map

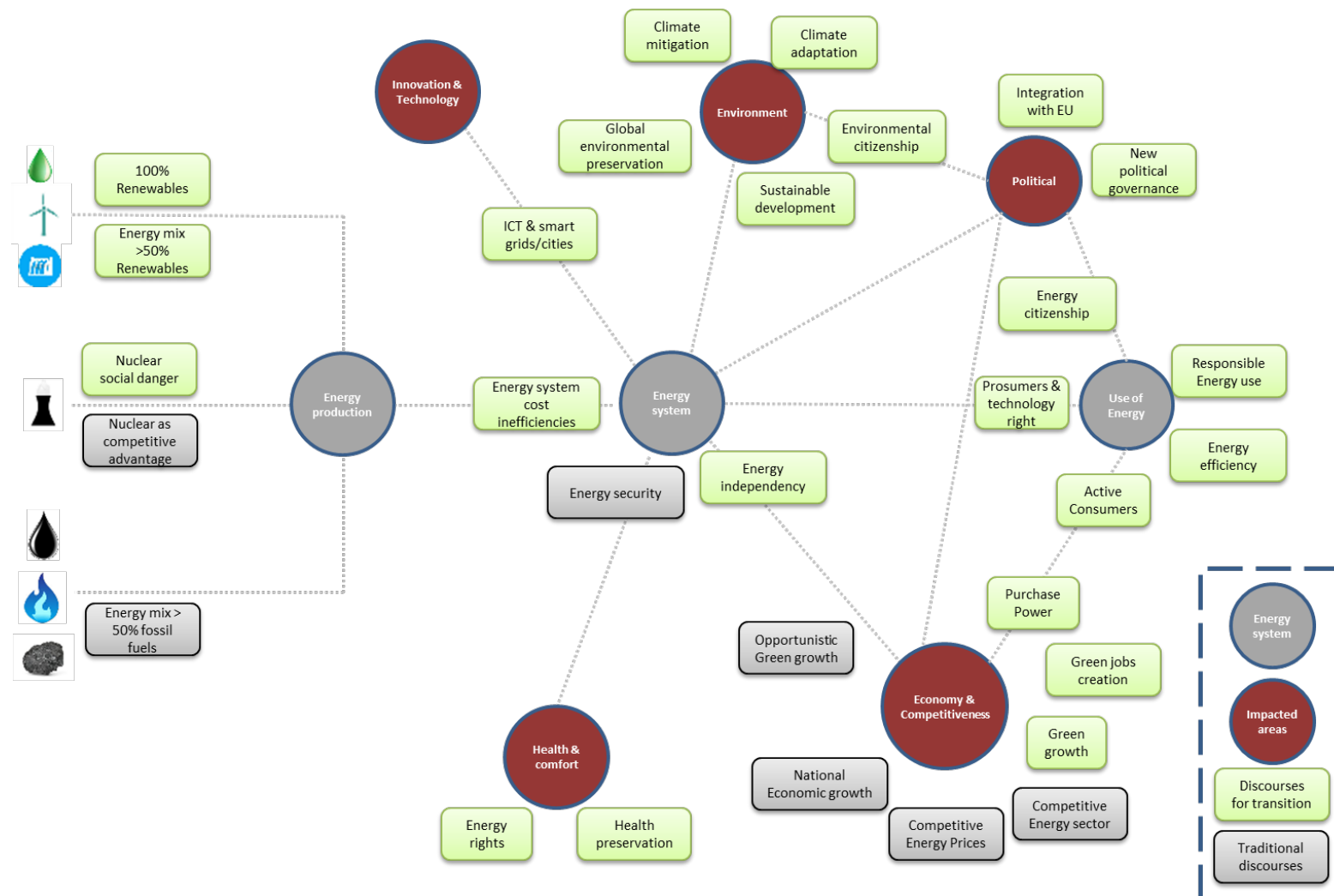


Figure 24: Spain energy discourse overview

3.5 Italy

3.5.1 Country overview

3.5.1.1 Global overview of the energy sector

Energy history

The first electric power plants in Italy were thermoelectric power plants, built at the end of 19th Century, inside big cities. After the development of the national transmission grid, it became possible to make use of the hydroelectric power potential of the Alps, with the construction of several hydroelectric power plants. For a period of time, it seemed possible that Italy could achieve energy independence.

After WWII, it became clear that hydroelectric power was not enough for Italy's growing industrial energy needs so thermal power plants started to be built again due to the low oil price in that period.

Hydroelectric power was almost totally exploited by the 50s and eventually, due to some tragic accidents like the Vajont Disaster, the building of new hydroelectric power plants was halted.

In 1962 the Italian parliament approved the nationalisation of the electrical system, which had previously been managed by private companies, and ENEL (National Company for Electrical Energy) was formed. It was given responsibility for production, import/export, transportation, transformation, distribution and the selling of electrical energy generated from all types of sources. Only private generation was excluded. In the 1960s energy production was growing at a rate of 8% each year, with thermoelectric power plants as the main production technology. This trend was interrupted by the oil crises of 1973 and 1979, which resulted in a first tentative step towards energy production diversification. As a consequence, there was an increase in carbon-based primary energy sources and the importation of energy from foreign states. The main change over those years, though, was the introduction of nuclear energy into the Italian energy system. By 1966 Italy was the third largest nuclear energy producer, after the USA and the UK, and by the end of 1970s nuclear energy was a key component of the national energy plan. However, in 1987, the Italian public was deeply shocked by the Chernobyl nuclear disaster and, with a national referendum, Italian citizens decided to abandon the use of nuclear energy.

Further increases in energy demand during the 1990s pushed the need for energy diversification further, in particular with the replacement of oil with natural gas as an energy source for electricity, and an increase in energy imports, especially from France and Switzerland. In 1999 the electricity market was liberalised again in order to reduce energy costs to consumers, by way of a competitive market. However, this was not successful.

During the last 10 years, due to an increased global awareness of environmental issues, Italy has seen an increase in the use of renewable energy sources, in particular solar and wind energy. In 2008, the reintroduction of nuclear energy was proposed by the national government in order to address the high energy dependence of the country. However, the 2011 Fukushima nuclear accident in Japan, followed by another national referendum, put a definitive end to the re-introduction of nuclear energy in the Italian energy system for the near future.

Local energy sources

Italy is characterised by a strong dependency on energy imports. In 2014, Italy imported 73.6% of its total energy, a small reduction from 74.7% on the previous year. In particular, oil produced in Italy accounted for only the 10% of the total demand of 57.3 Mtoe, with 90% imported. Similar results are obtained for natural gas, with only 9% of the total demand produced in Italy. Renewable energies are already the main source of energy production within Italy with its application divided into heating (50% of total consumption of RES), electricity (45%) and transport (5%). The main source of electrical energy production from RES is

hydroelectric energy (47-48%), followed by solar (19-20%), bioenergies (14%), wind (13%) and geothermal (5%) (International Energy Agency, 2014a).

In 2013, heating from RES accounted for 18% of the total heat consumption in Italy, equivalent to 10.6 Mtoe. Specifically, 9.8 Mtoe has been used for direct heating, while 0.8 Mtoe was used for cogeneration. The great majority of energy is provided by solid biomass (7.8 Mtoe), used especially for domestic heating in the form of wood chip or wood pellets. Also relevant is the contribution of heat pumps (more than 2.5 Mtoe), while geothermal and solar installations remain limited. Regarding transport, 90-95% of biofuel introduced into the Italian market consists of biodiesel.

The energy model

At the international level, 2014 has seen a strong decrease in oil costs (by 50%) and gas costs, while the importance of renewables in the energy mix has kept on growing. In this context, Italy is progressing well in its transition to a low carbon energy system, achieving higher efficiencies and becoming less dependent on imports. Renewable energies are the primary source of indigenous electricity production, with 43% of the national share, and already represent 16.7% of total energy consumption – only 0.3% under the 2020 European target.

Total energy consumption has kept on decreasing (-3.8%), reaching its lowest level over the last 18 years. Only in 2010 was an increase in consumption registered, due to the anti-crisis policies introduced in that year. The decrease in consumption is only partly explained by the reduction in GNP (-3.8%), it is also due to an improved energy efficiency which has registered an increase in 2013 of 13.4% with respect to 1990 (eniscuola, 2014).

Efficiency improvement is a key part of the Italian energy strategy. With the definition of the Plan of Action for Energy Efficiency (Piano d'Azione per l'Efficienza Energetica – PAEE), Italy has the objective of removing the barriers that slow down the spread of energy efficiency, both at national and regional levels.

An analysis of Italian energy consumption by source shows that, from 2000 to 2013, a strong reduction in oil and gas consumption has occurred, while solid fuels and electrical energy have remained almost constant. The only source of energy that has increased, despite the economic crisis, is renewable energy.

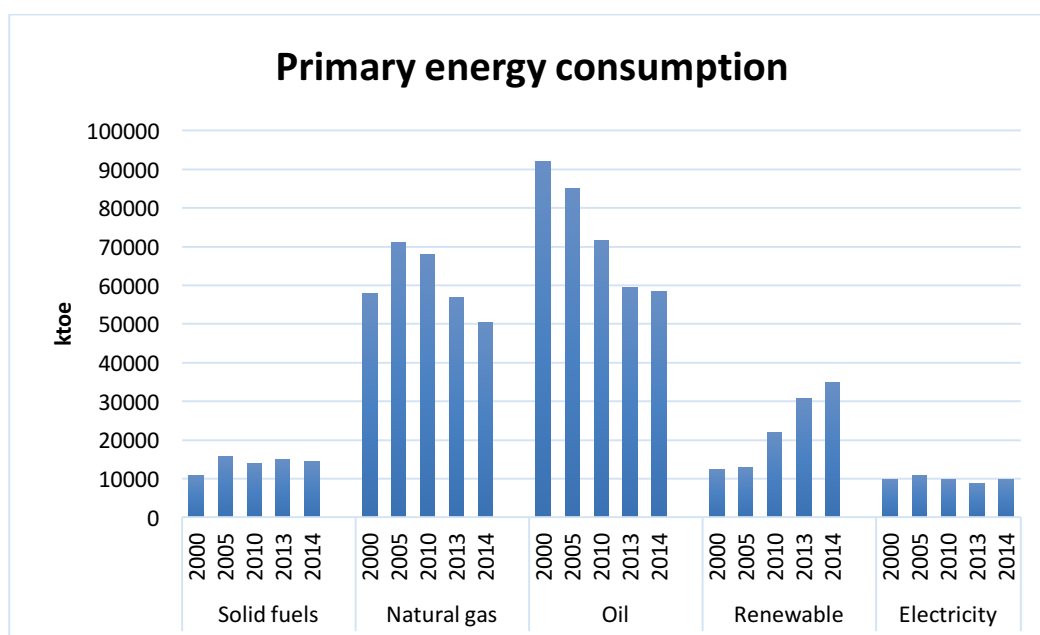


Figure 25: Italy primary energy consumption by source, 2000-13 (eniscuola, 2014)

Even though they are increasing their presence in the energy mix, renewable energy sources (RES) still have a marginal role in the Italian energy system and is confined almost entirely to electricity production. It is important to note that in 2013, for the first time, RES have exceeded natural gas in contributing to electricity production. Considering the energy consumption by sector, a reduction in the final energy consumption has occurred across all economic sectors and has been particularly significant in industry. This is due to the economic crisis of 2008 that caused the bankruptcy of many companies, with the consequent reduction in industrial energy demand. The building sector saw a reduction of consumption in 2014, mainly due to the warm winter and cool summer that occurred in 2014, but it still remains the main consumer of energy.

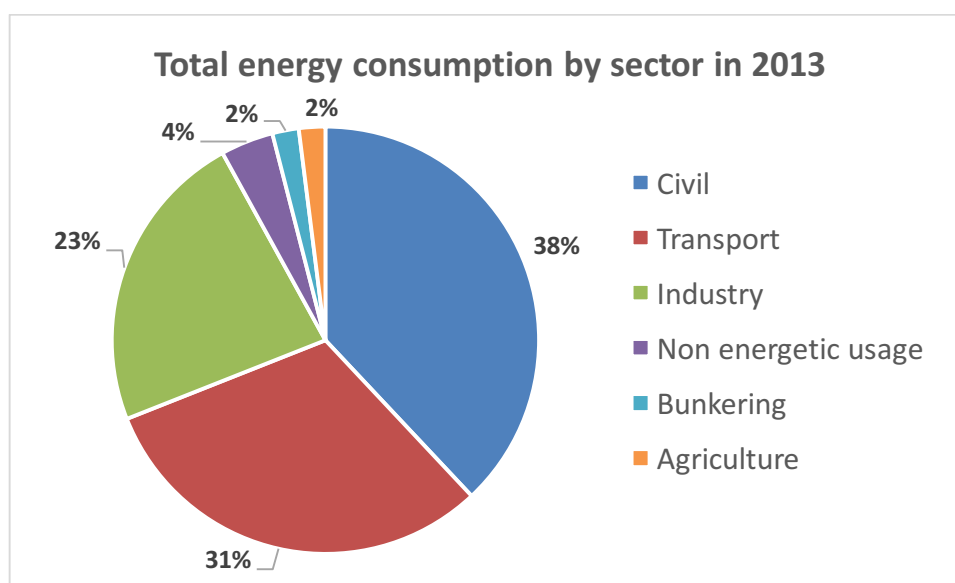


Figure 26: Total energy consumption by sector 2013, Italy (eniscuola, 2014)

3.5.1.2 Economics of the energy model

The Italian energy market is one of the most important in Europe. Italy is number 4 in the European electricity market and number 3 in the gas market rankings.

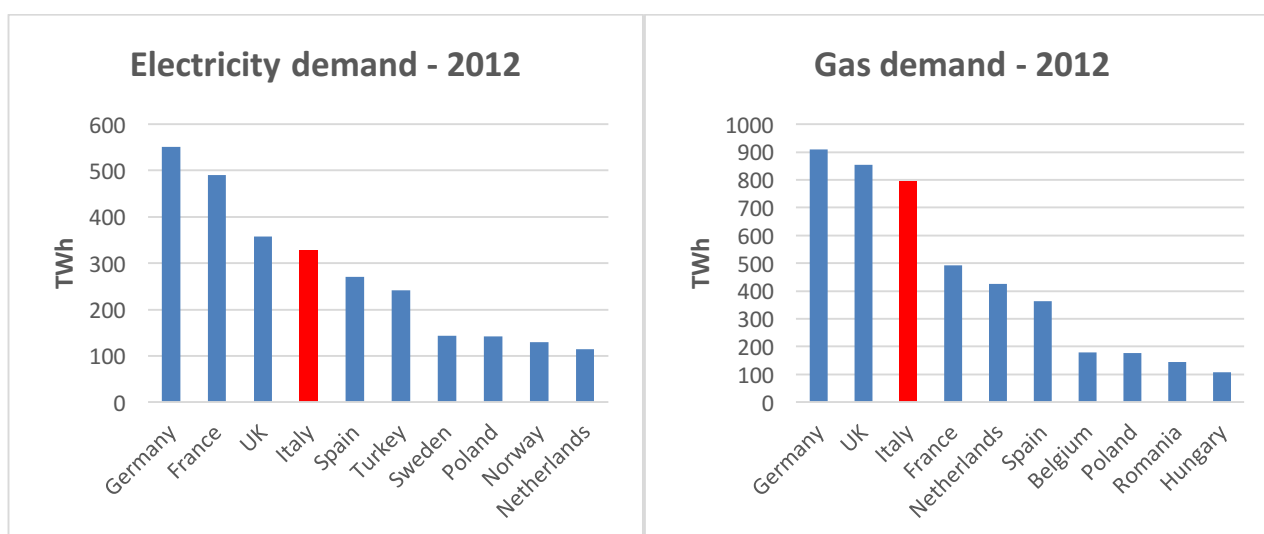


Figure 27: European electricity and gas demand ranking (top 10) in 2012

In 1999 the approval of the “Bersani Decree” started to liberalise the retail market in Italy. Today, the Italian power market is fairly dispersed, with Enel, the old monopoly company, maintaining a dominating

position in the electricity generation market (25% production in 2013). Other relevant companies are, in order of significance, Eni (9.5%), Edison (7.2%), E.On (4.4%) and a vast number of other minor producers. Electricity transmission is almost entirely operated by Terna, a state-owned company. Distribution, despite the existence of more than 133 local operators, sees Enel operating 86% of the network. Energy prices in Italy are among the highest in Europe due to a high level of taxation that, for every energy unit, is 68% above the EU average and second only to Denmark (Eurostat, 2015b). Together with the UK, Italy is the only European country where power exchange prices have not seen a convergence over the 2011-2014 period. This is mostly due to the high dependence in the Italian energy mix on natural gas.

For residential users, electricity bills have increased consistently between 2010 and 2012, reaching in 2014 a price 34% higher than the European average. This tendency is mainly driven by grid costs and increasing taxes to support the development of renewable energies, together with the promotion of new efficiency measures. For industrial users, the rise of energy costs translates into a market loss for competitiveness. As an example, for a mid-sized industrial company with similar facilities Italy will charge €200/MWh against €75/MWh in Finland (Eurostat, 2015b).

The energy sector affects Italy's global competitiveness because of some structural weaknesses:

- Energy prices are among the highest in Europe, due to the Italian energy mix relying on gas (less polluting but more expensive than coal) and to financing for renewable energies.
- Italian dependence on imports. In 2012, 82% of national demand was met by imports with national production accounting for only 19% (renewables 11.1%, gas 4.3% and oil 3.5%)
- However, the Italian energy system does have some strong points.
- The energy intensity level is one of the lowest in Europe due not only to the economic crisis, but also to the adoption of numerous energy efficiency measures. Thanks to this effort Italy was placed third in 2011 by The America Council for an Energy-Efficient Economy (ACEEE).
- Italy has also promoted several programs for technological advancement over the last few years, pushing for solutions such as smart metering and the installation of one of the world's most efficient combined cycle gas turbines parks.

3.5.1.3 Political energy framework and agenda

To date, Italy has implemented several policy measures to reach its 2020 targets regarding efficiency, renewables and greenhouse gas emissions. Due to the economic crisis, many objectives have already been met, but it is still not clear whether future growth in the economy could reverse this trend.

The National Energy Strategy (Strategia Energetica Nazionale – SEN), adopted in 2013, defined four main objectives to achieve a more competitive and sustainable energy system by 2020:

- To align energy prices with European average
- To meet and go beyond European 2020 targets
- To improve supply security, with a reduction of energy import from 84% to 67%
- Generate growth and employment with investments both in traditional sectors and in the green economy.

Efficiency is a key parameter in order to achieve all four SEN objectives. Italy has two main energy efficiency targets:

- A final energy consumption of 126 Mtoe in 2020
- Minimum energy savings of 15.5 Mtoe by 2020, with respect to 2011

Total energy consumption in 2012 was 119 Mtoe and has decreased further in 2014, meaning Italy has already reached and exceeded its 2020 target. However, an expected economic growth over the next few years could increase energy consumption again.

Regarding the saving targets, in 2013 Italy has reached 20.6% of its final 2020 objective, however, success has been uneven across sectors; both the residential and industrial sectors are in line with the targets, but the tertiary and transport sectors have achieved savings that are below expectations.

The Energy Efficiency National Action Plan (Piano d'Azione Italiano per l'Efficienza Energetica – PAEE) has set concrete measures to reverse this negative trend, such as setting minimum energy performance, especially for transport and construction, developing a compulsory energy efficiency scheme based on “white certificates”, and introducing financing support to incentivise project designs that increase energy efficiency in buildings.

Despite the recent economic crisis, Italy foresees a leadership role in the path towards European 2050 Energy Roadmap, with a carbon reduction objective of 80-95% with respect to 1990 levels. Italy remains vague, though, on how those targets will be met, primarily placing confidence in Europe's capacity to design a proper roadmap which will take into account future market and technological developments.

The SEN anticipates an energy mix, by 2030, where a minimum of 29% of final energy will be produced by renewables. Solar plays an important role in this path, having, according to ENEA (National agency for new technologies, energy and sustainable development), the greatest development potential among renewables in the Italian territory.

In the short term, Italy has no choice but to continue to rely on imports and it has projects already in progress to connect Italy's grid with neighbouring countries. The aim is to adapt and expand the Italian grid, connecting it with renewable energy exporting countries in order to diversify the sources of supply, now dominated by gas and nuclear, and to become an important energy hub for Europe.

3.5.1.4 Societal influences on the energy transition

Recent research carried out by the Institute of statistics (Istituto di statistica – Ispo) shows that renewable energies and green policies have strong support among Italian citizens. In particular, 3 out of 5 people think that renewables have the same efficiency as traditional energy sources, with 80% in favour of solar energy. This leaning towards solar is largely based on the perception that it is a clean energy with low impact on the landscape (81% of the interviewed people) and the fact that 89% of Italians see renewable energy as a sign of a country evolving in the right direction.

A high percentage of Italians (87%) are interested in the possibility of micro-generation and the self-production of energy offered by renewables.

These results depict a positive attitude towards the further development, and integration, of renewables into the energy mix, and an increased awareness on climate issues. However, only 19% of those interviewed believe that Italian efforts towards a greener energy system are on the same level as other European countries, while 66% perceive it as lower.

This negative attitude towards their government, even though Italy is doing well in achieving its 2020 objectives (and has already met some) is highly evident in Italian citizens, especially in this period of crisis. This may be a strong barrier to a real change in people's behaviour, which is fundamental for a renovated energy system.

One of many aspects that Italian citizens contest with the government is the price of electricity which is one of the highest in Europe. Regarding how well Italian citizens understand their bills, 54% pay attention to invoices regularly – they care about energy issues and how they spend their money – but only 1.8% can fully understand the bill. What generates the most confusion is the great number of taxes on energy (D'Arcangelo & Pontoni, 2013).

In particular, part of the electricity bill is due to the financing of renewable energy, which in Italy is paid by the citizens. It is significant that more than half of the citizens (54%) are not aware of this tax, and 90% of the people who know about it, underestimate its impact on the bill.

Another example of inefficiencies in information and support is related to fuel poverty, which in Italy affects over 3 million people (1 million families). In order to counteract this growing phenomenon, the Italian Government has decided to provide financial help for people with annual incomes below the Equivalent Economic Situation Indicator (Indicatore della Situazione Economica Equivalente – ISEE) defined limit. It is significant that, among the people having the right to receive the financial support, only 34% of those who qualified for electricity supports, and 27% who qualified for gas supports, actually received it; and that since 2008, the year when this financing started, these percentages have decreased every year. This denotes significant problems in the application process, with slow and over-complex application procedures that discourage, especially less educated, people.

Overall, all those aspects determine the need for more precise information to be disseminated in Italy, in order to give citizens all the tools that they need to understand and evaluate the energy system and cooperate in its sustainable transition. Social acceptance should not be underestimated as an important factor for the energy transition, since new technologies are more prone to generating opposition from people when they are not fully aware of the all the costs, benefits, and consequences.

3.5.2 *Energy system actors and discourses: characterisation and maps*

Centralised power management is prevalent in the Italian energy system. Governmental institutions like the Ministry of Economic Development, the Ministry of the Economy and Finance, and the Ministry of the Environment, define the guidelines of the national energy strategy; while little power is given to the Regions beyond the application of those rules, and so the capacity for decision making at local level is small. GSE and GME are the regulators for the energy market, while the Single Buyer (Acquirente Unico) is the body responsible for the electricity supply to the regulated market.

Concerning the energy supply chain, two main actors prevail in the production and distribution phase: Enel for electricity and Eni for oil and gas. The transportation of electricity is almost totally in the control of Terna – responsible for 98% of the total grid; while Snam is the main operator for the transportation of gas. The liberalisation of the energy market, together with the rapid increase in renewable energies, has contributed to the development of numerous smaller companies, which try to specialise in specific sectors, especially relating to renewable energy production, as they are not able to compete on the same level with Enel or Eni. Enel and Eni are also investing in the renewable energy sector in order to differentiate their areas of competence, increase their market, and maintain a good image as innovators and as green companies in the wider public opinion.

Italy ranks well in Europe with regard to energy efficiency measures, and this is reflected in the increased importance of companies and associations working in this sector. Certification centres like Rina or Certiquality have become an integral part of building construction and retrofitting, especially since the implementation of the new decrees of June 2015. ESCOs like Assoesco are increasing their work offering professional support and the promotion of energy efficiency.

This summer, Pope Francis, the first time in history for any pope, gave an encyclical on the environment, affirming that fossil fuel technologies have to gradually disappear, for the health of the planet and a more fair distribution of wealth internationally. Taking a clear position in support of green energy is an important step for the Catholic Church.

Online media and magazines are also gaining a growing importance in the dialogue on energy. Technological advancement has made online journals more accessible, and energy has become a central topic of discussion in political life. Online specialist energy magazines have emerged and gained in popularity, such as LifeGate, Nuova Energia or Quotidiano Energia; meanwhile popular journals now have

an online version, and these usually have a section dedicated to energy news. At the same time, thanks also to social media like Facebook, which have given people the opportunity to create groups online to discuss and give more voice to their opinions, many national or local citizens groups are emerging. This phenomenon has assumed particular relevance for small local groups, which can now gain rapid wide support, even from people from a different geographical area. The extended energy system map for Italy is presented in Figure 28 and the overview of its different available discourses is represented in Figure 29.



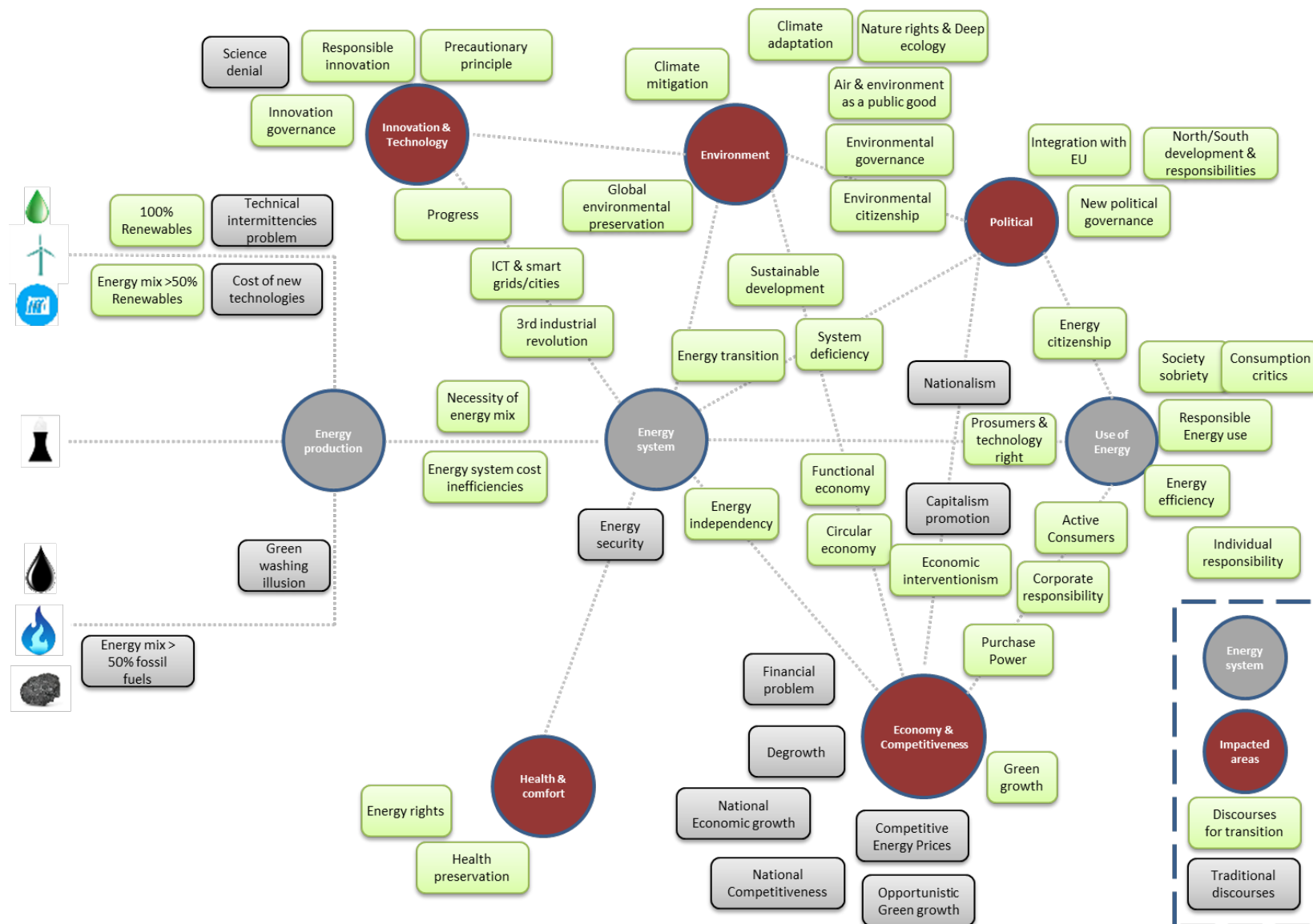


Figure 29: Italy energy discourses overview

3.6 Germany

3.6.1 Country overview

3.6.1.1 Global overview of the energy sector

Energy history

Post-war: the coal period

During the post-war period, the administrative and political division between West Germany (BRD) and East Germany (DDR) affected diverse fields from politics to the economy, from society to everyday life, including the evolution of the energy model. Since 1949, these two German states were integrated into different geopolitical World blocks, which deeply influenced their decision making on social organisation, including the type of energy market model, and which resources to use for productive activities.

Referring to DDR, the major source of fossil fuel was brown coal, or lignite, and it was burned in large amounts in the post-war period, thus resulting in huge pollution problems in the following decades; at the beginning of the 1980s, 80% of DDR surface water was designated as 'polluted' or 'heavily polluted'. During that period, the CO₂ emissions per capita in DDR were twice that in BRD, and the situation deteriorated with the reduction of Soviet oil supplies in 1981.

The nuclear era

The general dependency on fossil fuels, and the consequently high greenhouse gas emissions, was reduced by the nuclear programme of the both German states in the 1960s. In 1961, the first experimental nuclear power plant was commissioned, and in 1966 Germany produced its first MWh from this energy source. Other plants were built thereafter and the German nuclear era started. At the start of the nuclear era, when the long-term availability of coal seemed to be questionable, nuclear power had a great consensus (politics, media, scientists, etc.), because it represented the science-based solution to the incoming energy problem for the country. In addition, the oil crisis in the following decade pushed Germany to use nuclear power. In October 1973 the Arab member countries of the Organization of the Petroleum Exporting Countries (OPEC) decided to impose an embargo on States that supported Israel, as the Western-block countries did.

At the peak of the nuclear era, Germany generated about 30% of its electricity from nuclear power; this percentage share has since decreased, due to the crises affecting the nuclear power industry in the recent decades. These crises concerned: the underestimation of the construction costs of nuclear plants in the early phase of nuclear era; the overestimation of the lifetime of nuclear power plants; and the public pressure on the government after the Chernobyl nuclear disaster in 1986. All of these factors resulted in a decrease of the nuclear power share to 22% in 2010, down to 18% today. In 2000, the government and the German nuclear power industry agreed to phase out all nuclear power plants by 2021. In September 2010, Merkel's government reached a deal which would see the country's 17 nuclear plants run, on average, 12 years longer than planned, with some remaining in production until well into the 2030s. Then, following Fukushima Daiichi nuclear disaster, the government reconsider nuclear power again, deciding to proceed with the plan to close all nuclear plants in the country by 2022.

Renewables and efficiency

All of these recent events pushed the German government, industry and society to strongly concentrate on renewable energy sources such as wind, hydraulic energy, biomasses, biofuels, photovoltaic, solar thermal etc. In particular, the German Renewable energy Act (2000) provides investment protection for the renewable energy producers by holding the energy prices stable for 20 years, with a progressive decreasing of the prices themselves. Furthermore, it imposes extra taxation on the non-renewable energies. Moreover, the government has issued the Energiewende (2010), the new programme concerning

renewable sources and energy efficiency that proposes to reduce greenhouse gas emissions by 80-95%, to consume 60% of energy from renewable sources, and to improve the energy efficiency by 50% by 2050.

Local energy sources

Germany is one of the largest energy consumers in the world, both for the household sector (heating, electricity) and for industrial activities.

Germany is able to produce a significant share (26% in 2014) of its total energy consumption from renewable sources, by using raw materials or natural sources like biomass, wind, solar energy, and water energy. This makes Germany only partly independent from the import of raw materials in the field of energy production, because the country has little indigenous reserves of non-renewable energy sources such as coal, oil, natural gas. The proven oil reserves present in the German territory are very low (276 millions of barrels, against, e.g., 30 billions of barrels in USA and 6.9 billion in Norway), thus making Germany strongly dependent on importing oil from abroad.

Dependency on natural gas is also high: Germany has relatively large amounts of natural gas (175.6 billion m³ in 2010, 4th highest in the EU), but significantly less than big exporter countries (e.g., 32.6 trillion m³ for Russia). The large amount of gas consumption in Germany (79 billion m³ per year) makes the country heavily dependent on imports for gas too, as its reserves would be depleted in two years if it didn't import gas from abroad.

In contrast to other hydrocarbon sources, Germany can extract a large amount of coal from its own territory. With proven reserves of 40.7 billion tons (4.7% of total World reserves), the country produces about 200 million tons per year, which would give the country an adequate long-term supply, if Germany were to use all the coal it has in its reserves. With regard to nuclear power, the known uranium reserves in Germany were totally depleted in 2008, so the country is forced to import all the needed raw material for nuclear power plants.

The energy model

As previously mentioned, the German government is supporting the production and consumption of renewable energies over the use of hydrocarbons and nuclear power. The result of this policy is an increasing share of renewable power for internal generation, which in 2014 reached 26%. The main natural resource exploited is wind energy (9.1%), followed by biomass (7%), photovoltaic (5.7%) and water (hydro) (3.3%). As shown in Figure 30, Germany still has huge production of energy from non-renewable sources, even if their share is progressively decreasing because of the government's decisions.

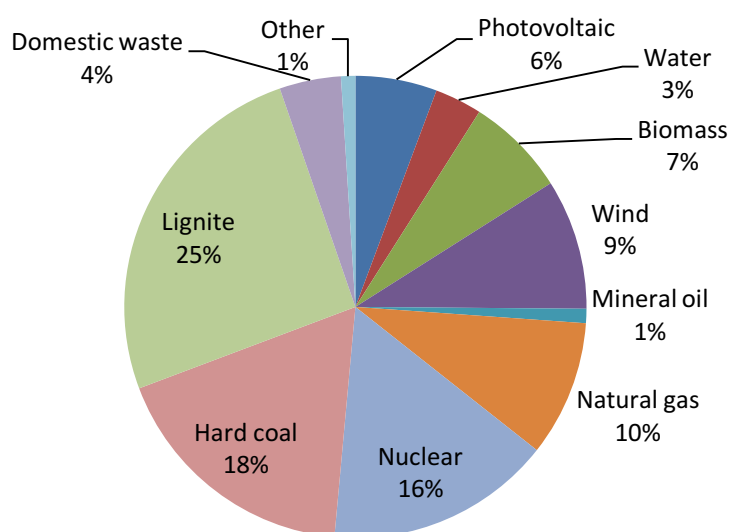


Figure 30: Germany electricity production by energy sources, 2014 (European Nuclear Society, 2014)

The total amount of electric power generation in Germany was 639.6 billion kWh in 2014. Particularly interesting is the trend of nuclear power production since it appeared in 1961. It increased until 2000, and it is now decreasing due to the government's nuclear power decommissioning. (European Nuclear Society, 2014)

With a total energy consumption of 3,822 kg of oil equivalent per person (2012), multiplied by approximately 80 million inhabitants, Germany is one of the largest energy consumers in the World. The main sectors of consumption are households (electricity, heating and cooling, hot water), industry (production machines, electricity for offices, heating), and other economic activities such as services and transport. Figure 31 shows the almost equal shares of oil equivalent consumption in industry, households and transport sectors, and a lower share of consumption for services and trade.

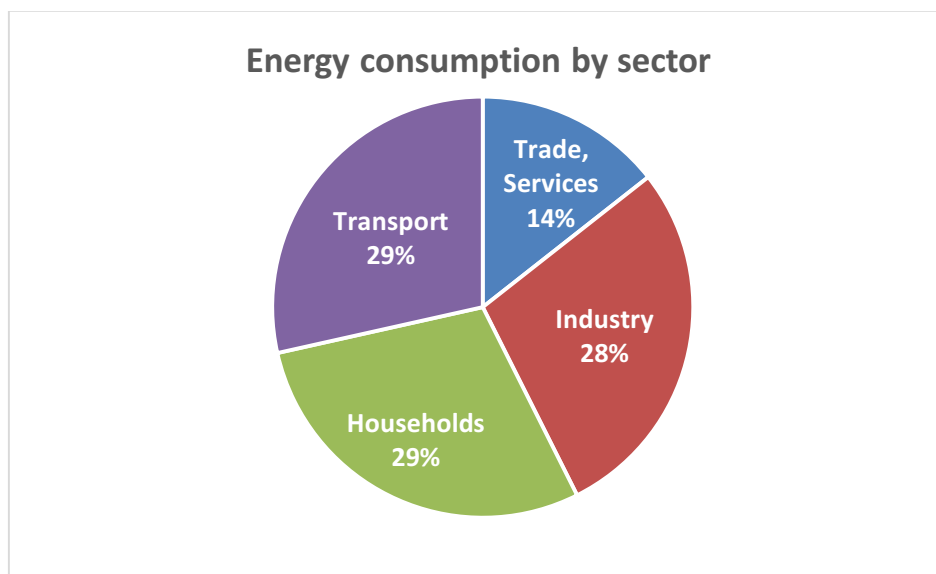


Figure 31: Germany energy consumption by sector (Federal Ministry for Economic Affairs and Energy, 2015)

When compared to the other EU Member States (MS) and to the average values of the EU, Germany is the largest energy consumer in absolute, but not per capita, terms. Regarding its energy consumption per capita, Germany lies in the high-middle values in comparison to the other EU countries.

The substantially stable energy consumption in the household sector in the 1990-2007 period in Germany, with a small percentage increase for electricity, is also interesting – particularly when compared to the increase in other EU countries. In the same period, the industry sector had a decrease in energy demand (European Environment Agency, 2015)

All of these changes in energy production and consumption are led by the German government, mainly by means of reforms and new laws produced by the Federal Ministry for Economic Affairs and Energy. This Ministry plays the primary role in the decision-making about the energy model in Germany, and takes both environmental sustainability and economic efficiency into consideration. In particular, its internal Federal Network Agency (BNetzA) is an independent federal authority for energy, telecommunications, mail and railways, and has responsibility for the energy market, network tax approval, removal of obstacles to network access, and connections for new plants and network expansion.

Also, many agencies and associations are collaborating with the government and the 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).

3.6.1.2 Economics of the energy model

More than half of the energy price paid by households and SMEs in Germany consists of components determined by the State. These include charges for using power grids (20%), levies for other services and for financing investment in renewable energy (30%), and two kinds of taxes (25%). The energy price and the supplier's margin (25%) are set by market arrangements. Commercial and industrial customers are exempt from some components of the energy price. Each of these components can vary based on the government's decisions and energy market reforms, resulting in a final energy price that varies greatly over time. Generally, the high taxation on energy distribution and supply imposed by the government makes the German private customers pay higher prices for energy than the rest of Europe. In fact, in 2014, the average domestic energy price was 0.2971€/kWh, against the EU average of 0.2001€/kWh. When compared to the historical data since 1998 (Figure 32), it is clear that production costs did not increase much year by year, while taxation and surcharge levies caused the final price to increase.

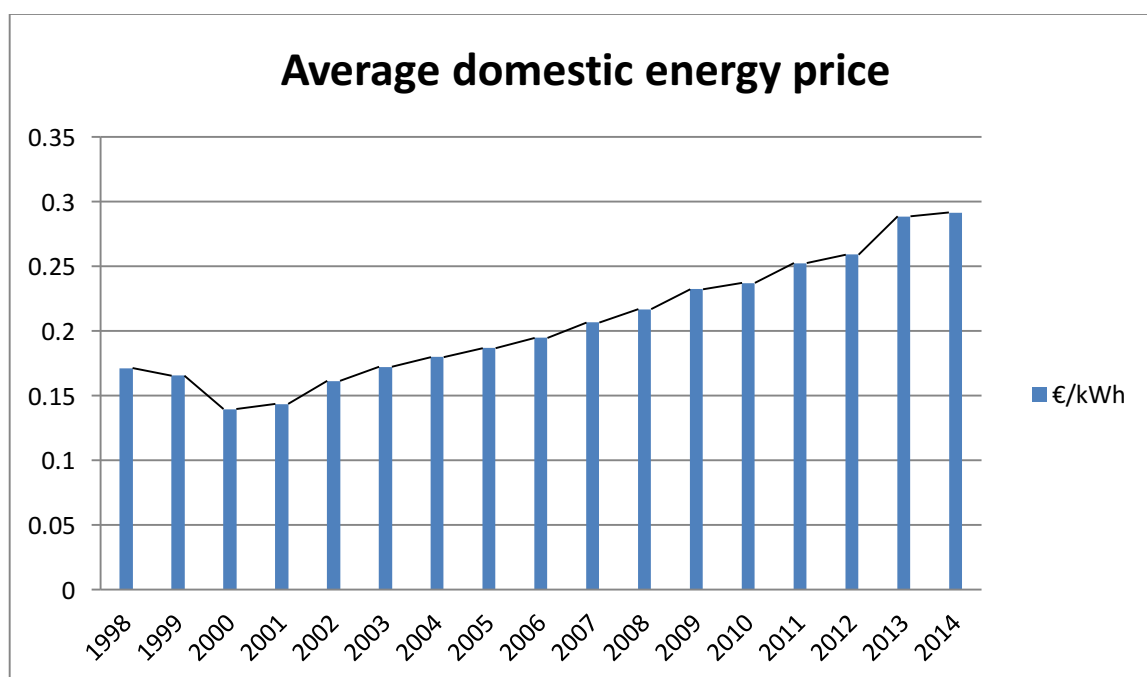


Figure 32: Germany price trend for domestic consumers (European Environment Agency, 2015b)

Energy prices are also affected by the EEG (Renewable Energy Act), which is holding prices of energy from renewable sources stable, in order to protect renewable investors, with a future progressive decreasing of the prices themselves. Another effect of the EEG is an added taxation on non-renewable energies, imposed by the government to discourage the use of these kinds of sources. These measures taken by German government are manipulating the energy market currently, with the result that it is not a completely free market.

While the German government is pushing to decommission their own nuclear plants, Germany is still buying cheap nuclear energy from France, re-selling part of it to Netherlands and (via Austria and Switzerland) to Italy.

Of course, energy is not only a tool for domestic use or for industrial production and services, but also represents an economic activity in itself. In recent years, many companies have been investing money into renewable energies (€16.09 billion in 2013, equal to 0.6% of GDP), in order to manufacture and install new facilities. About 230,000 people were employed in renewable energy facilities manufacturing, installation, and exports in 2013, while another 63,500 people worked in the operation or maintenance of existing

facilities. Lastly, publicly funded research and development of new renewable energy employs more than 8,300 people.

It is estimated that the employment attributable to the effects of the Renewable Energy Sources Act (EEG) totalled 261,500 jobs in 2013, making unemployment reach an all-time low since reunification in 1990. Referring to the non-renewable energy market since the introduction of EEG, a relatively slow decrease in employment in this field was registered, at around 150,000 jobs in the last period. EEG is radically changing the landscape of the energy market in Germany, by creating new business opportunities for companies focusing on research and development in the renewable energy sector and the installation of facilities.

3.6.1.3 Political energy framework and agenda

The recent awareness of environmental issues, which is growing in the Western World in recent years, together with the dependency on energy imports of specific energy sources, which characterises the German energy system, and the programmed shutdown of all nuclear plants in the country, has pushed the German government to take actions and make new laws to regulate energy production and consumption – moving towards a gradual increase in renewable sources for use in the national energy market.

The main action of government, with the particular involvement of the Federal Ministry for Economic Affairs and Energy, is the *Energiewende*, a programme started in 2011 whose aims are environmental care, reduction of energy imports, stimulating technology innovation and research in the field of the green economy, reducing and eliminating the risks of nuclear power, and increasing energy security. This is a long-term programme (to 2050) that proposes to reduce greenhouse gas emissions by 80%, compared to the values of 1990, by increasing the share of renewable sources to 80% of energy consumption.

In order to perform this energy transition, Germany has implemented a number of laws, the most important being the Renewable Energy Act (EEG). The main aim of this law is giving renewables a high priority on the energy grid, and encouraging investors to invest their money in this energy. With the law made in 2000, and its subsequent amendments (2004, 2009, 2014), the feed-in tariffs for purchasing energy from renewable sources were increased in order to provide a proper return on investment. For each newly installed system, the prices are fixed for the following 20 years, and the rates drop down each year for the energy coming from new installed plants with decreasing trends of 1% per year for hydropower, 0.4% per year for wind energy, 0.5% per month for photovoltaic, 0.5% per quarter for biomass – this strongly pushed the market of renewable energies, making it more convenient for investors to install new renewable energy plants.

As mentioned above, the nuclear phase-out, a central part of *Energiewende*, further pushed the German government to move in the direction of renewables. The Fukushima disaster in March of 2011 mobilised anti-nuclear sentiment in Germany and there were large public anti-nuclear protests within days of the disaster. In May 2011 the German government announced its decision to decommission its nuclear power industry by 2022. 9 of the 17 nuclear reactors that were then in operation have already been permanently shut down. The plan foresees a gradual decommission of all the remaining plants by 2022, filling the energy gap (1345 MW are generated by nuclear power at present with electricity from renewables, natural gas turbines and efficiency improvement).

3.6.1.4 Societal implication in the energy transition

The German people had a great influence on the government's actions in the energy field. After the agreement reached by Merkel's government in 2010 to extend by 12 years the operation of nuclear power plants, the state elections held after Fukushima disaster seemed like a referendum on nuclear power, with many votes shifting to the Green Party and about 90,000 people protesting in the streets against nuclear

power in Berlin alone. These facts persuaded the government to change its mind about the plants, bringing forward their complete decommissioning to 2022.

Despite this general anti-nuclear feeling, there was some criticism of the government's decisions with regard to some aspects of the Renewable Energy Act – mainly concerning the feed-in tariffs. The surcharge paid by consumers to support investment protection measures for renewable energies resulted in the public claiming that these new policies were promoting more expensive energy sources. Furthermore, German consumers and small businesses are currently covering a big share of the cost of green power, because energy-intensive industry and the railway sector in particular are largely exempted from the EEG surcharge. This surcharge is becoming an issue for social policy, in particular for fuel poverty.

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 the transition will have positive impact on the job market, Germany will become more competitive, the environment and climate will be better protected, and consumers will be less dependent on power providers.

The survey also underlined the lack of education of consumers and companies with regard to the energy market, as a result of which we can see a certain misapprehension about the return on investment from EEG: 32% of those surveyed wanted a payback time of 3 years, with another 30% expecting it within 5 years. These expectations are completely unrealistic since, under feed-in tariffs, the return time is close to 12 years.

Overall, the negative public opinion and the criticism of the energy transition is due to the high prices and high levels of investments faced by Germany (€106 billion estimated) for energy grid expansion and technology transition. However, these drawbacks are balanced by the strong positive impact on employment (number of jobs doubled in the renewable energy sector between 2004 and 2010) and GDP growth. It is estimated that by 2030 German renewable energy exports will reach €47-69 billion.

3.6.2 *Energy system actors and discourses: characterisation and maps*

In Germany, the government's recent instigation of the Renewable Energy Act, and Energiewende, which will shift the German energy system from a carbon fossil and nuclear-based energy production and importation, to a renewable share of energy production of 80% by 2050, are driving the energy transition. These actions have brought about some changes in the energy scene.

New actors have been created in order to assess and support the government's decisions, such as the Energiewende Research Forum – a transdisciplinary platform that brings together actors from politics, academia, industry, and civil society – assesses the policies and research projects of Energiewende. Research organisations have been created too, such as Agora Energiewende, in order to find better technical solutions for the development and use of renewable energy sources..

In addition to these new actors in the German energy system, existing actors are also changing because of the energy transition. The most important instance of this, from a political perspective, is the German government's view about nuclear power production in the country. Merkle's government, having previously agreed with nuclear companies to extend the life of reactors by 12 years in 2010 – pushing the previously planned decommission of nuclear power plants from 2022 out to 2036 – the growth of anti-nuclear sentiment, especially following Fukushima, made nuclear power an election issue during the State elections in 2011. The negative public sentiment, and widespread public demonstrations on the issue of nuclear power, brought about the shift in government policy, with the resulting commitment to full decommissioning of all nuclear power plants by 2022. This decision demonstrates the increased importance of energy and environment issues to the government.

Some energy providers are changing their business model in order to take advantage of the new markets created by the energy transition. This is the case of E.ON Kernkraft GmbH, one of the largest nuclear power producers in Germany. It owns six power plants employing 2600 workers, and is investing €1.2 billion into research projects in the renewables field, adding 274 MW of capacity – produced by solar, wind, and hydropower. EnBW Energie Baden-Wuerttemberg AG is also changing its business strategy by supporting Energiewende with the planned expansion of renewable energies by 19% to over 40% by 2020 – this energy is primarily produced by onshore wind farms.

The number of new actors (associations, opinion groups, research organisations) is likely to continue increasing into the future: in particular, business opportunities that have recently opened up in the renewable energies market are attracting investment both in industry and research, generating new service companies and new jobs in the energy sector. The German extended energy system map is presented in Figure 33 and the overview of the different available discourses is represented in Figure 34.

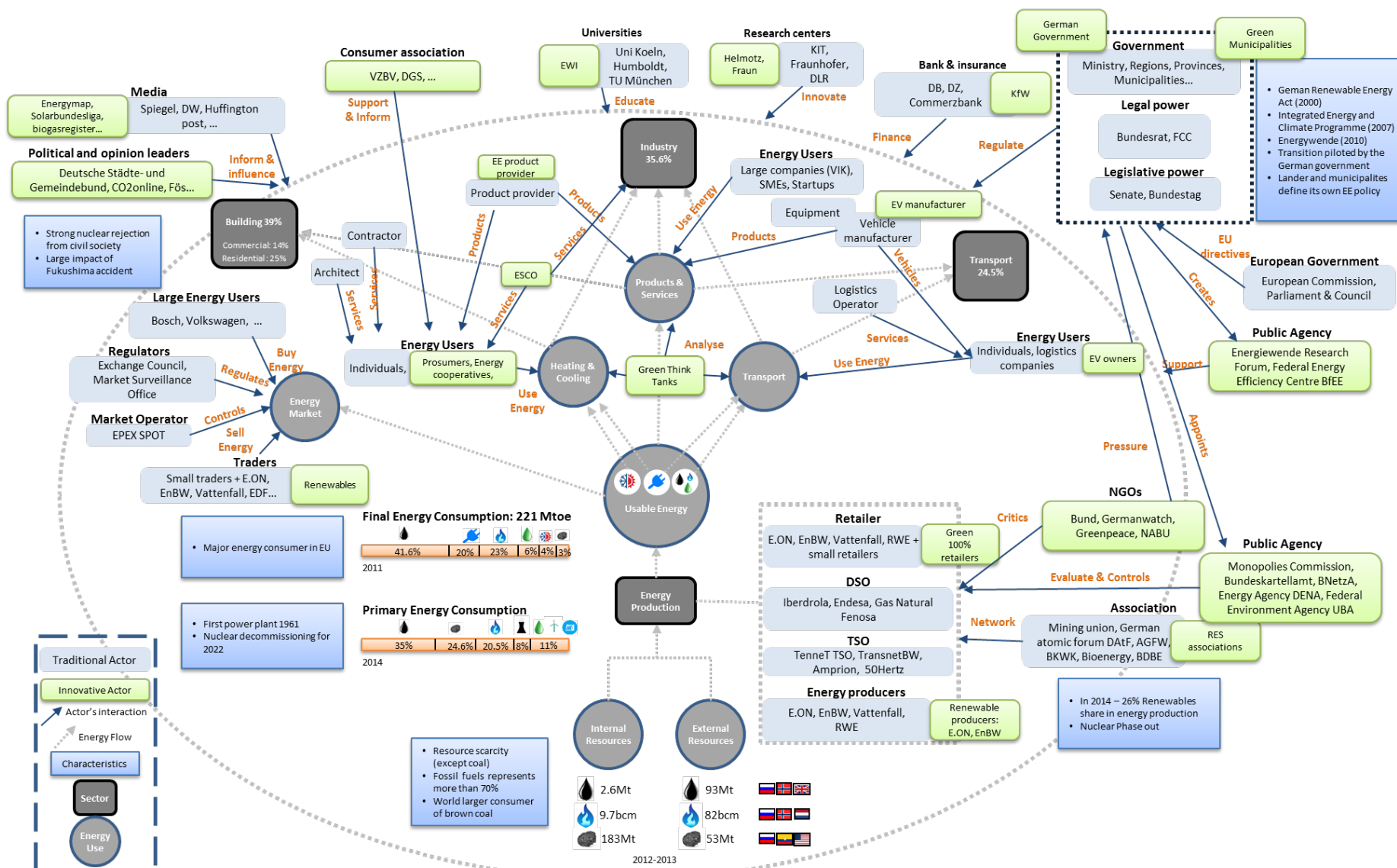


Figure 33: Germany extended energy system map

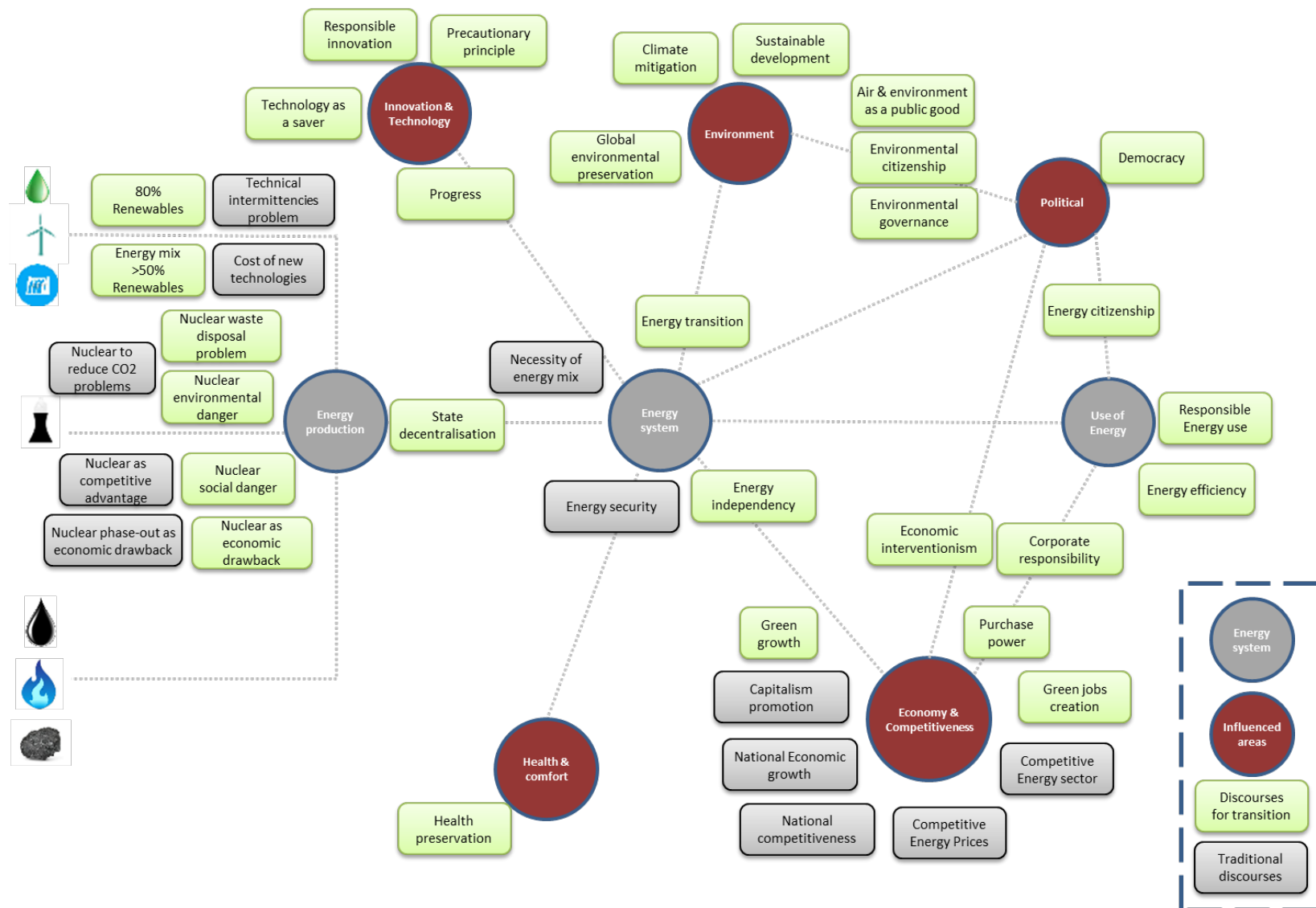


Figure 34: Germany energy discourses overview

3.7 EU

3.7.1 Overview

3.7.1.1 Global overview of the energy sector in Europe

Energy history in Europe

Energy policies at the EU level and an integrated internal energy market would enhance energy security in the EU, leading to better prices due to more competition and provide stronger political leverage vis-à-vis the energy exporters. In spite of these advantages, the community institution's competence to act was limited in the first decades of European integration.

The 1960s were characterised by a focus on the nation state level. Only after the oil crises in 1973/74 did a real need for cooperation become evident to EU members. As a consequence, a few years later, energy objectives for 1983 were defined, with the focus on coordination among Member States and guidelines concerning energy supply and demand.

Over the following years, the issue of environmental protection became more prominent, though not yet central to the common agenda. This aspect changed slightly with the Single European Act in 1987, although its focus was still on economic targets, such as the completion of Internal Energy Market.

But with the first assessment report of the Intergovernmental Panel on Climate Change (IPCC), published in 1990, and the following reports of the IPCC, the Earth Summit in Rio in 1992, and the adoption of the Kyoto protocol in 1997, climate change and thus energy issues emerged strongly on the global agenda – leading to a more favourable atmosphere for ambitious goals. Policy makers came to the conclusion that energy and climate challenges were of such a scale that solutions were not to be found on the nation state level, and the European Union set the target of becoming the World leader in the fight against climate change.

Following a series of discussions over the previous years, the EU Commission's "An energy policy for Europe" strategy marks the beginning of a more integrated European energy policy. At the core of the policy, which remains current, were sustainability, security of supply and competitiveness. In its Action Plan 2007-2009 the European Council adopted the 20-20-20 targets, which defined European energy policy. These targets refer to three 20% goals, to be reached until 2020:

- 20% minimum reduction in EU greenhouse gas emissions below 1990 levels
- 20% of EU energy consumption to come from renewable resources
- 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency

The action plan was included shortly afterwards in the Lisbon Treaty (2007), which included, for the first time, a title on energy. The Lisbon Treaty still refers to the functioning of the internal energy market, but introduces several innovations, such as "ensuring security of energy supply in the Union", which was traditionally a Member State domain.

Currently, the energy domain in Europe is regulated by two main strategy papers: "Energy 2020: A strategy for competitive, sustainable and secure energy", published in November 2010, and "Energy Roadmap 2050", published at the end of 2011. "Energy 2020" is based on the 2007 action plan, but provides new tools to make achieving the 2020 targets possible. It also emphasises the urgent need to act in order to not only restructure the energy market in the EU and to reach the climate targets, but also to stay competitive in the future. In order to meet the challenges, the Commission estimates investment needs of €1 trillion, especially for (re-)building infrastructure.

In order to reach the 20-20-20 goals, five main areas of priority have been identified:

- Achieving an energy-efficient Europe
- Completing the internal energy market

- Empowering consumers and achieving the highest levels of safety and security
- Extending Europe's leadership in energy technology and innovation
- Strengthening the external dimension of the EU energy market

Renewable energies do not have a particular priority in the strategy, but represent an important technological tool to reach the defined targets.

The Roadmap 2050 aims at giving a direction for after 2020, following a market based, and supposedly "technology neutral" approach. Since in the coming decade a lot of infrastructure will need to be replaced, in order to fulfil the 2020 objectives, its Roadmap aims to provide planning certainty for long-term investments.

Energy sources in Europe

Europe is historically dependent on primary energy imports, due to its relative absence of traditional energy sources. Almost half of the oil reserves are located in the Middle East, while 18% are located in South and Central America, and 14% in North America. European and Eurasian Oil reserves were 8.8% of the total global share in 2013, with Russia, Azerbaijan and Kazakhstan owning up to 7.7%. The top European country is Norway, with 0.5% of the global share (BP, 2014).

Regarding natural gas reserves, the Middle East has 43% of the proven global natural gas reserves, while 31% are located in South and Central America and 8% in North America. European and Eurasian natural gas reserves corresponded to 30.5% of the total global share in 2013, with Russia and Turkmenistan owning up to 26.2%. The top European country is Norway, with 1.1% of the global share (BP, 2014).

Considering coal reserves, Europe and Eurasia appear in the top position with 34.8% of the total global share in 2013, while Russia and Kazakhstan own up to 21.4%. The top European country is Germany, with 4.5% of the global share, followed by Ukraine, with 3.8%. In order to overcome the lack of fossil fuel resources, more than half of the European production of primary energy comes from nuclear and renewables.

European energy model

The production of primary energy has decreased in Europe in recent years, mainly because raw materials have become exhausted, and their extraction and exploitation have become increasingly uneconomical.

The biggest decrease has occurred in oil and natural gas, while the production of renewable energies is increasing rapidly. Nuclear remains the main contributor to primary energy production in Europe, even though it is slowly decreasing, due to the fact that many EU countries have started to take the path of denuclearisation (Eurostat, 2015a); among them Germany and France, the two largest nuclear energy producers in Europe.

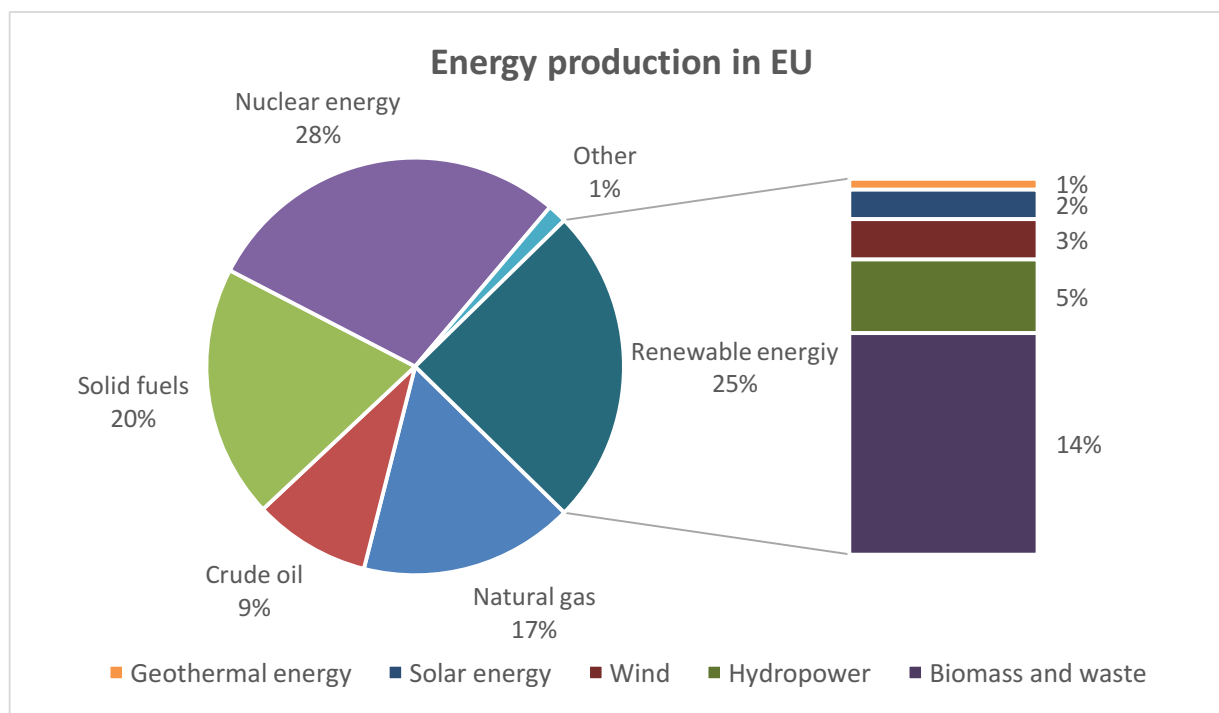


Figure 35: EU-28 Production of primary energy, 2013 (Eurostat, 2015b)

In 2013 a range of different energy sources was exploited to generate primary energy, such as nuclear energy (28.7%), renewable resources (24.3%), solid fuels (19.7%, largely coal), natural gas (16.7%), and crude oil (9.1%). The largest increase in growth was registered for renewable resources – during the period 2003-2013 their production increased by 88.4%. The production from other primary sources of energy generally decreased in this period, for crude oil (-54%), natural gas (-34.6%) and solid fuels (-24.9%).

The EU major primary energy producers are France (16.8%), Germany (15.5%), the United Kingdom (14.6%) followed by Poland (8.9%) and the Netherlands (8.2%). It is important to note that in the decade running from 2002–12, the United Kingdom has reduced its primary energy production by more than 50%.

Gross inland energy consumption in the EU-28 has been on a decreasing trend. In 2012 it was 1% lower than in 2011 (approximately 70.5 million TJ). It was stable from 1990 to 2012, except in 2009, when it decreased by 6% from the level of 2008, due to the financial crisis. That year solid fuel consumption decreased by 12%, followed by natural gas and petroleum products by 6% each. In 2010 consumption showed a recovery, only to decrease further in 2011 and 2012 when it stood just below 2009 levels. In 2012 petroleum products recorded the biggest decrease by 4% while renewable energies recorded the biggest increase (9%) (Eurostat, 2015a).

The structure of gross inland energy consumption in 2012 indicates that total petroleum products hold the largest share (34%), followed by gas (23%), and solid fossil fuels (17%). The nuclear energy share of consumption was 14%, and renewables was 11%. The solid fuels share of consumption saw an overall reduction by 10% since 1990 (from 27% in 1990 down to 17% in 2012). Renewable energy sources on the other hand saw an increase in their share of consumption – from 4 % in 1990 up to 11% in 2012. When considering the energy consumption by sector, transport is the most energy demanding (31.6% in 2013), followed by Households (26.8%), and Industry (25.1%).

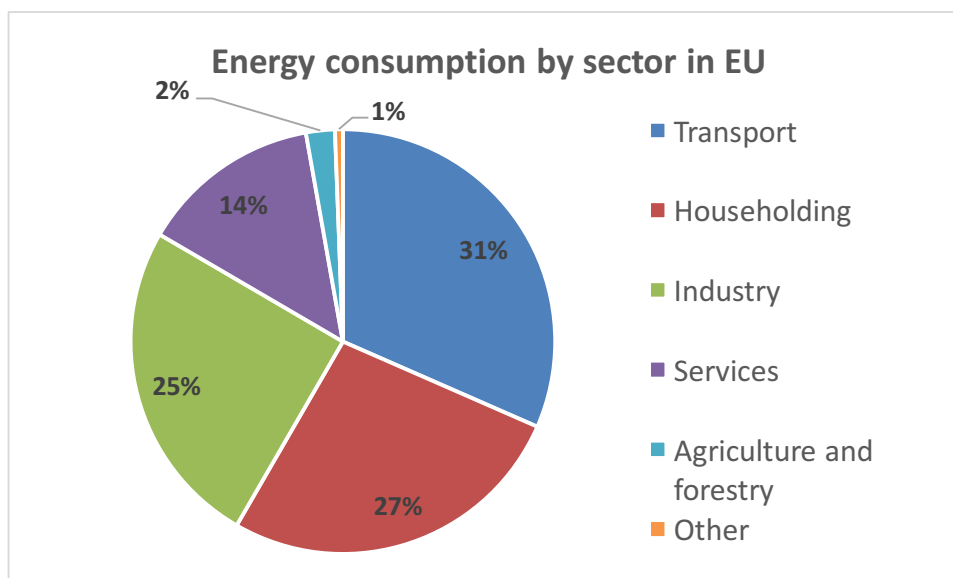


Figure 36: EU-28 Energy consumption by sector, 2013 (Eurostat, 2015a)

3.7.1.2 The economic energy model in Europe

Evolution of the energy price

Many factors influence variability in energy prices in a specific region over a period of time. Due to the dominance of fossil fuels in the energy system, the main factor has been the price of raw materials (e.g. coal, oil, natural gas), which depends not only on international market fluctuations, but also on the presence of primary energy sources directly within the examined area. In addition, policy-makers often modify energy prices by means of distribution fees and sales taxes for end users, such as households and industries. In the European Union, in particular, energy prices have increased in recent years. This increase is also due, in part, to the level of investment in research and implementation measures already undertaken (and yet to be done) in the move towards a decarbonisation of the energy model, and to the ongoing privatization of the energy sector. In this scenario, the end users of electricity or gas cover the costs of new energy investments. Wide differences lie between different national prices in the European energy market – consumers in the highest priced Member States pay 2.5 to 4 times as much as those in the lowest priced Member States, and the gap has widened over time, especially in the case of household gas prices (Eurostat, 2015a).

With regard to trends in electricity prices within the EU as a whole – during the 2008–2012 period, average household electricity prices have risen by 4% a year, which is higher than the rates of inflation in many Member States. Turning to the retail price of energy for industry, the average increase in the price of electricity was 3.5% a year over the same period; while the price of gas rose by 1% – below the rate of inflation in most Member States.

Regarding the electricity market, taxes were the biggest contributor to the increase in prices for end users over the analysed period (+36% for household, +127% for industrial consumers – before exemptions); while the actual cost of producing the energy (both electricity and gas) has seen the smallest increase. Network costs went up by 18.5% for households, and by 30% for industry. Looking at gas prices – the production cost has stayed stable, but network costs increased by 17% for households, and by 14% for industry; while taxes went up by 12–14% for households, and by 12% for industry. Wholesale energy prices in the market are liable to fluctuation – usually related to the price of raw materials. The price of wholesale electricity has had a decrease of between 35%–45% over the years (Eurostat, 2015b).

Energy importation and exportation

In order to satisfy the internal energy demand, due to the decrease in primary energy production, the EU Member States were generally pushed to import raw materials from abroad. Import dependency for energy consumption in EU was 53.2% in 2013 (Eurostat, 2015a), mainly for crude oil (88.4%) and natural gas (65.3%). The lowest energy dependency rates were in Estonia, Denmark, Romania, Poland, Netherlands and Czech Republic, while the highest ones were in Malta, Luxembourg and Cyprus.

In 2013, Russia was the main supplier of crude oil (33.5% of EU's imports in 2013), natural gas (39%) and solid fuels (28.8%). Norway was the second largest supplier for crude oil and natural gas, and surpassed Russia for natural gas in recent years, after the EU decided to cut its energy dependence on Russia because of tensions over events in Ukraine in early 2014.

In the 2008-2013 period, energy export trends have followed different paths for the different types of resources. In particular, crude oil exportation, year by year, decreased from 55 to 40 million toe, while electricity exportation grew from 25 to 30 million toe, natural gas from 75 to almost 90 million toe, and fuel oil from 60 to almost 70 million toe. In 2013, 23.8% of the available (produced + imported + recovered) energy sources and products were exported: 12% of solid fossil fuels, as well as 37.9% of crude oil and petroleum products, 18.6% of natural gas and 3.9% of renewable energies. In 2013, the import/export balance was +909 million toe for import (Eurostat, 2015c).

Energy system impact on the European economy

All stages of the energy generation process contribute significantly to the European Union economy – from the extraction of raw materials, to the production of energy, to the distribution in the grid – it employs approximately 1.6 million people within the EU, and generates €250 billion for the economy (4% of value added of EU business economy and 2% of GDP). The impact of the energy sector on the whole European economy stems from the essential role that energy played in the development of the industrial revolution, and its evolution in the intervening centuries, with the result that energy has become intrinsic to the entire economy. Energy is required in almost every field of employment, and, in particular, it's required in large amounts for industrial production, and transportation.

Due to the significant on-going energy demands for the business sectors, for households, and for transportation – the new developments in energy, and in the energy market, offer a range of business opportunities for private companies operating across many fields. As previously mentioned, in the 2003–2013 period the European production of renewable energies has almost doubled (+88.4%), and this indicates the level of growth in the businesses of manufacturing photovoltaic panels, wind and hydraulic turbines, solar thermal panels, and their integration into electricity grids and energy systems. This level of growth is inducing companies to make significant investments into these forms of energy generation, so that in 2012 1.2 million people were directly or indirectly employed in the renewable sector in EU countries. Not only is energy production stimulating development and investment, the issue of energy efficiency has also increased the number of companies identifying, and creating, solutions for energy efficiency in industrial and household contexts. For example, prefabricators of highly energy-efficient houses are creating new materials and construction solutions in order to reduce household energy demands, as well as reducing costs and the impact of pollution. The European prefabricated buildings market was valued at US\$ 31.5 billion in 2012, with Italy accounting for the largest share at 25.4%, followed by Germany (12.7%), France (10.7%), UK (9.2%), and Russia (8.5%) (Timetric, 2014).

Energy model transition

The transition from a fossil fuel-dependent to a low-carbon energy market in Europe is a very important point of discussion at EU level both because of the concern for environmental issues in society, as well as the future potential for low cost energy production from renewable resources. There is a requirement for policies, and regulation, in particular due to the high investment costs required to develop the new

technologies involved in the renewable energy production and exploitation. An additional reason to focus on renewable sources of energy is to facilitate the move towards energy independence for Member States, however, it remains the case that the cost of energy from renewables is higher than the cost of energy from traditional sources. In order to be competitive, the development of renewables requires financial incentives, and further research and development.

There are a range of barriers to be overcome in order to create a free market for renewable energy in the European Union. The first one is the structural barrier – the infrastructure of power grids in the individual Member States mitigates against the integration of renewable sources of energy. European networks are the oldest in the world and were developed to transport electricity generated from conventional power plants – this means that the grid infrastructure itself requires major structural intervention. An additional issue is that of new renewable energy entrants to the energy market gaining access to the existing grid infrastructure. In order to counteract this problem, EU directive 77/2001/EC establishes an obligation on Member States to accelerate the development of renewable energy, and to ensure a transparent and level-playing field with regard to access to energy infrastructure within Member States.

The second is the administrative barrier – in many countries there are a multiplicity of decision-making bodies and organisations, often with complicated procedures to access operating permits, funding, and subsidies. The, often high, degree of bureaucratic overlap between organisations results in systematic inefficiencies, in many cases. Also, local governments are often insufficiently informed on the pertinent issues, and do not have the expertise to make strategic decisions.

Also there can be significant social barriers to the energy transition in Europe. Although social opinion about renewable energy is generally very positive, there is often opposition from local communities in the areas where it is intended to build renewable power generating facilities. The lack of consultation with the local community, as well as the, real or perceived, lack of benefit to the community from the siting of the RES structures may significantly contribute to local opposition. Another factor contributing to the negativity about renewable energy generation is that the means of generation – wind turbines, for example – are highly visible and can greatly intrude on the landscape, particularly in comparison with the more traditional means of generation where power plants could be more discretely located with lower visual impact.

Finally, economic and financial barriers exist – recovery times for the initial investment into RES are generally long, and in some EU states investors are discouraged by the inconsistency of policy approaches where regulations concerning financial supports often change on an annual basis. In an already high-risk sector, the long timeframe for the return on investment, and the insecure financial policy landscape can lead to significant cash-flow problems in the short and medium term, thereby increasing the financial insecurity of the sector.

3.7.1.3 The political energy framework and agenda in Europe

The internal energy market

The implementation of the so-called “Third Package”, in 2009, led to a greater harmonisation in cross-border trade and network rules, with greater independence for national regulators and TSOs, and facilitating their co-operation through newly created European bodies – the Agency for the Cooperation of Energy Regulators (ACER) and the European Networks for Transmission System Operators – Gas and Electricity (ENTSO-E). A further opening of the market has also been supported by the enforcement of competition in the energy sector.

Since 2008, energy markets in the European Union have become more integrated with increasing trade flows. However, the European Union has yet to create a fully integrated EU energy network and energy market. Both gas and electricity markets suffer from low cross-border capacity, leaving large parts of the market in Eastern and Southern Europe isolated.

Another important challenge is the transformation of the energy system to accommodate a higher share of renewable energies. For electricity, the implementation of unified rules for trade and network operation has been difficult, as system operation remains largely confined to national grids. Moreover, wholesale price reductions have been largely offset by higher green levies, taxes, and network costs. Consumers do not gain much benefit from switching suppliers. Indeed, regulated prices and the market power exercised by the historic incumbent provider/s persist in many member states.

2020 climate and energy targets

Significant progress has already been made towards a low-carbon energy system, and the EU has taken a leading role in this among IEA member countries, however, further efforts are required in order to achieve the expected outcomes by 2020. Regarding the three 2020 targets, the European Union is on track towards achieving its goal:

- In 2012, GHG emissions had decreased by 19.2% compared to the level of 1990, as a result of lower demand during the economic crisis, the growing deployment of renewable energies, and actions taken on energy efficiency.
- The EU share of renewables in final energy consumption increased to 14.1% in 2012 from 8.7% in 2005, thanks to support schemes for renewables encouraging investment – in particular in solar photovoltaic (PV) and onshore wind. IEA analysis suggests, however, that the 2020 target may not be met, unless policy initiatives are taken to further stimulate the market.
- The European Commission estimates that, with measures in place today, the EU could achieve 18% to 19% of energy savings up to 2020. A third of the savings will result from lower demand caused by the economic crisis. The rest comes from efficiency measures, notably the Energy Performance of Buildings Directive, Eco-design and Labelling Directives, the Energy Efficiency Directive, and EU funding with a focus on energy efficiency. Progress towards the 20% target will depend on further implementation of energy efficiency policies and investments.

EU policies created to meet energy and climate-change targets have also brought some unintended and unexpected results. Increased electricity generation from renewables, and reduced electricity demand – arising in part from energy efficiency policies, and in part from the economic crisis – have resulted in a surplus of carbon allowances, with the consequential collapse of the carbon price, from 30€ per ton of CO₂ in 2008, to 6€ in 2014. Consequently, the EU saw a revival of coal use in energy production, due to its low price.

Competitiveness

The relative competitiveness of the European Union vis-à-vis its trade partners has changed as a result of the shale gas revolution in North America and the growth in energy demand in Asia. During 2013, EU gas import prices at major hubs (Germany, the Netherlands, and the United Kingdom) were around USD9 to USD10 per million British thermal units (MBtu), compared to gas prices of USD4 per MBtu in the United States. Despite the overall decrease in EU wholesale electricity prices since 2008 (approx. 35%–45%), according to IEA and Eurostat data EU electricity prices for industry in 2013 remained 40% above the United States prices. This difference is particularly important in energy-intensive industries. A more integrated energy policy at EU level, investments in innovative energy technologies, and a fully functioning internal market supported by investments in energy infrastructure are key priorities to help the competitiveness of EU industries.

Energy security

The European Union is the largest energy importer in the world, importing 53% of the energy it consumes. European fossil fuel production continues to decline, gas imports are expected to increase between 2020 and 2030, while oil imports are projected to remain stable, even in a decarbonisation scenario. For these reasons, energy security has become a central issue in EU energy policy. In particular, the security of the gas supply has been threatened by tensions between Russia and Ukraine, in 2009 and 2014, as roughly 15%

of EU gas imports arrive through Ukraine. On 30 October 2014, an agreement between Russia and Ukraine was brokered by the European Commission to secure winter gas supplies to the EU. After the 2009 crisis, the European Union has started to reform its gas emergency policies and today benefits from new gas pipelines and reverse flows, higher LNG imports, and increased gas storage capacity.

However, the European Union will continue to depend on Russian pipeline gas imports for the foreseeable future. Several policy actions are required to reduce this dependence, with the focus on the liberalisation of the gas market, the implementation of new unconventional gas extraction technologies [fracking], the further deployment of low-carbon technologies, and the promotion of energy efficiency. Greater engagement and an increase in dialogue between producer, transit, and consumer regions will also be required to maximise the negotiating power of the EU, and to provide consistency in its external energy policy.

Achieving security for Europe's electricity supply will largely depend on the way the European Union can accommodate the integration of renewable energy, and support investment in the transformation of the electricity system in the longer term, while ensuring the adequacy of generation in the medium term. In 2014, the European Union entered a new institutional cycle, and among the key priorities of the EU's Strategic Agenda is the work towards an Energy Union, with a forward-looking climate policy directed towards 2030. At the heart of this Energy Union, the core priorities should focus on enhancing energy security by the completion of the internal energy market, ensuring competitive and affordable energy prices for business and consumers, as well as the reduction of GHG emissions and improvements in energy efficiency, while promoting the leadership of the EU in low-carbon technologies.

3.7.1.4 The European society and its suitable transition

Environmental and energy issues have become a central topic of discussion not only at the European level, but amongst ordinary people too. This is, to a large extent, in response to the increased attention given to the topic by the media, and to the rapid growth of the internet – that has made a large volume of information more easily accessible to the general European population. A survey conducted in 2013 by TSN Opinion & Social, at the request of the European Commission, showed that half (50%) of all Europeans think that climate change is one of the world's most serious problems and around one in six Europeans (16%) think it is the single most serious problem. The proportion of people who think that it is one of the most serious problems ranges from 81% in Sweden to 28% in Estonia. Climate change is perceived to be the third most serious issue facing the world – behind poverty, hunger, and the lack of drinking water; and the economic situation. Notably, nine in ten Europeans (90%) think that climate change is a very serious or a serious problem, while only a minority (9%) believe that climate change is not a serious problem.

Even though one in four Europeans (25%) think they have a personal responsibility for tackling climate change, they are most likely to think that responsibility for tackling climate change lies with national governments (48%), business and industry (41%), and the EU (39%). This demonstrates a tendency to see energy as a simple commodity and not as a coordinated system where everyone plays an equally important role. Nevertheless, half (50%) of all Europeans report that they have taken some form of action to tackle climate change, with the majority of people trying to reduce their waste, and recycling it. Respondents in Sweden were the most likely to say that they have taken some form of action (80%), compared to a quarter or less of people in Estonia (25%), and Romania (23%). There is also strong support for the idea that fighting climate change and using energy more efficiently can boost the economy and jobs in the EU, with more than nine out of ten Europeans (92%) of the opinion that it is important for their government to provide support for improving energy efficiency, and to set targets to increase the amount of renewable energy used by 2030.

Fuel poverty is a considerable issue in Europe, currently affecting between 50 and 120 million Europeans. Despite the fact that there is no common European definition, the importance of the problem as well as the severe health impacts caused by fuel poverty are widely recognised. In 2012, 10.8% of the total European

population were unable to keep their home adequately warm, an indicator often used to measure fuel poverty. Increasing the energy efficiency of buildings, and thus reducing energy bills, as well as improving the EU economy, can help in the reduction of fuel poverty throughout Europe. As part of the Europe 2020 strategy, at least 20 million people should be lifted out of the risk of poverty and exclusion by 2020, making the fight against poverty and social exclusion a priority for the EU. However, due to the economic crisis, the number of people at risk of poverty increased from 80 million prior to the crisis to 124 million in 2012, with an estimated 100 million European citizens still at risk of poverty in 2020, even if all the proposed measures were to be fully implemented.

The social subsidies and other economic aids that have been implemented for people in need, can be described as passive measures, which do not change the actual status quo. The most effective and sustainable way for consumers to reduce their energy bills is through reducing the energy demand of buildings by implementing energy saving measures.

Recognising the problem, a few EU Member States are already implementing programmes and measures to deal with fuel poverty. However, these programmes are not sufficient. In order to address the problem in a strategic way a common European approach is required, together with an increased use of EU funds, in order to help the least developed regions to effectively deal with fuel poverty.

3.7.2 Energy system actors and discourses: characterisation and maps

As with all policy fields in the multilevel system of the EU, energy policy is made by a wide range of actors.

The most important EU institutional actors are the European Commission, the European Parliament, and the Council of the European Union. Other important actors are the Member States, which have the decisive say with regard to the energy mix and energy foreign policy.

The EU Commission is the executive body of the European Union with responsibility for proposing legislation, implementing decisions, upholding the EU treaties and managing the day to day business of the EU. It operates as a cabinet government, and has 28 Commissioners – one for each member state. Each commissioner heads up a particular policy area, undertaking to perform their duties in the interests of the EU as a whole, rather than in their respective national interests. The EU Commission has the right to initiate legislation and thus has considerable influence due to its position as an agenda setter. The Commission has responsibility for monitoring the implementation of energy legislation.

In the legislative process, the Council of the European Union and the EU Parliament are the main decision-making bodies of the EU. The Council consists of government ministers from Member States, and it has a rotating presidency of six-month duration. The government ministers in charge of the specific policy area under discussion from each MS attend the meetings where they represent their country's interests, and have the authority to commit their respective governments to agreed actions.

The EU Parliament is the parliamentary institution of the EU, and its members are directly elected by the citizens of Europe. It is the second legislative body in the EU and has gained more power in the recent years, especially under changes introduced by 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 Member States are the most important actors outside the institutional EU level. They influence energy policy via their energy ministers in the Council of the European Union, and their Heads of State determine the general direction of energy policies in the European Council. While the EU has defined the common targets for the Member States with Energy 2020, most of the decision-making remains at a national level. For example, decision-making on the energy mix is still within a Member State's competence, depending on national preferences, available natural resources, industrial requirements, and energy foreign policy.

With the adoption of the “third energy package” in 2009, two new European bodies have been created: the Agency for the Cooperation of Energy Regulators (ACER), and the European Networks for Transmission System Operators for Gas and Electricity (ENTSO-E), in order to provide guidelines and coordination for national operators.

While member states are central to the EU, with a strong capacity to orientate decision-making at the EU level, there is however an overarching “EU voice” with its own discourse and political vision. Many organisations, networks, and programmes have been created by the EU, which work on energy and environmental issues, such as the H2020 programme, the European Technology Platforms, the Concerto initiative and its continuation, and the Smart Cities Information System. In general, the EU is very keen on reinforcing its strategic power to compete at the global level, thus favouring partnerships among EU and non-EU countries, as well as excellence in research.

While the EU political decision-making power is still concentrated in the EU institutions, transnational initiatives of local decision-makers have developed, such as the Covenant of Mayors. The Covenant of Mayors gathers together local and regional authorities that are committed to increase energy efficiency and the use of renewable energy to meet and exceed the European 20% CO₂ reduction objective by 2020.

Lobbying – officially referred to as “European interest representation” – has a significant impact on European policy-making and legislation. Lobbying is defined as “all activities carried out with the objective of influencing the policy formulation and decision-making of the European institutions” (CEC 2006), and is a multi-billion euro industry. A broad range of lobby groups, representing a diversity of interests, tries to influence policy at EU level. Europe’s biggest corporations have a visible presence concentrated within a kilometre to the EU institutions in Brussels. While “lobbying is an integral part of a healthy democracy ... [and] allows for various interest groups to present their views on public decisions that may come to affect them. ... [However] without clear and enforceable rules, a select number of voices with better resourcing and contacts can come to dominate political decision-making” (Mulcahy 2015, 6). The European Transparency Initiative was first introduced in 2005, and the EC brought in a voluntary register of lobbyists in 2008 – establishing the Transparency-register for the European Parliament and the EU Commission in 2011. However, registration is voluntary, although required for official access to the EU institutions. “Despite serious risk factors, lobbying regulation in Europe is woefully inadequate, allowing undue influence to flourish” (Mulcahy 2015, 7). All type of lobbies exists, although the main ones, with respect to the energy transition topic, are the companies with an interest in energy and environmental NGOs, movements and networks.

National and international energy companies have a significant lobbying presence in the European institutions. Via their associations, they take part in the Economic and Social Committee, as well as in various European dialogue forums. Apart from these activities, they lobby on all other levels, for example via direct contacts with EU MEPs or Members of the Commission. The “national champions”, such as France’s EDF, Germany’s RWE and E.ON or ENEL in Italy, also exert influence via national channels. Progress in the liberalisation process in the energy sector has been intermittent within the EU, allowing some national champions to profit economically, thus gaining ever more influence. Given that liberalisation and stronger market integration are key priorities of the EU, the EU should take action to tackle the power and market dominance of big energy companies.

Together with the increased international awareness on climate issues, environmental NGOs enjoy a high level of credibility and have gained considerable influence, as they provide valuable scientific research and data on climate change and energy issues. The lobbying channels for these actors are very similar to those of the energy companies. Pro-green energy voices are increasingly emerging in the Parliament, like the Greens/EFA Group, which advocates for a transition to 100% renewable energies. Consumer associations also exist at the European level, such as the BEUC organisation, which take positions on various topics from product sustainability, consumer rights, political decision-making and policy direction, to international

trade deals (such as the TTIP). Anti-EU voices exist, although their scope of action remains at the national level rather than at the European level. To provide a better understanding of the energy system in Europe, the different discourses present in Europe have been mapped and categorised.

The range of different discourses concerning the energy system current at EU level has been categorised and the different areas of society strongly linked to these discourses have been identified. In order to map out the identified connections between these discourses and their primary areas of influence, these areas have been thematically organised into five groupings. These are: innovation and technology, environment, politics, economy & competitiveness, and, health and comfort. Discourses intersect widely with a range of areas, and actors, in multiple and complex ways. Given this complexity, it is not possible to map them all, however, a pragmatic approach allows a sufficient representation of the most visible intersections of discourses with these identified areas. Where a discourse has an influence in a number of areas, they are represented in between the areas. The colour code has been used as follows:

- Traditional discourses have been represented in grey boxes
- Discourses fostering the energy transition have been represented in green boxes
- Areas of society influenced are represented in deep red circles
- The areas related to the energy system itself (production, the whole system and energy use) are represented in grey circles

Energy production has been defined by source (fossil fuels, nuclear, and renewables or alternative sources), so the discourses related to the source of energy are represented close to its energy source (no matter the impact they have in the other areas). Neither the size of the boxes nor their proximity to their areas of influence is of significance, these simply reflect the limitations of graphical representation. While this exercise aims to be as comprehensive as possible, it has obvious limitations. Primarily, the discourses are limited to those that can be captured from available resources—such as the media, government, and research. What are not captured are the discourses of communities and community members—those actors who form the “human” aspect of the energy system outside of technologies, policy making, and industry. It is these discourses that ENTRUST intends to capture in order to uncover, and include, actors and interconnections hitherto unrecognised. The overview of the different available discourses is represented in Figure 37.

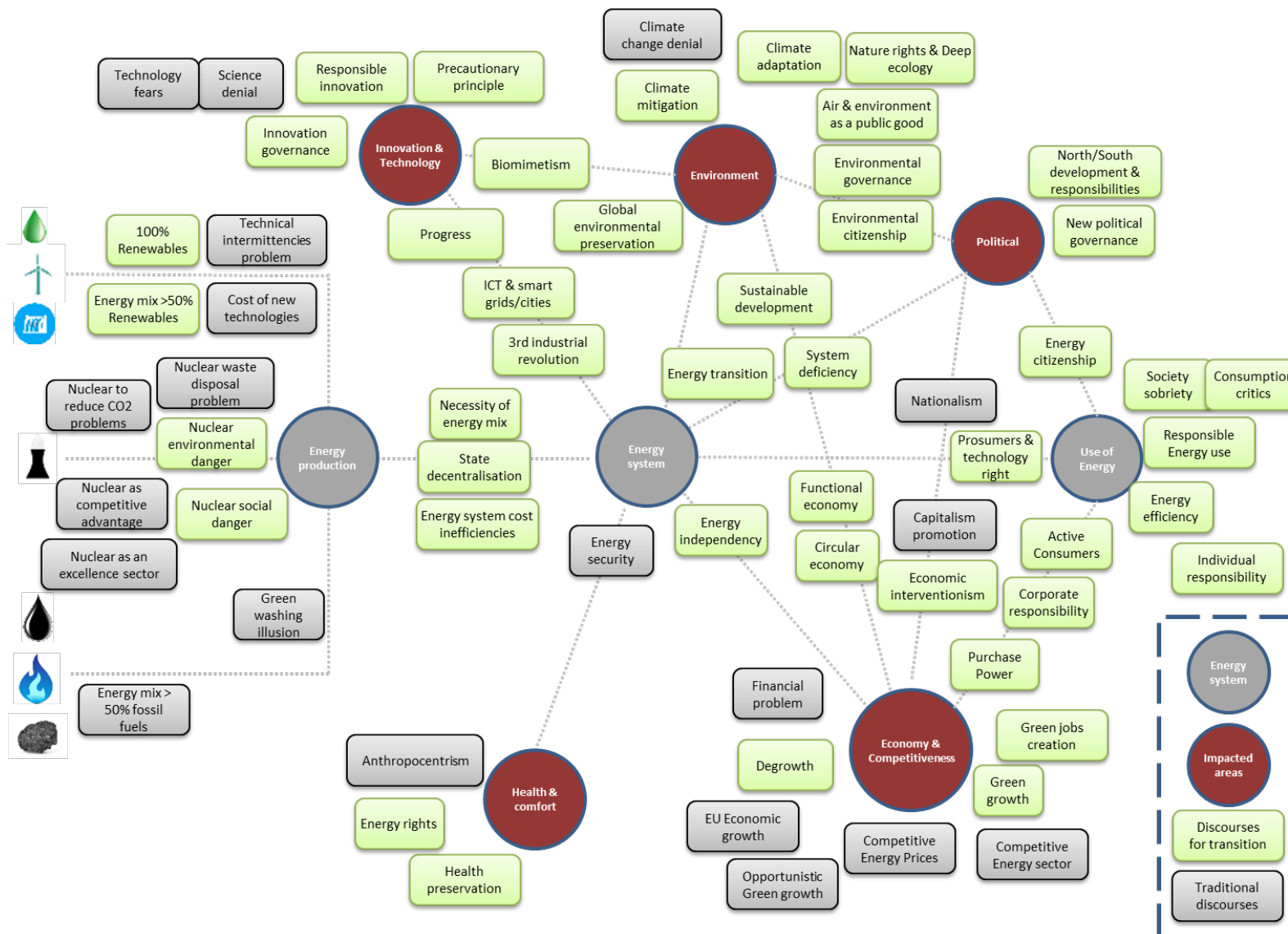


Figure 37: EU energy discourses overview

3.8 Case-studies analysis

3.8.1 Fuel poverty in UK and Ireland

3.8.1.1 Introduction

Our understanding of inequality and its impact on the lives of numerous groups within our society has grown in complexity in recent years. So much so that political discourses abound deconstructing issues concerning everything from (un)equal access to public services, to (mis)treatment relating to gender, sexual orientation, or religious beliefs. In many instances the considerable effect economic/income inequality has on the social fabric of Member States across the European Union is also increasingly being acknowledged. This growing wealth gap between the bottom and top deciles of earners, which has emerged in many post-war economies since the 1970s, has led researchers to explore new ways to explain the negative manifestations arising from this inequality. The idea of fuel poverty (FP) as a term to capture the unequal impacts on many households' experiences when attempting to access energy to heat and light their homes has been largely developed by key researchers in the United Kingdom and Ireland⁷. Both countries offer some interesting opportunities for comparative analysis, especially in terms of fuel poverty, since they share a land border, a similar climate and have (in many respects) similar socio-political and financial structures in operation in both jurisdictions. Having said that, Ireland still provides a useful counterpoint to the UK given its differing socio-demographic history, particularly since independence. Northern Ireland, in turn, offers a useful perspective that enhances our understanding of the complexities involved when trying to come to terms with fuel poverty in the UK. The factors that contribute to fuel poverty there, which we will explore shortly, more closely resemble those in Ireland than they do to the rest of the United Kingdom. This has led to calls for an 'all-island'⁸ approach to tackling fuel poverty (McAvoy, 2007).

Fuel poverty has many definitions, and related terms, but the widely accepted understanding essentially refers to an inability to maintain adequate heat in one's home (Harris, 2005), or more specifically the inability to heat (light and power) one's home to an adequate, safe and comfortable level (Healy & Clinch 2002). Isherwood and Hancock were among the first to define fuel poverty in 1979 when they described it as households having high fuel expenditure, spending more than twice the United Kingdom's national median (i.e., 12%) on fuel, light and power. These figures were roughly based on the median set down in the 1977 Family Expenditure Survey (Liddell et al., 2012).

In the UK the 2000 Warm Homes and Energy Conservation Act states that a person is to be regarded as living in fuel poverty if she is a member of a household living on a lower income in a home that cannot be kept warm at a reasonable cost (Hills, 2011). So how warm is warm? According to the World Health Organisation (WHO) and the governments of Ireland and the United Kingdom, the general range of comfortable temperatures is 21°C in living areas, and 18°C in bedrooms and all other rooms generally (Lidell, 2008). These temperatures are revised upwards for the elderly and infirm, with 23°C or 24°C seen as more appropriate for living areas accommodating such individuals (Lidell et al., 2011; Goodman et al., 2011). There are three main factors that influence the level of fuel poverty, namely: fuel prices, household income and energy efficiency performances of the housing stock (CPA, 2009). Other factors can also include age, health, marital status and the tenure of occupants. Due to greater life expectancy and a desire to continue to live in one's home, even in the face of ill health or disability, older people tend to experience the "dual burden" of fuel poverty more than other sections of society. The literature also suggests that they are more likely to experience fuel poverty and, as a consequence, are particularly vulnerable to the negative health and social issues that result from it. Roughly one-quarter of older people in Ireland, and one-third of older people in Northern Ireland, live alone (Goodman et al., 2011). Levels of fuel poverty in

⁷ Ireland is both the name of an island and of a state which covers occupies five-sixths of the island – in this report 'Ireland' shall be used for the state, where a reference is made to the island this will be made clear by the context.

⁸ An euphemistic shorthand for an policy which encompasses both Ireland and Northern Ireland

Ireland and the UK are high, although exact figures vary depending on the definitions and methods of calculation applied. At present, several formulae are in use since the term ‘fuel poverty’ was first officially recognised. However, in general terms rapidly rising fuel prices and macroeconomic slowdown have placed a policy spotlight on fuel poverty in both countries (Scott et al., 2008).

Fuel Poverty is now recognised to be a distinct and serious problem and can be separated from poverty more generally (Hills, 2011; Scott et al., 2008; Walker and Day, 2012). While there is no single, universally accepted, definition of poverty, for those not residing in underdeveloped countries it is considered to be relative. The European Union's working definition of poverty is “persons, families and groups of persons whose resources (material, cultural and social) are so limited as to exclude them from the minimum acceptable way of life in the Member State to which they belong” (Moore, 2012: 21). Fuel Poverty on the other hand has been named and broadly defined since the late 1970s, with Isherwood and Hancock (1978), Bradshaw and Hutton (1983) and Boardman (1991) all contributing to the debates over the years (Liddell et al., 2011; Moore, 2012). Although there is no common definition of fuel poverty in the EU it is estimated that if measures were taken to tackle fuel poverty on an EU-wide basis it could apply to over 20 million households (Liddell et al., 2011).

Definitions

The concept of fuel poverty as such is well understood, but there is considerable diversity with regards to the measurement and definition frameworks set out in government policy (Goodman et al., 2011). The EU Statistics on Income and Living Conditions (EU-SILC), along with its predecessor the European Community Household Panel (ECHP), are the most widely used surveys for quantifying aspects of European fuel poverty (Thomson & Snell, 2014). Only three EU member states have an official working definition of fuel poverty, viz., France, Ireland, the UK (Thomson & Snell, 2013). These definitions are presented below:

- **Ireland:** The Irish government defines fuel poverty as: the inability to afford adequate warmth in a home, or the inability to achieve adequate warmth because of the energy inefficiency of the home;
- **United Kingdom:** the UK government defines a person as fuel poor when one cannot afford to keep one’s home adequately warm at a reasonable cost. The most widely accepted definition of a fuel poor household is one which needs to spend more than 10% of its income on all fuel use and to heat its home to an adequate standard of warmth;
- **France:** The French governments defines a person as being fuel poor when she encounters particular difficulties in her accommodation in terms of energy supply, related to the satisfaction of elementary needs, as a result of the inadequacy of financial resources or housing conditions.

It should also be noted that only six member states (Austria, Belgium, France, Hungary, Ireland and the UK) have attempted to measure fuel poverty in any meaningful sense (Thomson & Snell, 2014).

In order to protect health and well-being, all households require a minimum standard of heating and electricity in their home.

The cost of this varies from country to country, but in Northern Ireland households should ideally need no more than 15% of their income to achieve this minimum standard.

Households that are in fuel poverty are unable to afford this minimum standard.

Consequently:

- many go without heat and electricity because they cannot afford it
- others go without essentials such as food in order to pay for heat and light

People in low incomes are most likely to experience fuel poverty, especially if they live in homes which have poor quality insulation and heating. However, when energy prices are high, fuel poverty can become widespread throughout a region.

Box 1: A lay definition of fuel poverty (Liddell *et al.*, 2011:65)

According to Liddell *et al.* (2011) a formal definition of fuel poverty should allow for information to be collected in three different areas to formulate a strategy for tackling fuel poverty, to shape policies that achieve that strategy's objectives, and to guide programmes that tackle the strategy's objectives. The three areas are as follows:

- **Extent.** A definition should provide a means by which the prevalence of fuel poverty can be quantified, and hence monitored over time.
- **Demography of risk.** A definition should provide a means of determining who the fuel poor are, according to criteria such as age, tenure, and household type.
- **Geography of risk.** A definition should help identify where the fuel poor are most likely to be located.

According to the literature, when calculating the extent of fuel poverty three main methods are used to describe and measure it. These are the Expenditure Method, the Objective Method, and the Subjective Method (Scott *et al.*, 2008). Other contributors, including Healy (2004), and Thomson and Snell (2013) have in recent years also proposed a combination of these methods known as the 'Consensual' method. This takes aspects of affordability into account, such as the ability to keep the home adequately warm or to make ends meet, along with aspects of energy efficiency, such as leaking roofs or damp walls. As such, it is a combination of subjective (*e.g.*, ability to keep the home warm) and objective (*e.g.*, leaking roof or damp walls) indicators of fuel poverty (Heindl & Schuessler, 2015).

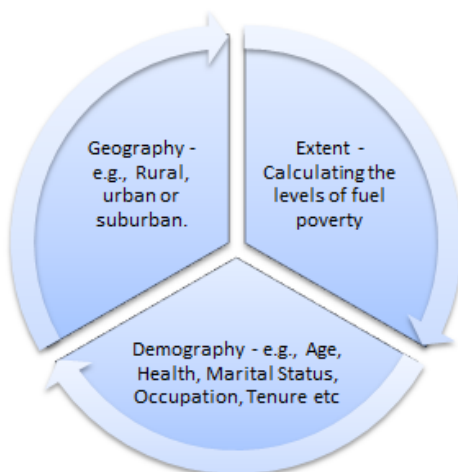


Figure 38: Information requirements for estimating fuel poverty

The Expenditure Method – The Ten Per Cent Rule

The expenditure method is based on the actual spend of a household, and is most often cited as having derived from the work of Brenda Boardman of Oxford University. Particularly noted is her seminal 1991 book titled ‘Fuel Poverty’, which has been described by another expert in the field, Prof. Christine Liddell of the University of Ulster, as a master class in fuel poverty research (Walker *et al.*, 2013). While Boardman did not invent the term, and was not the first to describe it, hers is the most often cited definition in the literature and is still perceived to be one of the most comprehensive works on the issue. According to Boardman fuel poverty occurs when a household is unable to obtain adequate energy services including heating from at least 10% of its income (Shortt *et al.*, 2007; CPA, 2009; Moore, 2012). The Boardman approach is applied in the UK by fuel poverty strategy advocates, where they look to the 10% threshold based on net income – excluding housing costs (Scott *et al.*, 2008). The application of this method has been found to be not always perfect and has been described as somewhat arbitrary in nature. Having said that, it does give an indication of the household resources that are consumed to procure home heating (Scott *et al.*, 2008). One noted problem with the expenditure method is the variation that occurs when trying to make any cross-country comparison using the 10% calculation. Some calculations include housing costs, others exclude them, some use gross income and some use net income, while some countries have more available data than others, e.g., housing condition surveys, and so on (Healy & Clinch, 2002).

The Objective Method – “Needs-To-Spend”

This method is to some extent an elaboration of the expenditure method, but it differs from it in that it is based on modelled spend as opposed to actual spend – modelling what a household needs to spend to achieve an adequate temperature based on the size and characteristics of the home and household and current fuel costs (Watson and Maitre, 2015). This is why this method is often referred to as the ‘Needs-to-Spend’ method. It was first used in the 1996 English Housing Condition Survey. Under-heating is a very common practice in the UK, and consequently is not accounted for in actual spend calculations. However, it is accounted for, when the Needs-to-Spend metric is used. The Needs-to-Spend method is embodied in the UK’s fuel poverty policy (Liddell *et al.*, 2011). It has been proposed by several authors that fuel poverty should be measured against a Minimum Income Standard (MIS) in order to establish if what the household needs to spend on energy is available within the available disposable income limits of the MIS (Heindl & Schuessler, 2015). The MIS is defined as “income required for a specified household type to reach a socially acceptable minimum living standard. It is based on research on what members of the public, informed by experts where appropriate, think is needed to achieve this minimum living standard...In contrast to poverty measures based on arbitrary percentages of average income, the minimum income standard is calculated based on a requisite basket of actual goods and services, as decided by members of the public and selected experts” (Smith *et al.*, 2009; cited in Liddell *et al.*, 2011: 107).

The Needs-to-Spend method is seen as a means to ensure that the most vulnerable households are not excluded, embodying both the letter and the spirit of the UK fuel poverty strategy according to Liddell *et al.* (2009). In the UK, calculating the Needs to Spend proportion of income has been done using the Building Research Establishment (BRE) algorithm known as BREDEM-12 (the BRE Domestic Energy Model), which estimates the cost of heating a property to World Health Organisation (WHO) standards taking into account factors such as the property size, solar gain, insulation, heating systems, fuel prices, climate, and lifestyle (Liddell *et al.*, 2011). BREDEM was developed in the early 1980s and has been continuously reviewed and developed since, however it is not used outside the UK and is unlikely to be adopted elsewhere.

The Subjective Method – Self-Reporting

The subjective indicators of fuel poverty are self-reported indicators based on householder statements made in response to survey questions (Scott *et al.*, 2008). Classifying households using the subjective

measure of 'Feeling Fuel Poor' gives very different results to the 10% expenditure rule. Many households who spend less than 10% of their income feel that they are in fuel poverty, whereas not all homes spending more than 10% consider themselves to be so (Waddas *et al.*, 2012). Comparisons of fuel poverty across the EU use a metric derived from the European Union Survey of Living Conditions (EU-SILC), (UU, 2009; Liddell *et al.*, 2012). This is a subjective method of self-reporting using questions such as:

5. Has the household had to go without heating in the last 12 months?
6. Has the household been unable to afford to keep the house adequately warm in the last 12 months?
7. Has the household been in arrears with energy bills in the last 12 months?

This method also has some issues in terms of its accuracy. There may be that households cannot afford to pay for heating, yet they have high electricity usage levels from non-essential or home entertainment appliances or other utility bills such as television subscriptions, while such outgoings can not be considered necessities, they may often be prioritised in the household energy budgeting. On the other-hand, there may also be households where the occupants have only the bare essentials in fuel-consuming home and heating appliances, but have become so accustomed to poor living conditions or low temperatures that they do not consider themselves to be fuel poor. In 1971 the average indoor temperature in the UK was 13°C, by 1989 it was 15°C, and by 2006 it had risen to 17.5°C (Lidell *et al.*, 2011). This could make it likely that elderly people, for example, may still consider low indoor temperatures to be acceptable while younger people might consider the same temperature ranges to be unacceptable. Others may also be faced with the choice Walker and Day (2012) refer to as 'Heat or Eat', where money spent on fuel is money that has been taken out of the grocery budget, for example.

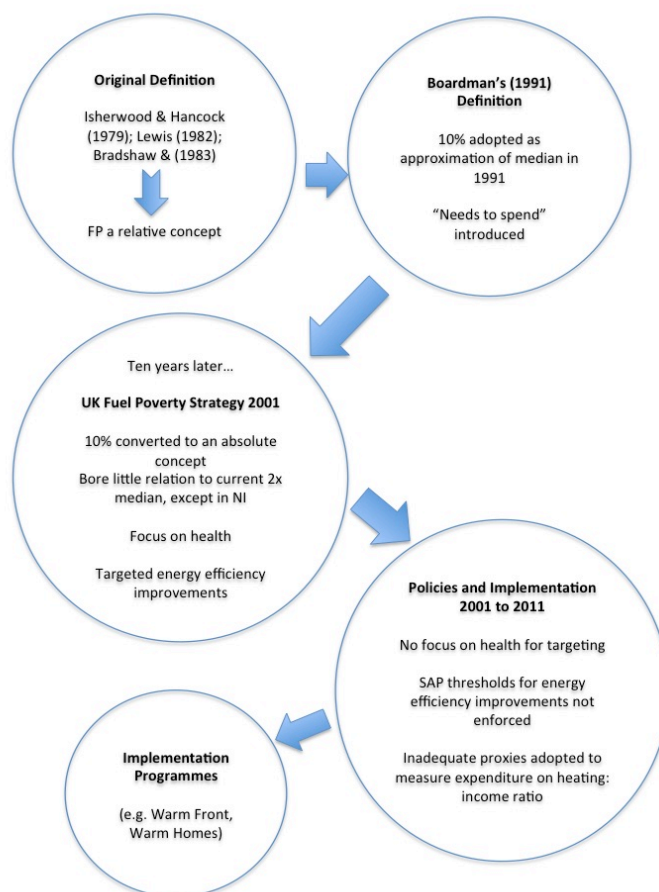


Figure 39: Relationship between Definition, Strategy, Policies and Implementation, of fuel poverty in the UK (adapted from Liddell *et al.*, 2011: 145)

Alternative Terms & Concepts

The following are a collection of the alternative terms and concepts that have been drawn from the literature.

- The Energy Affordability Gap (EAG): The Energy Affordability Gap (EAG) is an approach that was developed in the United States of America and is calculated by subtracting the Affordable Home Energy Bill, from the Actual Home Energy Bill. Under the AEG the Affordable Energy Bill is assumed to be 6% of the gross household income and the Actual bill is a modelled bill where energy costs are calculated as a function of energy use intensity, tenure, house size, household size and type of heating fuel (Liddell, 2008). This is an intuitive indicator that illustrates how much households are over-extending themselves with respect to energy costs.
- Energy Poverty: There is no consensus on what exactly constitutes energy poverty. One definition that has been posted refers to: “households that spend more than a pre-defined threshold share of their overall consumption expenditure on energy products”, where the threshold equals “double of the national average ratio number” (EC, 2010: 10). This sounds rather similar to Fuel Poverty, and is sometimes synonymous with fuel poverty although Moore (2012) suggests that it is often considered to only refer to the costs of electricity and gas and to be somewhat narrower than fuel poverty, which considers all fuels. Therefore, in this form, the term would not be wholly appropriate for use with regards to the island of Ireland since home heating oil is prevalent in rural areas that are not connected to gas grids. 84% of Northern Ireland homes use oil, as opposed to 4% in England, 8% in Wales and 15% in Scotland (Liddell et al., 2011). According to Liddell et al. (2011) it is more often used in relation to developing or industrializing countries in terms of their access (or lack of access) to electricity power grids and their reliance on charcoal and biomass for heating and cooking.
- Affordable Warmth: As an expression of social injustice, fuel poverty highlights the right of access to affordable warmth. Affordable warmth refers to the fuel required for the thermal component of overall fuel use (Walker and Day, 2012). The definition of Affordable Warmth is similar to the Needs to Spend method, in that it considers the fuel costs needed to achieve the minimum-heating regime required to safeguard health or a standard regime to provide thermal comfort, i.e. affordable warmth. Adequate lighting, cooking and typical appliance use are then considered in addition to affordable warmth, when calculating total fuel use and fuel poverty levels as opposed to just the fuel required to keep warm (Moore, 2012; Walker and Day, 2012).
- Energy Insecurity: This term also originated in the United States and has subsequently been used more in climate change narratives than those concerned exclusively with fuel poverty. That being said it is still concerned with overlapping elements of fuel poverty in its definition, “an energy insecure household lacks consistent access to the energy needed for a healthy and safe lifestyle. Children’s Health Watch (2011; cited in Liddell et al., 2011: 63) defines energy insecure families as those who have experienced:
 - threatened utility cut-off
 - actual utility cut-off
 - unheated/uncooled days because of non-payment
 - heating the residence with a cooking stove”
- Energy Precariousness: This is a French concept (*precarité énergétique*) defined in French legislation as “anyone who meets, in its housing, particular difficulties to have the necessary energy to meet its basic energy needs because of the inadequacy of its resources or of its housing conditions” (Dubois, 2011: cited in Liddell et al., 2011: 63).
- Energy Vulnerability: This term is used when the focus is placed on identifying vulnerability indicators in relation to energy. Vulnerable households are generally deemed to be those with children, elderly persons, sick persons, or disabled persons (Liddell et al., 2011), although other complex mathematical formulae for calculating vulnerability indicators also exist (Gonzalez and Moreno, 2015). Other contributors, including Walker and Day (2012), warn against crude generalisations about vulnerable groups that may underestimate the complexity associated with the causes of vulnerability.

3.8.1.2 Fuel Poverty and Health

Living in cold homes can have serious negative effect to one's mental and physical well-being and (worse still) may contribute to higher mortality rates in winter (Hills, 2011). Even when winter outbreaks of influenza are taken into account there is still a strong link between cold temperatures and higher rates of mortality. The difference between the health effects due to very high temperatures and those due to very low temperatures is that the effects on health at high temperatures tend to be immediate (usually on the day of, or the day after the high temperature) and tend to dissipate once temperature levels drop. The effects of cold temperatures, however, can persist for days after the temperature drop takes place according to studies from America that show the links between high and low temperatures and cardiovascular mortality (Goodman et al., 2011).

The link between higher rates of death and cardiovascular disease and a sharp drop in temperature is well proven; along with links to other conditions requiring hospitalisation in cold temperatures include hypothermia, respiratory problems and pneumonia. Elderly people are especially at risk, as research shows that people over 65 years of age are seven times as likely to be hospitalised as a result of frigid temperatures (Houston, 2015). Levels of surplus, or excess deaths during winter (December to March inclusive) due to the cold (EWD – excess weather deaths or excess winter mortality (EWM)), are very high in Ireland and the UK. In Ireland the figure of EWDs is estimated at 2,800 per annum – one of the highest levels in the EU. The number of EWDs in England and Wales has fallen from 40,000 per annum in the 1970s to 27,000 in recent times, which is still more than ten times the figure for road deaths (Lidell, 2008 & Hills, 2011). Globally the WHO states that fuel poverty causes more deaths than TB or Malaria (Gonzalez-Eguino, 2015). The figures for Ireland and the UK are actually far higher than those for countries like Norway and Sweden, which have much colder winters as shown in Figure 40.

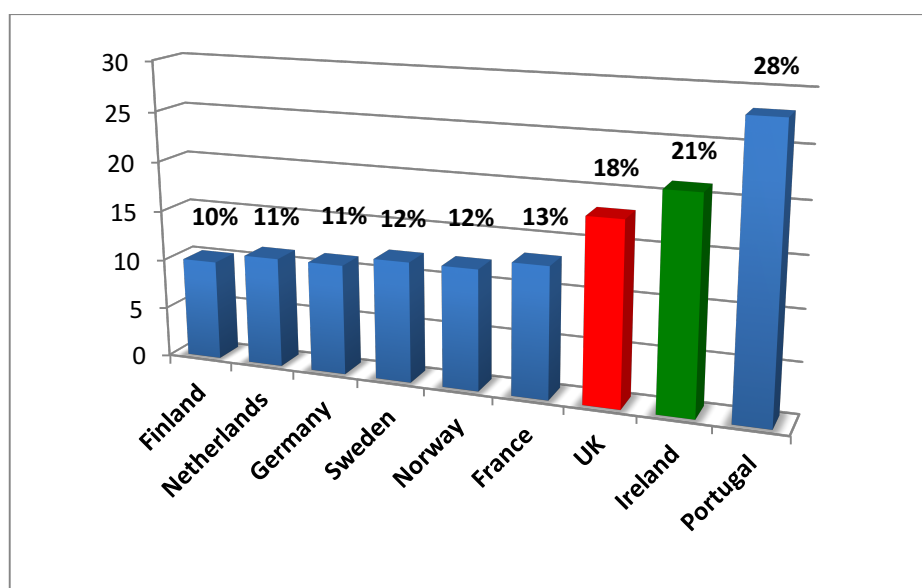


Figure 40: Excess winter deaths 1988-1997, selected European Countries (adapted from Healy, 2003; cited in Hills, 2011: 71)

The most serious health effects associated with cold temperatures manifest themselves in the form of cardiovascular and respiratory illnesses (Hills, 2011). The occurrences of each are more likely when temperatures drop below the following levels: Below 16°C – respiratory problems; Below 12°C – circulatory problems. Below 5-6°C – risk of hypothermia.

Sudden increases in winter deaths are not normally recorded as being due to hypothermia, but cold weather interacts with other mitigating factors too, triggering deaths from cardiovascular and respiratory illnesses. A study of temperature-related mortality rates in Dublin showed that for every one degree drop in temperature there is a 2.6% increase in total mortality over the following 40 days. The maximum effects

tend to be felt within three days of the cold peak. This study showed similar results to other studies conducted elsewhere, including England, Scotland and London in particular (Goodman et al., 2011). It is interesting to note that some of the highest rates of excess winter mortality have been recorded in countries like Spain and Greece, which both have relatively mild winters, while much lower rates of excess weather deaths (EWDs) appear to occur in Scandinavian countries, all of which have extremely cold winters. Countries like Spain and Greece have traditionally tended to build their homes with a focus on keeping cool during the summer months, whereas conserving heat and improving thermal efficiency in buildings during the winter months has long been a design goal in northern European countries. This is reflected in the statistics with the rise in the number of cold related deaths correlating with the drop in outdoor temperatures below 23°C in Greece, 17°C in Holland and only at 12°C in Stockholm (Liddell et al, 2011).

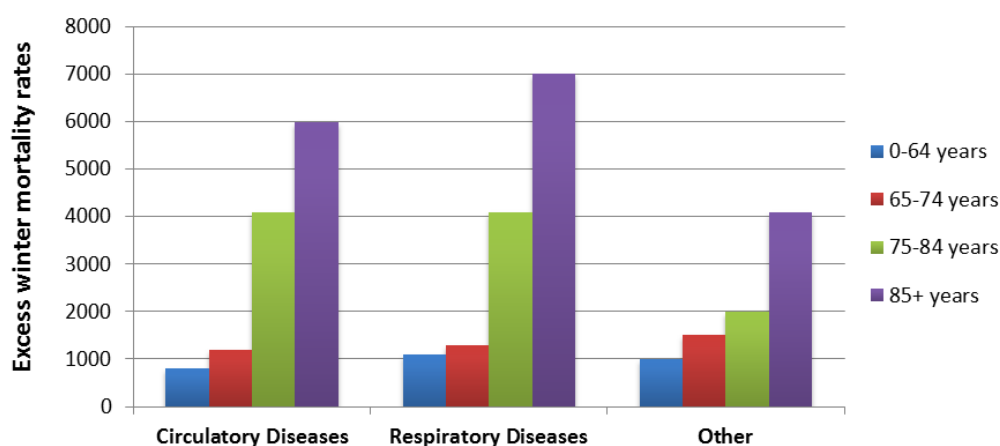


Figure 41: Excess winter deaths by cause and age group 2008/09, England and Wales (Office for National Statistics UK, 2010; cited in Hills, 2011: 72)

These negative health related effects can be exacerbated by the 'Heat or Eat' factor where people may forgo healthy eating in order to pay for heating, and then suffer from the effects of low calorie intake and/or poor diet instead of low temperatures (Walker and Day, 2012). This phenomenon can prove especially detrimental for certain groups such as very young children and the elderly (Liddell, 2008). Households may also have to go into debt in order to pay for fuel, at which point they are very likely to be at risk of stress and other mental health problems. According to McAvoy (2007) the cost of fuel-poverty to the Health Service in Northern Ireland has been estimated at GBP£30 million annually, while the estimated cost in the Ireland is €58 million per annum.

3.8.1.3 Case Study: Fuel Poverty Levels in Ireland and the UK

The 10% threshold, whereby households are either in or out of fuel poverty depending on whether they spend more or less than twice the median amount on fuel (which come to around 10% of their income) is most common and also most appropriate to England. In Northern Ireland, however, 10% is not approximate to twice the median since fuel costs are much higher there, due to the prevalence in use of home heating oil. Therefore, there is strong argument for more regional assessments to be incorporated into the calculations. In addition, in Scotland the definition of fuel poverty goes beyond the 10% spend threshold (or the twice the median threshold) with additional categories included in the fuel poverty matrix there. These categories include:

- Severe fuel poverty, where a household is required to spend 15-20% (or between three and four times the median) to meet its heating needs
- Extreme fuel poverty, where a household is required to spend more than 20% (i.e. greater than four times the median expenditure) to meet its heating needs (Liddell et al., 2012)

Building Standards for thermal efficiency for new buildings in Ireland and the UK are now such that it would be difficult to fall into fuel poverty, if one were to reside in one of these new buildings. However, new builds account for such a small portion of current building stock that this does not yet constitute a sufficient policy intervention. Addressing the issue by controlling fuel prices is not feasible for Ireland, since it imports the majority of its fuel and is therefore at the mercy of international fuel pricing trends. The UK, which is now importing more oil and gas than it is producing, is also ceding control of its fuel prices. The (grant-aided/subsidised) upgrading of existing building stock, along with winter fuel payments and heating and electricity allowances, through various social welfare schemes, appear to be the most effective methods of policy intervention available to both countries at present.

Fuel Poverty figures for Ireland

Figures for fuel poverty seem to vary widely in the literature, and as mentioned earlier, even within one country depending on the research being referenced. Accurate cross-country like-for-like comparisons are also virtually impossible due to different measurement methods being applied in each country. According to Liddell et al. (2011), when calculating the numbers for households in fuel poverty in Ireland the numbers ranged from 117,264, using one definition, to 2.4 times that number (396,947) when an alternative definition was applied. Furthermore, and again depending on the definition selected, fuel poverty prevalence rates between 2004 and 2009 had either reduced by 1% or increased by as much as 73%. Unlike the UK, Ireland does not appear to have a coherent fuel poverty strategy. It is a policy issue that has been taken up by several government departments with differing policy goals between them.

From the literature, the amount of Irish households coping with fuel poverty seems to be anywhere between 4% and 21%. Much of the literature points to calculations using the expenditure method in Ireland. However, Healy and Clinch (2002) – who espouse the consensual method – have in the past carried out some of the most extensive research into the matter in Ireland. Their calculations put the figures for occasional fuel poverty at 12.7% and persistent fuel poverty at 4.7%. However, these figures are now over a decade old. They also pre-date recent energy cost increases and the current economic downturn. The Institute for Public Health (Ireland) placed the figure for fuel poverty in Ireland for 2007 at 9.5%. Just one year later, Scott et al. (2008) estimated the figure upwards to 19.4%. The OECD calculation for Ireland in 2010 put a figure of 7%, though it must be noted this was for lacking affordable warmth only as opposed to total fuel poverty (Lidell and Morris, 2010). More recently, in the Irish media Buckley (2015) put the figure for 2011 at around 21%, based on an Economic and Social Research Institute (ESRI) research finding published in May. Interestingly the current Irish National Energy Efficiency Action Plan 2014 only mentions Fuel Poverty once in a passing reference to the existence of the Better Energy Warmer Homes grant scheme (DCENR, 2014) and does not provide any detail on the issue beyond that. The Irish Government Policy on Social Inclusion dating back to 2007 does mention fuel poverty, but does not elaborate on this with any figures or a methodology for calculation.

Fuel Poverty figures for the UK

The Fuel Poverty Strategy for England was updated in 2015, while the Northern Ireland Fuel Poverty Strategy was last updated in 2011. The Welsh Fuel Poverty Strategy has not been updated since 2010, but the 2002 Scottish Fuel Poverty Statement was reviewed in 2014. The official method of calculation in the UK is based on the Needs to Spend method and calculations using the BREDEM-12 tool. According the Department of Energy and Climate change (DECC, 2015) the estimated level of fuel poverty for England (based on 2013 estimates) is 12% of households, and for Scotland it is 39% of households. The figures for Wales and Northern Ireland are based on 2012 estimates, since 2013 estimates for those two administrations were not available. Both the Welsh and Northern Ireland administrations provide figures of 30% and 42% respectively (DECC 2015; Davies and Simpson, 2013; Frey *et al.*, 2012). Considering the

similarities between Ireland and Northern Ireland in terms of fuel poverty indicators, fuel prices, climate, and the lack of rural gas grids it seems rather surprising that the figures for Ireland appear to be much lower than for Northern Ireland. This is indeed more curious given that Northern Ireland seems to have been quite proactive and more strongly engaged with the issue (Scott *et al.*, 2008). It is likely that figures for Ireland, if calculated using the Needs-to-Spend model and the same methodologies used in the UK, could actually be far higher than the estimates indicated.

3.8.1.4 Conclusion

Definitions of fuel poverty reflect the close relationship between the three main determinants of fuel poverty; low income, energy inefficient housing and high energy costs, as well as sensitivity or vulnerability to changes in relationships between those determinants, such as loss of income, injury, onset of illness or infirmity, and/or rises in fuel costs. The prevalence of fuel poverty is further shaped by household characteristics such as tenure, education, employment, marital status, number of persons per dwelling, and number of vulnerable persons per dwelling.

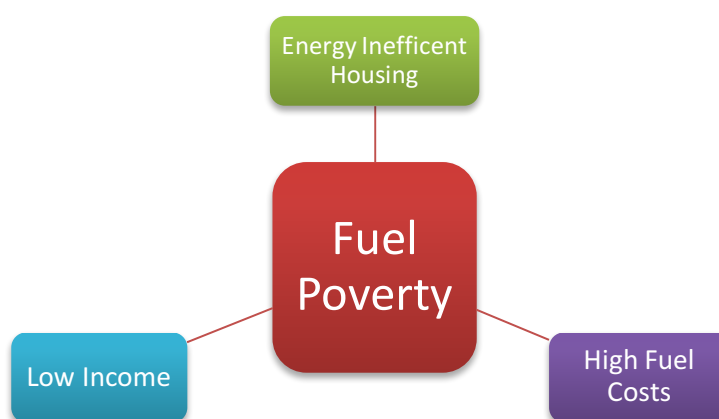


Figure 42: Determinants of Fuel Poverty

From an academic point of view there are several definitions of fuel poverty. From a political and policy perspective there appears to be no meaningful consensus. Having said that, there are now three official Member State definitions within the EU: France, Ireland and the United Kingdom. There are also many alternative concepts found in the literature including: lack of affordable warmth, energy poverty and energy vulnerability. The underlying meaning behind all of these definitions and alternatives is that fuel poverty is essentially the inability to obtain basic energy services and maintain adequate heating, lighting and power in the home.

Due to the different definitions and methods applied in the calculations, any cross-country comparison will need to ensure that the same method is applied in each state. An EU-wide definition and methodology would therefore be most useful for carrying out such like-for-like comparisons, establishing indicators, assessing the scale of the problem and formulating appropriate policy and interventions. For the purposes of a case study, literature pertaining to fuel poverty in Ireland and the UK has been reviewed. The figures found in the literature for Ireland in recent years have varied from between 4% to 21%. The method of calculation appears to be the Expenditure Method in some of the literature but the method is not clear in others. Given the similarity in contributing factors to fuel poverty, in Ireland and Northern Ireland, we have included the 21% rate for Ireland in Figure 43 below. The most recent figures for the UK where the Needs-To-Spend method was used are: England 12%, Scotland 39%, Wales 30%, and Northern Ireland 42%, with the total number of fuel poor households across the UK estimated at 17% (DECC, 2015). Rates of Excess Winter Deaths are also very high in both Ireland and the United Kingdom despite the relatively mild climate in both countries. In the context of global climate change, and the growing insecurity relating to fuel prices

(particularly fossil fuels), Fuel Poverty and Excess Winter Mortality rates are quite rightly a concern for the EU as a whole, and not just Ireland and the UK.

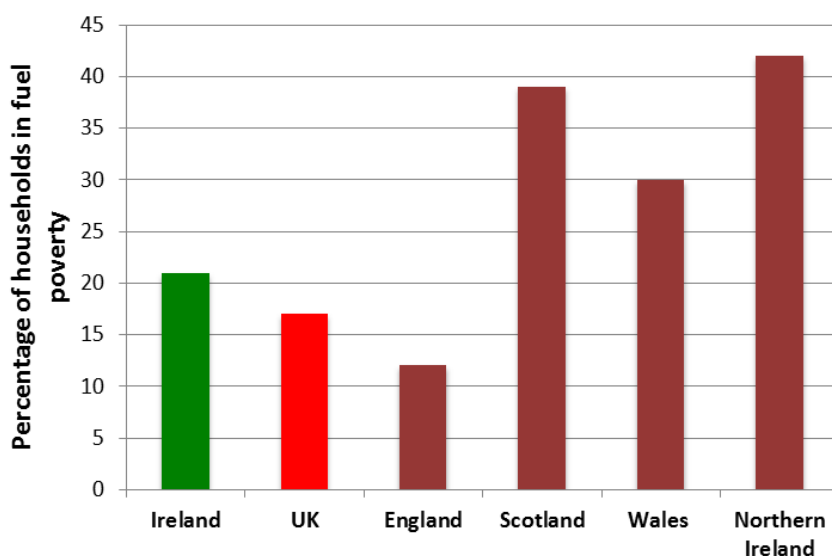


Figure 43: Levels of Fuel Poverty in Ireland and the United Kingdom (England, Scotland, Wales and Northern Ireland)

3.8.2 Renewable energy in Spain

3.8.2.1 Identification of actors and discourses in case-study: Renewable energies

Overview of the topic of Renewables in the energy system

In an effort to reduce the energy dependency of Spain, renewable energy was highlighted as having the potential to make the most of local resources. The Spanish government started its serious commitment to foster renewable energy around 2000. From that time until the present day, the sector has been a “roller coaster”, mainly due to regulatory uncertainty.

Favourable legislation, the government’s commitment, and the interest of many investors, helped to position Spain as one of the global leaders in renewable energy – including business, industries and research centres. However, the subsequent changes in legislation and the economic crisis slowed down the renewable energy sector, which almost ceased its activity. Renewable energy contributes effectively to decarbonisation of the high-fossil dependent energy mix. European legislation and the high level of public acceptance, has helped to develop and deploy the installation of renewables in Spain.

As an introduction to the topic, some figures on the allocation and evolution of renewables in the energy mix are presented below in order to give a clearer picture of the current production, type of renewable source, its potential and its importance with respect to the whole energy sector.

Spain, as part of the European Union, follows the guidelines of the European Directive 2009/28/CE on Renewable Energy, which aims to produce 20% of its primary energy with renewables. In accordance with this directive, Spain developed the *Plan Energías Renovables (PER) 2011-2020* replacing the previous versions 2005-2010 and 2000-2010. The new plan incorporates the two European objectives which are 29.4% of electricity generation from renewables and 5.75% from biofuels.

So, the current Spanish *PER 2011-2020* is aligned to the European Commission objectives; Table 9 presents the estimated progress of the renewable percentages comparing both PER and the European directive, in the Spanish energy mix.

Table 9: Comparison of PER and EU RES shares projection to 2020 (Energía y Sociedad, n.d.)

	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%

With the latest data on the share of renewable energy, Spain achieved a 14.1% (17.06Mtoes) of the primary energy demand in 2013 and 14.6% (17.27 Mtoes) in 2014. Also in 2013, the RES technologies contributed 42.4% of the total electricity production – 119.6TWh – which surpasses the objective set for 2020.

Having a closer look to the renewable sources for each sector, Table 10 describes the power installed and the energy produced from each source during the year 2014 (IDAE, 2015).

Table 10: 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
Thermosolar low T ^o	259		
Geothermal	18		
TOTAL	4.325		

Analysing the above figures, it should be noted that wind and hydropower are the two sources with the largest capacity installed and therefore are the largest RES electricity producers. Regarding renewable thermal production, which includes heating and cooling, biomass and waste has the largest share accounting by 92% of the total heating and cooling renewable production.

It is also worth noting the fluctuations in the installation of renewable power capacity from 2000 to 2014 which reached its peak in 2008. In numbers, the renewable capacity installed in 2000 was 878MW, constant annual growth reached its peak in 2008 when 4,656 MW was installed; from that point on, new installations decreased year by year until 2014 when only 51MW was installed (IDAE, 2015).

Discourses

There are different points of view regarding the implementation and the promotion of renewable energies in Spain, from more radical positions to more sceptical ones; as well as some negative positions – mainly due to personal fears that renewable energy could negatively affect their business.

Pro-renewable discourses

The pro renewable energy discourses, can be assigned to different categories according to the actors' position; however, they agree on most of the arguments, for instance:

- Promoting renewable energy is the best option to decarbonize the energy system and reduce the Green House Gases associated with energy production. This position has a high rate of acceptance within society generally, and also among institutions such as the European Commission.
- Is the cleanest way to reduce energy dependency in Spain, where there are few fossil fuel resources and a high level of dependency on energy imports of around 70.2%. RES can take advantage of local resources, this also has an economic benefit for the national economy – in 2014 renewable energy saved 15,899 M€ on energy imports.
- Economically, the defenders of renewable energy state that the RES sector can produce a positive effect on the national GDP and job creation – fostering local industry and manufacturers, and allowing them to be more competitive as happened between 2005–2009, when Spain was one of the worldwide RES leaders.
- Another point is that renewables are seen as an opportunity for consumers to produce their own energy, becoming prosumers – for instance installing PV panels on the on their rooftops, and promoting decentralised energy production. It is also seen as the first step to uncouple from, and rely less on, the big electricity and gas companies, which don't generate the customer's trust as they behave like an oligopoly.
- During the RES peak, business and investors were in favour of the RES installation only because they see them as an attractive investment. But not anymore because of the changes in the regulations that mean that no more feed-in-tariffs are available.

Anti-renewable discourses

There are a range of sceptical positions, as well as arguments against the implementation and promotion of renewable energy, mainly for economic reasons, as well as the interests of particular lobbies. Some examples follow:

- There is a section of society that argues that the implementation of renewables entails extra costs for electric consumers, although they accept that RES can bring environmental benefits. So, the feed-in-tariffs from which RES producers are benefitting both generate and intensify the current tariff deficit that the Spanish energy system is supporting now, and it imposes an extra cost on the end consumer's energy bill. This is still the case, even though the feed-in-tariffs are no longer applicable, as the accumulated deficit still exists.
- There is also the position that renewable energy costs more than the conventional forms, so the switch should only be done when grid-parity is achieved; and also that renewables are less reliable for their intermittence over time. However, this position is weak nowadays as grid-parity has already been reached with some RES technologies, and the technologies and quality of predictions have evolved.
- The five big traditional utilities in Spain, which have a market share higher than the 90%, the owners of conventional plants (nuclear, thermal, combined cycle), as well as the distribution network (DSO) and energy retailers (contravening the unbundling principles of the energy sector) took positions in the renewables market. However, they were totally against the entrance of new players in the energy arena.
- To finalize, it should be pointed out that on October 9th 2015 the regulation regarding self-consumption in Spain was approved (Royal Decree 900/2015), with much controversy among the pro-RES advocates, which see this RD endanger the deployment of self-consumption, instead of promoting it. Primarily, this RD stipulates imposing a tax on domestic producers on account of their connection to the grid (the so-called "taxing the sun") in order to contribute to the system's cost. It does not allow sharing the same installation among a number of consumers, among other restrictions. The Spanish government wants to avoid the bankruptcy of the electricity market (due to the tariff deficit) by taxing the prosumers.

Actors

- **Government:** It is responsible for the regulation of renewable energy in the energy mix, and is the main actor according to the legislation. The renewables sector reached its height some years ago and is at its lowest at the present.
- **European Commission:** It is a high level actor. Spain, as part of European Union, has to follow the European Directives in terms of renewable energy. The EC is responsible for establishing the targets, and giving the guidelines to each state, so Spanish regulation is subjected to the EU Directives.
- **Big energy companies:** The largest energy utilities (Endesa, Iberdrola, Gas Natural, EDP, and Viesgo) have almost 90% of the total market share of both gas and electricity. They are the owners, and responsible for the large conventional power plants (nuclear, thermal, combined cycles, and also hydropower). They coordinate with each other, working together as a powerful lobby to protect their interests, and ensuring that they have the power to wield their influence on the government's decisions.
- **Green 100% retailers, change energy model:** Since the liberalisation of the market new utilities, mainly traders but also some small producers want to enter to the market by offering a better customer service or cheaper, but also offering 100% renewable energy as a differentiation factor of their business.
- **RES associations and NGOs:** Another important actor inside the renewable energy sector are the different associations promoting RES as a whole, or promoting a particular renewable source (wind, solar PV, biomass). They also act as a lobby, however, their influence is quite low with the government. They also aim to:
 - Make society more conscious of the importance of changing the energy model, and promoting the use of the renewable sources.
 - Protect the interests of the agents of the renewable energy sector, for instance the small and medium PV plant owners and investors that are in trouble due to the changes in the regulation.
 - Help and give information to different groups of people, such as in rural areas, giving advice to land owners on the use of biomass.
- **Building sector:** the RD 7/2006 which regards the Código Técnico Edificación (CTE), the Spanish new building code, establishes the mandatory installation of solar thermal and PV panels in new building construction.
- **Universities, research centres and companies:** The activity of all of them has decreased, in part, due to the regulation, but also due to the economic crisis. Education, research and industry were the leaders of the sector for a period of time, however nowadays this sector's influence and activity is much lower.
- **Civil society:** End consumers are the last step in the energy chain – both residential and industrial – today the commitment to RES is only theoretical – it is recognised that it is of benefit to the environment, but in practice, it entails an economic effort that a major part of society is not able to afford.

3.8.2.2 Actor-networks

Identification and selection of actor-networks to be analysed

Figure 44 presents all the different actors into the renewable energy sector in Spain – showing the interconnections between the actors mentioned. In this overview, the Spanish government is placed in the centre of the network branching out to the other actors in the network. The principle behind that positioning is that the government is the policy-maker and regulator affecting the activities of the renewable energy sector, and its actors. Because the national government is following the European Directives imposed by the European Union, the EU is included in the network, as it is an actor that has a direct influence on the government's decision-making.

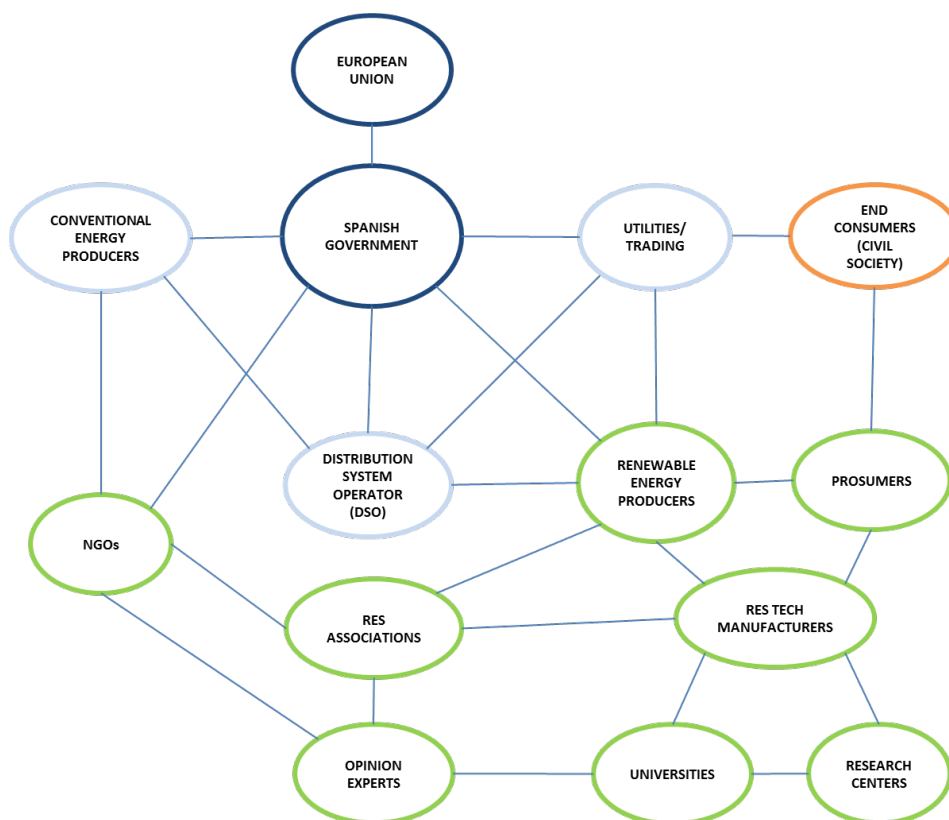


Figure 44: Spanish renewables actor-networks

Laws and Royal Decrees that regulate the renewable energy sector, affected the already existing agents in the traditional energy sector:

- Conventional energy producers, such as nuclear and thermal plant owners or natural gas providers, have seen the renewable feed-in-tariffs as a threat to their activities. They took a strong position against it, and put pressure on the government to remove them.
- Distribution System Operator (DSO) and Utilities/Trading are included in the actor-network as in the RD 436/2004 states that the RES producer can sell the energy generated either to the DSO (for whom it is mandatory to purchase it) or, if preferable, to the trader (after the liberalization of the electricity market) with a bilateral agreement.
- The end-consumers are part of the energy sector, and they are directly affected by government regulations, as the cost of the feed-in-tariffs has an impact on their bills.
- The prosumers are also affected by the regulation changes. As mentioned above, on October, 9th, 2015 the government approved the Royal Decree that regulates self-consumption, placing significant obstacles against its further development.

The lower part of the diagram is exclusively related the renewable energy agents and actors, which are marked in green, and are analysed below:

- The renewable energy producers (PV, wind, thermoelectric, biomass, biogas...) that were established, did so in most cases as it was a secure investment due to the feed-in-tariffs provided by government regulations, and many investors were attracted for this reason.
- The large number of producers attracted to developing RES had a direct and positive effect on renewable energy technology providers. The increased demand for technological expertise during the peak years fostered the growth of renewable energy business and companies supporting the development of renewable energy. These had a significant impact on the evolution of the wind and solar thermoelectric Spanish industries, for example, into worldwide leaders. When the government decided to cut the subsidies, the demand for new installations decreased, which resulted in the closing of many industries in the sector.

- This increase in renewables fostered a closer interaction among RES technology providers, universities, and research centres – which were also supported by the government. Nowadays, this interaction has been reduced, again for the same reasons mentioned above.
- This period of time saw the formation of a variety of RES groups and associations, for instance to promote renewable energy as a whole, or a particular renewable source like PV, wind, biomass, etc. Nowadays, these associations are more focused on providing legal assistance to the small and medium RES producers and investors affected by the regulatory changes; and on putting pressure on the government.
- NGOs have more of a presence nowadays because of the negative position of the renewable sector, and the lack of incentives given for its promotion. NGOs are included in this actor-network, as critics who are putting pressure on the government to ease the regulations hindering the implementation of RES. Another focus of pressure by the NGOs is on the conventional energy producers (nuclear and coal). NGOs are allies of the RES producers, and technology manufacturers; and they are aligned with RES associations, and with RES opinion leaders.

3.8.2.3 Overview of key actor-networks at play

Classification of actor-networks

Government

The government actor-network concerns high level actors with a significant level of power and the authority required to make decisions. The government is the policy maker, and, subject only to EU guidelines, has complete legislative control. The link between the dominant traditional utilities and the government is very strong as many retired politicians are currently assisting these large utilities, in order to influence the policies and laws introduced by the government, to benefit their interests.

The former government brought instability to the Spanish energy market through their regulatory changes which retrospectively changed the incentives to producers. The current government excuses their lack of support to the renewable energy sector for economic reasons, arguing that it is necessary in order to balance the electricity tariff deficit. These actions generated hostility and significant criticism from the pro-RES movement, as the new regulatory regime is seen as an obstacle to the further deployment of renewable energy.

Pro's movement

The actors in the pro-movement network have a high level of knowledge on renewables, as it is the primary part of their business or career; however they are not in a position to have an impact on decisions that could influence the regulation, meaning they have little decision-making power. Their strength is their close association with civil society, end-users, and the RES producers and prosumers which are the most affected by the unexpected regulation changes. The majority of their actions are coordinated, and supported with practical reasoning and research. They are highly critical of, and strongly against, the regulatory changes because they put many obstacles in the path of the development of the renewable energy sector – the latest clear example of this is the RD regarding self-consumption.

Evolution of actor-networks with key energy system trends at EU and country levels

Evolution of actor-networks with regards to key trends

EU guidelines provide a framework which will influence the direction that the national governments take, and which can be modified depending on their requirements. It will be interesting to see if, in the future, the EU will increase its influence within the actor-network, becoming a more significant actor, and, if then, will the national government's role become more limited. From the other perspective, looking at the past, the manufacturers of renewables, research centres, and renewable energy producers had a really high practical and instrumental impact in the whole energy sector. However, nowadays their influence has been

significantly reduced, and the role of the RES associations and NGOs is primarily confined to criticising government decisions, and the current situation regarding RES.

Internal and external locks and levers that foster/prevent change and actor-networks evolution

The current economic situation in Spain is one of the most significant blocks to the implementation of the desired renewable energy policies. In addition, the historically close relationship between the government and large utilities has long influenced the energy system giving both of them a dominant role inside the network. More recently, the liberalisation of the energy market offered the possibility of reducing the dominance of these large companies, however they have retained their power, and still control the generation, distribution and trading of energy. A lever that could foster changes in the actor-network would be the severing of the close association between government and the interests of the dominant players in the energy sector – which could bring impartiality to the government’s decision-making processes and law-making.

3.8.3 Italian energy independence

3.8.3.1 Introduction

Security of the energy supply is a central topic of the energy discourses in Europe, and it concerns every Member State, even if some are more vulnerable than others. Today, the EU imports 53% of the energy it consumes. Energy import dependency relates to crude oil (almost 90%), natural gas (66%), and to a lesser extent, solid fuels (42%), as well as nuclear fuel (40%) (Eurostat, 2015).

The EU external energy bill represents more than €1 billion per day (around €400 billion in 2013) and more than a fifth of total EU imports. The EU imports more than €300 billion of crude oil and oil products, of which one third is from Russia. Italy is one of the EU countries most affected by energy dependence. In 2014 Italy imported 73.6% of its total energy, much higher than the EU average of 53%. Even if the trend is decreasing, with a small reduction in comparison to that of 74.7% in 2013, a lot still needs to be done to achieve a more secure Italian energy system.

The main aim of this case-study analysis is to define the problem of energy dependency in Italy, and to discuss the different strategies proposed to improve the security and economic competitiveness of the country.

3.8.3.2 The historical view of energy dependency in Italy

Between the end of the 19th and the beginning of the 20th Century, thanks to the development of the national transmission grid, and the availability of hydroelectricity from the Alps, the energy supply in Italy was internally sourced. The low energy demand was entirely met by several hydroelectric power plants that were developed in those years. For a period, this gave Italy the illusion of the possibility of energy independence. Moreover, in 1904, the first geothermal power plant in the world was built in Larderello. This plant is still active today, even if, due to the restricted area covered, its contribution never exceeded 8% of the total national demand.

After WWII, it became clear that hydroelectric power alone was not enough for the growing industrial energy needs, and Italy couldn’t afford energy independence. Hydroelectric power was almost totally exploited by the 1950s and the building of new hydroelectric power plants in less convenient spots was halted just a few years later due to a series of tragic accidents like the Vajont Disaster. With increased energy needs, and no potential for further exploitation of hydroelectric generation, thermal power plants started to be built again. Energy security and dependence issues were not seen as a big problem during the years of rapid economic growth and low oil prices. Only after the oil crises in 1973 and 1979, was the diversification of the energy mix a consideration in the Italian energy strategy, with an increased use of coal and energy importation.

Italy was one of the first countries to integrate nuclear into the energy mix. It started to use it during the first half of the 1960s, and by 1966 Italy was the third largest producer of nuclear energy in the world. At the end of 1970 a big injection of confidence was given to nuclear industry with the proposed building of new nuclear power plants. The aim was to make nuclear a central part of the energy system, reducing the need for energy imports. However, many of those projects either did not commence, or were not completed as a result of a national referendum in 1987, when Italian citizens decided to abandon the use of nuclear energy following the Chernobyl nuclear disaster, which had occurred the same year.

The increase in energy demand, together with the economic and geopolitical uncertainties related to oil, forced Italy to intensify its effort to diversify the energy mix. The price of oil was rapidly increasing, and coal had a high social cost, due to its polluting effect – so natural gas started to be adopted. Italy started to import electricity, in particular from France and Switzerland, due to night-time overproduction in those two countries, because of the constant energy production from nuclear plants. Renewables started to be financed, but their implementation was still too marginal to constitute a remarkable improvement in Italian energy independence.

With the difficult economic situation generated in Italy by the global crisis and the rising awareness of the energy dependence problem, the government lead by Berlusconi, in 2008, proposed a reintroduction of nuclear energy production into the Italian energy mix. This was seen as an effective way to reduce greenhouse emissions, improve energy security, and reduce importation. The building of ten new nuclear power plants was proposed, in order to meet up to 25% of national energy needs. However, in 2011, Italian public opinion was again negatively influenced by the nuclear accident of Fukushima, and in a new referendum, the people decided to definitively abandon nuclear energy in Italy.

The 21st Century has seen the rapid growth of renewable energies, especially solar in Italy, thanks to the increased international awareness of climatic issues, the Kyoto protocol, and the Europe 2020 targets. However, the energy mix is still dominated by fossil fuels and Italy is still highly dependent on gas and oil imports. Efforts have been made to diversify with regard to the supplier countries, and Italy is in a better situation than many other EU countries in that regard, but it is still highly dependent on gas imports from Russia.

In order to gain more direct access to Russian gas, to reduce costs, and to increase its importance in the European market, Italy signed an agreement with Russia in 2009 for the construction of a pipeline from Russia to south Italy – passing through the Black Sea, Bulgaria, and Greece – called South Stream. Due to the opposition of the government of Bulgaria, after the Ukrainian war, and the increasing costs of the project, the South Stream was cancelled in 2014.

Another important project, proposed in 2013, is the Trans Adriatic Pipeline (TAP), which will bring natural gas coming from Azerbaijan into Italy. This project will help Italy to reduce its dependency on Russian gas, and to become a transit country for gas coming from Azerbaijan to northern Europe. The TAP is supposed to be completed before the end of 2020.

3.8.3.3 Overview of the energy importation system in Italy

Importation statistics

The most recently available Eurostat data (2013) shows that Italy has reached its lowest level of energy dependency since 1990, with net importation for gross inland consumption down to 76.9%, compared to 84% in 1990. Despite the improvement, this value is still much higher than the European average of 53.2%.

Italy imports much of its oil (90% of total consumption), which is increasingly concentrated in the transportation sector; and its natural gas (91%), which is used for generating electricity in combined cycle plants, for district heating, and as a fuel for transport. The supply mix remains dominated by oil and natural

gas, which – although now declining – have together accounted for well over 70% of Italy's energy since 1973.

Oil imports (crude and refined) have decreased by 38% over the period 1990-2012, while natural gas has increased by 119% in the same period. Growing economic and geopolitical uncertainties related to oil supplier countries, together with a more stable price and the lower environmental impact of gas, have contributed to the increased replacement of oil with natural gas in thermal power plants. The old oil-fired plants are used only to guarantee the fuel-switching mechanism during a possible gas system crisis.

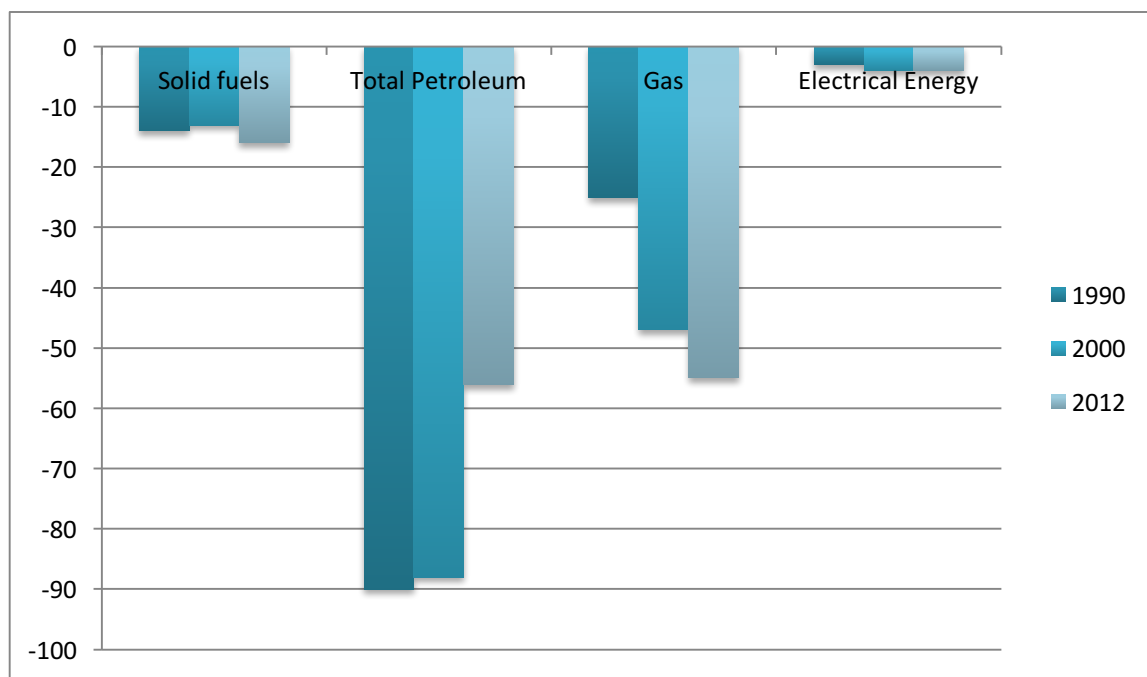


Figure 45: Italy, energy import by source in 1990, 2000 and 2012

Italy imports significant amounts of electricity, especially from France and Switzerland, and benefits from low prices driven by excess power during off-peak periods. Electricity production has seen a rapid development of renewable technologies, which (for the first time in 2013) have exceeded natural gas as the primary source of electricity production.

Concerning coal, Italy represents an anomaly. Even without the presence of nuclear in the energy mix, only 13% of energy was produced by coal in 2014, against the 35% average of EU. In 2012 Italy imported 4.6 million tons of coal.

Supplier countries and infrastructure

Natural Gas: Data provided by the Italian Ministry of the Economic Development for 2013, show that Italian natural gas importation amounts to 61.9 billion of m³, the great majority of which coming from Russia (45.3%). Other main gas suppliers are Algeria (20.2%) and Libya (9.2%) (Ministry of the Economic Development, 2014). Imported gas is roughly ten times the amount of indigenous gas production in Italy.

There are four natural gas pipelines (TransMed, Greenstream, TAG, TENP/Transitgas) and three LNG terminals for importing natural gas into Italy. Two pipeline 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 north-east 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).

Oil: Data provided by Unione Petrolifera, shows that Italy imported 49.3 Mtoe of oil in 2014. The majority came from ex-USSR countries (41.8% of the total); of these, 17% was imported from Russia, and 17.1% from Azerbaijan. Other important suppliers were the Middle East (23.6%) and Africa (24.3%).

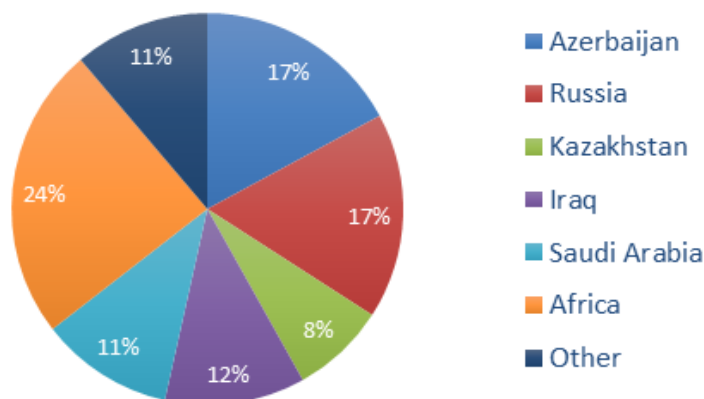


Figure 46: Italy, oil import by supplier countries, 2014 (Unione Petrolifera, 2015)

Italy has 16 crude oil tanker ports, four of which (Taranto, Milazzo, Falconara [Ancona], and Augusta [Santa Panagia]) can receive cargo ships of up to 300 000 dead weight tonnes. As most refineries are located along the Mediterranean coast, there are relatively few crude oil pipelines in Italy. There are two major crude oil pipelines: The Central European Line (CEL) from Genoa (1 mb/d capacity), which supplies inland refineries in northern Italy and the Swiss refinery of Collombey; and the Trans-Alpine Pipeline (TAL) from Trieste, which supplies Germany, Austria and the Czech Republic. The trunk line, from Trieste to Ingolstadt (TAL-IG), has a capacity of 850 kb/d. However, there is no connection between the eastern and western halves of the northern pipeline network, reducing its potential flexibility during an oil supply disruption.

Coal: Italy imports 90% of its coal via the sea, thanks to a fleet of 60 ships. Supplier countries are several, the most important being the USA, South Africa, Australia, Indonesia, and Colombia.

Impact of energy dependency on society

The high dependency on energy imports has had a considerable impact on many aspects of the economy and society. The most significant one is the high price Italy has to pay to buy energy from supplier countries, which is affected by market fluctuations and changing international scenarios. In 2012, energy imports represented 65 billion euros, and this cost is destined to increase if Italy does not reduce its dependence on imported energy.

This expense has a negative impact on energy bills, which in Italy are among the highest in the EU. Of course, many factors are responsible for high energy bills, such as high taxation and the cost of incentives for renewables – but a reduction in the importation of primary energy would definitely translate into a price reduction in the energy bills for consumers.

Another important impact of energy dependency, in particular gas, on society is relative to the security of supply in emergencies. The combined effect of a low gas storage infrastructure on Italian territory, and the high percentage of natural gas coming from a single supplier, Russia, resulted in a gas crisis in February 2012. That year, an extremely cold winter blocked gas supply from Russia for a period longer than the maximum that was sustainable from Italian storage, and the Government had to suspend supply to several industries in order to provide the gas needed for district heating.

3.8.3.4 Actions to improve energy security

In the current difficult economic situation, Italy is directing its effort towards sustainable growth, in order to obtain an improvement in the competitiveness of the economic system. It is also necessary that economic growth is achieved while maintaining the focus on environmental sustainability issues. For this

reason, Italy produced a National Energy Strategy (Strategia Energetica Nazionale, SEN), approved in March 2013, which set the targets and strategies for the energy system transition towards European 2020 and 2030 objectives. This strategy defines four main objectives:

- To reduce the gap between Italian and European energy prices
- To reach and exceed European 2020 energy targets
- To improve energy security
- To promote sustainable economic growth

The proposed strategies to improve energy security in Italy are given focus here.

Analysis of SEN strategies to improve security of supply

Energy efficiency improvement

Energy efficiency is the main, and most effective, tool to achieve all 2020 energy and environmental targets. In particular, reducing the demand for energy is the most direct way to reduce primary energy importation, with benefits to the overall system. Italy foresees, for 2020, a reduction of around 8 billion €/year on energy importation. Improved energy efficiency will also lead to reduced costs for the consumer, reduced greenhouse emissions, and improved energy security.

Italy has taken a leadership role in the field of energy efficiency compared to other EU countries, thanks to the interventions defined in the Action Plan on Energy Efficiency (Piano d'Azione sull'Efficienza Energetica, PAEE) in 2007, such as financing and subsidies for efficiency improvement measures, the implementation of White Certificates, and defining minimum performance levels. However, a large margin for improvement still persists and, even though efficiency measures always generate positive outcomes, institutional and financial barriers slow down its implementation.

Make Italy a hub for the south-European gas market

Gas is destined to remain a key component of the Italian energy mix in the near and medium future. For this reason, Italy should take advantage of its central geographical location in the Mediterranean Sea to become a key hub for the south-European gas market, developing a more competitive gas market.

There are a number of advantages to this strategy. By becoming a central point of passage from southern to northern Europe, Italy would strengthen its market and realign its gas prices to the rest of Europe, with a positive impact on electricity prices too. A wider differentiation of gas suppliers would make Italy less dependent on Russia, and so would be of positive benefit for energy security. The construction of new LNG regasification plants would be important, both as gas importation infrastructure – especially at a time where shale gas from the USA is becoming more relevant in the market, and as an efficient tool to maintain energy security during crisis periods. This solution has recently received media attention thanks to the discovery, made by the Italian oil and gas company Eni, of a big natural gas deposit in the Egyptian sea (Lettera 43, 2015).

Sustainable development of renewables

Renewable energy, in 2014, represented 16.7% of total Italian energy consumption, and is the largest source of electricity production, with 43% of the national share. Renewable energy is essential not only to reduce greenhouse emissions in the atmosphere, but also to increase indigenous energy production, and to increase the national energy mix.

Due to the unpredictability and the discontinuities of supply from renewable energies, the SEN foresees an improvement in the national grid, with more connections, and the introduction of smart grids to manage the instabilities in production, as well as integration with traditional technologies – in order to guarantee energy security during periods of low or zero activity of renewables.

Italy is taking a leadership role in implementing RES, having already reached its 2020 targets in 2014, however, in part, this result has been achieved thanks to an over generous financing system. For this reason, in 2014, the Government proposed a reduction in financing for renewables, but had to face strong opposition from environmental NGOs, and negative public opinion. Even with the technical and economic limitations that green energies present nowadays, the great majority of Italian citizens support their implementation and financing, with 89% of them considering renewable energy a sign of the country's evolution (Ansa, 2011).

Increase production of national reserves of fossil fuel

Italy has the biggest fossil fuel reserves of south-continental Europe, fifth after Norway, the Netherlands, the UK, and Denmark. Its certified reserves amount to 700 Mtoe, however, considering the fact that exploration in the last ten years has been almost zero, this value may be higher. In particular, the Adriatic Sea and Sicily present the most promising areas.

Actual production amounts to 7% of the total National needs and SEN aims at reaching 14%. Knowing well the environmental impact of the fossil fuel extraction process, the Government intends to stipulate stringent security measures, and to forbid extraction in sensitive and protected areas. With an investment of 15 billion €, it will be possible to create 25000 new jobs, and save 5 billion €/year on the national energy bill.

A key factor in the success of this strategy will be the discussions with the local communities, in order to avoid the so-called NIMBY (Not In My Backyard) effect. These discussions will be held, not only on a technical level, but will involve society at many levels: local communities, public administrations, and schools and universities, in order to create a positive dialogue that will include the interests of all parties.

Main actors' representation and motivations

Many actors are taking part in the process of dealing with such a big transition for the Italian energy system. The common actor of the whole network, coordinating and defining the guidelines for future development, is the Italian Government. The main institutions in charge of defining the Italian energy strategy are the Ministry of Economic Development, the Ministry of the Economy and Finance, and the Ministry of the Environment. They have defined the National Energetic Strategy, and they have the role of controlling and guiding all actors in applying it correctly. They allocate public financing for new technologies and scientific research, and they provide simple bureaucratic processes for obtaining financing and permissions. This last point, in particular, is a big barrier in the Italian system.

Regarding the fossil fuel supply system (production, importation, storage, transportation, distribution, and sale), Eni is the most important actor, especially in the first three phases. During the summer of 2015, Eni found an important reserve of gas in the Egyptian sea, which, with its 850 billion m³ of gas, is the biggest reserve ever discovered in the Mediterranean Sea. This discovery has increased public attention on the possibility of making Italy a hub for the South-European gas market. Recently interviewed on the topic, Alberto Clò, one of the most important Italian economists on energy and ex-board member of Eni, declared that this discovery will "strengthen the prospect of Italy becoming a hub for the Mediterranean gas supply to Northern Europe". An immediate effect was the impact on the economic value of Eni, with benefits also for all those companies producing and selling components for the mining industry, which is excellence for Italian industry. Those companies could also take advantage of the renewed extraction of fossil fuels on Italian territory.

On the possibility of increasing oil extraction in Italy, the president of FederPetroli Italia, Michele Marsiglia, said "Italy could satisfy half of its whole national demand". Pro-extraction opinion says that Italy has great potential – new reserves are being found, and, with an intensification of exploration, much more could be found. Oil production is up to 47% of national requirements, increasing production could reduce the energy bill, create new jobs, and give a big impetus to both the local, and the national economy. On the other side,

oil extraction is a delicate topic for Italian people, they are very attached to the landscape, and sensitive on environmental issues; and opposition from environmental NGOs and local communities is strong.

FederPetroli Italia defends its position by referring to the Norwegian model, which has been able to integrate oil extraction and economic growth with environmental safety. It also blamed the Government for lacking interest in the situation, more than the opposition of NGOs, since, as Michele Marsiglia said, the “oil topic is not appealing for electoral purposes”.

Environmental NGOs have an important influence, not only as an opposition, but as a strong promoter for renewable energies, and they engage in intense dialogue with institutional powers. Legambiente, the most important and active NGO, has recently opposed a proposed governmental decree, which aimed to reduce financing for renewable energies other than photovoltaic, denouncing a lack of balance between the need for respecting a limit in financing, and ensuring the growth of renewable energies.

In summary, the strategy to reduce Italian energy dependency is complex and concerns many different sectors of industry, economy, and society. Many actors are involved in the process, and the same actor can support some aspects of the strategy, but oppose some others. The only way to achieve a sustainable economic growth is for actors with opposite view to engage in a dialogue and to find a common path, under the coordination of the central Government – which needs to be active participant in the dialogue as well – providing simple and efficient rules, without getting lost in overcomplicated bureaucracy.

3.8.3.5 Barriers and alternative propositions

The need to reduce Italian energy dependency is widely recognised, and there is no significant opposition to that view. There are a range of different opinions on the best way to achieve this goal. In this section, alternative views and opposing voices will be presented, together with the barriers that currently block the implementation of the strategies discussed above.

Analysis of barriers

Distrust in Italian Government

In the Italian system, one of the main barriers is the distrust of its citizens towards its government and companies. With the evidence of the economic crisis, people have become more aware of political corruption, and in the specific case of Italy, this phenomenon is even more relevant. In the Corruption Perception Index 2014, Italy was classified last in the EU, with only 43 points in a range from 0 (absolutely corrupted) to 100 (absolutely fair). This data gives an indication as to why all big projects find strong opposition; more than simply disagreeing on a technical or economic level, people are afraid that security measures will not be correctly applied, that cheap substandard materials will be substituted to profiteer, and that, in general, corruption will result in a waste of public money and contamination of the environment.

Complicated bureaucracy

Slow and unnecessarily overcomplicated bureaucracy is another barrier that slows down the Italian economy in comparison to the rest of Europe, the cost of renewable energy is increased because of this. Simplifying the authorization process to connect to the national grid, and to activate a plant (especially small ones), would result in a reduction of indirect costs, making renewables more competitive.

Also, investment in the mining industry is limited by an overly complex decision-making process, where waiting time can be up to ten times longer than expected. Exploration and production activities require two or three certificates of authorization, against only one in other European countries. Moreover, decision-making requires consultation between State and Regions, with no time limit imposed.

Initial cost and long-term payback of efficiency measures

Energy efficiency measures often generate a financial reward, which it might be expected, would result, even on a purely rational level, in a wide implementation of these kinds of technologies. Unfortunately, this is not the case. Numerous barriers to their implementation occur, these differ depending on the sector.

- In the civil sector, private users are often discouraged from implementing efficiency measures by the high initial cost of these. This is in conjunction with weak information on the real benefits and the resultant future savings these measures offer.
- In the industrial sector there's a lack of expertise, especially in small and medium companies, to proceed with often complicated interventions. Moreover, due to the difficult economic situation, there's a tendency to avoid long-term investment.
- In public administration, an important barrier is created by the impossibility of obtaining financing, and difficulties in deciding how to allocate costs and risk between different parts.

Analysis of opposition voices and alternative propositions

Increase the use of Coal

Italy is the only country in Europe that, even without making use of nuclear energy, has a very low percentage of coal utilization. Assocarboni denounces this as an inexplicable anomaly in the Italian energy system, presenting the advantages that a higher presence of coal in the Italian energy mix could bring to Italy:

- Security of supply, thanks to the presence of coal reserves in many countries
- Competitive costs
- Labour intensive, creating higher occupation than other sources
- Security in usage and transport
- Environmentally safe, thanks to new GHG emission reduction technology

Assocarboni pushes for an increase in coal usage in order to reduce energy costs, and to improve industrial competitiveness, as well as solving the problem of energy security. They also focus on how the coal-fired power plants present in Italy have received strict environmental European certification, while having an average efficiency of 39%, with peaks of 46% – higher than the European average of 35%.

Even if supported by several positive aspects, their proposition is most probably destined for rejection, as public opinion has already given its full support to renewable energies. Given that the technologies for the containment of carbon emissions are not mature yet, an increase of coal in the energy mix would be a big step backwards from a carbon-free energy system.

Local communities and NIMBY effect

Local communities generally oppose the construction of big new infrastructure in their territory, afraid of the negative impact it could have on the environment, and/or the health of the inhabitants. The reasons behind the so-called NIMBY effect are several, and even infrastructure or technologies that are supported by the wider public can be strongly opposed at local level. This is the case, for example, with wind energy, which found strong opposition at local level, due to the dimensions and noise of the turbines. The main objection to turbine installation is that they will ruin the natural landscape, with negative impact on tourism and the traditional lifestyle of the area. Even stronger opposition is found to infrastructures related to traditional fossil fuels, considered an old and polluting technology. As stated above, local protest gains a lot of its support from the fear of corruption, and the belief that even a worthwhile project will end up causing trouble due to the non-implementation of safety and security measures.

Renewable energies are not competitive yet

One of the main discourses against the rapid increase of renewable energies is that they are not yet competitive with traditional ones, in terms of both performance and cost; although a recent report for the European commission showed that onshore wind energy was Europe's cheapest form of energy (Ecofys 2014). Renewables have rapidly become a significant power source in the energy system thanks to generous financing, which in Italy is paid by the consumers in their final bills. The proposal is not to completely avoid renewable energy, which is still supported as the energy of the future, but to reduce the financing, and introduce more technologically ready systems. Particularly criticised is the Italian financing system for renewables, which for many years has been too generous, creating distortions in the market, and which is unsustainable in the long-term.

Financing on fossil fuels should be redirected toward renewables R&D

On the other side, one pro-RES discourse acknowledges that renewable energies are not yet fully competitive, but still argues that full support must be given to them, whatever the cost. The environment is seen as the priority, and green energy as the only possible path to follow for energy development. Financing for fossil fuels, (for new thermal plants, regasification systems, exploration for gas and oil reserves), should be avoided, and instead redirected towards R&D for green energies. In this way, their development will be much faster, both in terms of the final energy mix, and in terms of technological competitiveness.

3.8.4 The Importance of Nuclear Energy in France

3.8.4.1 Introduction

The representation of the French energy system is often associated with the image of nuclear power by the general public. This idea is especially bolstered by the figures of the French energy mix: 73.3% of national electricity production is generated by 58 nuclear power plants located on 19 sites throughout the national territory (EDF, 2013). To give an idea of the magnitude of the role of nuclear in the country, France has the largest nuclear fleet in the world in proportion to its population and the second largest production capacity (407 TWh in 2012) of the world behind the USA.

Despite the dominance of this technology in the national energy landscape, nuclear remains a divisive topic; furthermore a majority of the French population is unaware of living within 200 km of a nuclear power plant. An IFOP survey conducted in 2014 indicates that 66% of respondents deplore the lack of transparency and information in relation to nuclear energy, which could explain the ambiguous position of French society on the topic (IFOP, 2014). At the same time, a BVA poll (BVA, 2013) carried out in 2013 found that 67% of French people support nuclear energy even if there are strong disparities among the population depending on sex, age, social category and political orientations, whereas 53% of French people back the idea of a progressive exit from nuclear energy. Some of France's European neighbours take the path of denuclearization (Germany and Belgium with a phase out policy, Italy deciding by referendum to not restart a nuclear programme), in the wake of nuclear accidents (Chernobyl, Fukushima). France is proceeding with President Hollande's ambition to cap nuclear production at 50% of the power mix by 2025. We have sought to analyse the features that have driven the French situation by answering the question: how to explain the continued prominence of nuclear power in France? This question is of particular interest in the context of environmental and energy transition and leads to another one: to what extent is the French "energy transition" possible?

3.8.4.2 The historical development of the nuclear industry in France

The post-war reconstruction

At the end of the Second World War, France is a devastated country on account of both the intense fighting and the rigor of the German occupation. The country had one million homeless families, 20% of the housing had been destroyed, and many cities were razed to the ground (Caen, Brest and Le Havre). The electrical industry is seriously affected by the destruction or dismantlement of equipment either needed for the war effort or stolen during the German retreat.

The energy deficit constitutes one of the main curbs on a rapid economic recovery after the Liberation. The shortage of coal due to German exploitation, mine destruction, insufficient miner workforce and equipment wear is a major concern for the government in power, which decided to modernize collieries and promote other sectors such as hydro (large dams built after 1945 in the French Alps) to meet the energy demand. Electricité de France (EDF), the national power company, is created in 1946 to replace approx. 200 local electricity companies existing before World War II.

Additionally, on the advice of the Minister of Reconstruction and Urbanism, President De Gaulle instructed Raoul Dautry and Frédéric Joliot to propose an organization for the French nuclear industry. The Commission for Atomic Energy (CEA) was created in 1945 to develop civil and military atomic research to foster the use of nuclear fission in fields of power generation, industry, science and defence. However, the importance attributed to nuclear in 1945 should not be over-estimated: the French nuclear programme, constructed independently, was not the priority of the government in power, but should be seen as the first step for constructing the French nuclear model.

Nuclear power: core of the political independence of France

The deployment of the French nuclear programme accelerated in 1958 under the direction of President De Gaulle, who confirmed the date of the first French nuclear bomb test. The possession of nuclear weapons as a deterrent was central to the policy of national independence in the Cold War context. At that time, De Gaulle aimed to embody a “third way” between the USSR and USA blocks. The nuclear bomb offered France a position in the Community of Nations, and secured France an independent position, separate from the influence of the two superpowers, by taking part in the “Balance of terror”. The ambition for independence was not only a diplomatic or geopolitical concern but rather a strategic and economic preoccupation since, contrary to most of its neighbours; France does not have very abundant natural resources and relies mainly on energy imports. Progressively losing its colonies, France counts on nuclear energy to support its economic growth.

While nuclear power provides 5% (900 MW) of the electricity produced in France at the end of the 60s, two international events will lead the government of President Pompidou to accelerate dramatically the French nuclear programme. The Yom Kippur War and the first oil shock revealed the Western block’s energy weakness, confirming Minister Messmer’s decision to increase the nuclear generating capacity in the country. This industrial turn, which aims to progressively give France a nuclear park of 50,000 MW, dramatically changed the French energy landscape.

Nuclear power: the extension of French influence

The rapid defeat of France during World War II had tarnished its image as a great nation. Shaken by the process of decolonization, the country sought to restore its greatness; the mastering of the nuclear cycle is expected to contribute to this. The building of a nuclear programme was an object of national pride, which broadcast the technological know-how of the country around the world. This is still relevant today despite the nuclear accidents of Chernobyl and Fukushima, which revealed the potential dangers the nuclear industry can pose. In France, nuclear power is regularly associated with the word “advanced technology”

or “excellence” and the government relays how the extent of French nuclear expertise is frequently recognized abroad.

3.8.4.3 Overview of the nuclear energy system in France

The transformation of the French energy system that accorded a predominant place to nuclear industry has led to large-scale infrastructural changes with numerous consequences.

A new energy model

The progress of nuclear energy in France was logically accompanied by the set-up of a new energy organization in the country. The former supply networks of gas, oil and coal were gradually abandoned due to the depletion of natural resources and the rise of importation costs to make room for a new energy model and new actors.

The mining industry shifts from coal mining to the extraction of uranium ore in 210 extraction (open air or underground) national sites (IRSN, 2009). The low content of ore requires important processes as physical operations (pre-concentration and conditioning) and chemical operations (by acid attack of the ore path and purification of the concentrate) to reach the correct concentration of uranium. These processes take place within large processing plants owned by Cogema, with a relative efficiency: out of 52 million tons of ore treated, it was only possible to produce 76,000 tons of uranium. To meet its demand, France had to resort to importing large amounts of uranium from Australia, Kazakhstan, Canada and Niger. This is now more necessary than ever, as France stopped domestic uranium production in 2001.

This ready-for-use uranium is purchased by EDF, a nationalized company created in 1946 which is the sole provider of public electricity services instead of the 200 electricity companies existing before WWII. EDF is the driving force of the country’s energy policy, ensuring power generation and distribution.

The deployment of the nuclear industry created the new activities of reprocessing, waste management and disposal. It was a completely new energy structure which lead to the creation of specific companies employing a qualified workforce: highly skilled engineers and technicians.

In the same time, nuclear research opened new areas of applications:

- Health: medical imaging and diagnosis through nuclear markers
- Archaeology: radiometric dating
- Agribusiness: food preservation
- Environment: markers

The French nuclear industry has been gradually structured with the creation of Framatome in 1958 (nuclear reactors & engineering) and COGEMA in 1976 (on the nuclear fuel cycle). EDF and Framatome were the driving force of the large-scale nuclear development programme from the 1970s to the 1990s.

In 2001, Framatome and COGEMA merged to form a vertically integrated firm, AREVA, covering the entire nuclear energy cycle, from mining to generation to fuel backend cycle & waste treatment. However, in 2015, this integrated model has been questioned following strategic errors by AREVA, and it is expected that the firm will be divided back into a reactor venture absorbed by EDF, and a separate fuel cycle company.

Impact of the nuclear energy in the French society

Modification of the French economic landscape

The transformation of the French energy landscape led to significant changes in the society. The implications were primarily economic. The creation of a single national company, EDF, to the detriment of independent power producers, is a strong symbol of State interventionism. This centralization process confers upon the State the role of both shareholder and regulator. There were also political implications at

the time. In the post-WWII context, the State is a major player and concentrates the power to make decisions in its own hands. To reaffirm its power, the State tends at this time to impose its decisions with little concern or consultation with public opinion.

Additionally, the transition of the French energy model, from predominantly coal and oil, to predominantly nuclear, left many behind. For instance, in some of the coalmining regions of northern France which were strongly impacted by this transformation, miners protested to express their dissatisfaction. At the time new energy-related activities started in France, mainly industries requiring a more skilled workforce able to integrate new vocational fields. Today, the nuclear industry directly employs 125,000 people across the country (IRSN, 2009). Some regions have developed specific nuclear skills such as Rhône-Alpes in enriching uranium or Burgundy in the manufacture of large components for reactors.

Modification of the French environmental landscape

As the natural environment was not at that time a major concern, the French natural landscape was modified by either the gradual development of nuclear power plants or by the open air uranium quarries like Brugeaud exploitation (an excavation of 15 ha and 130 m depth).

The selection of sites to host nuclear power plants was executed on the basis of geotechnical data, water proximity and population density. Nuclear power plants are typically built in the vicinity of small to medium towns located in rural areas.

Modification of the nuclear image after Chernobyl

The consequences of the Chernobyl disaster in France have created debate since the disaster in 1986. Indeed, officially, there was no negative health impact in France but this statement is disputed by some associations, often close to anti-nuclear movements, which demand greater government transparency on the subject. The controversy around Chernobyl in France is, to a large extent, the result of poor communication from French authorities via the message “the radioactive cloud stopped at the border”. Even if this expression was not explicitly used, it was the message presented in the media and in French society. Since then, a sense of distrust surrounding the subject of nuclear energy has always been present. Indeed, the French people are very suspicious of information concerning nuclear.

Transparency is in particular ensured with the constitution of independent public bodies in charge of monitoring nuclear safety:

- The ASN (Autorité de Sûreté Nucléaire), the national nuclear regulator, was established in 2006 as an “independent administrative authority”: whereas previous nuclear safety control entities established since 1973 operated under the control of ministries (industry, health, environment), the ASN is independent from ministerial intervention, and reports to the French Parliament
- IRSN (Institut de Radioprotection et Sûreté Nucléaire), the nuclear safety and radiation protection institute, was created as an independent body in 2001: prior to that it was IPSN, an institute which formed part of CEA. IRSN provides technical safety expertise to ASN and is entitled to visit and control the nuclear installations of EDF, CEA and AREVA.

Furthermore, transparency is also ensured by non-governmental organisations such as CRIIRAD, an association created in 1986 in the wake of Chernobyl, with the purpose of delivering independent information to the public, and which in particular continuously monitors radiation levels around nuclear installations. This “nuclear watchdog” is financed by work delivered, such as lab analyses (55% of its income in 2009), membership fees (36%) and a minority of public subsidies, thus ensuring its full independence.

Several NGOs represent the voices of civil society on the topic of nuclear power: most are anti-nuclear (Sortir du Nucléaire, Greenpeace, Amis de la Terre, Réseau Action Climat, France Nature Environnement) but some are in favour (such as EFN - Environmentalists For Nuclear). It should also be noted that in recent

years some renowned environmentalists (e.g. David J. McKay, or former Greenpeace executives such as Patrick Moore or Stephen Tindale) have defended a pro-nuclear position driven essentially by the need to mitigate climate change which is seen as a far greater risk than the ones posed by nuclear power.

3.8.4.4 Nuclear energy model promotion

Analysis of pro-nuclear speech

Supporters of nuclear energy have built a discourse based on different levers.

A low carbon electricity

Taking advantage of the growing societal concern worldwide for global warming and climate change, the low-carbon character of nuclear energy is promoted as a key asset. This is based on factual estimates such as “such power allowed France to have CO₂ emissions (5.5 tCO₂ / cap / year) lower than the European average (7.4 tCO₂ / cap / year) and two times lower than those of Germany (SFEN, no date)”. Therefore, nuclear energy occupies a central place in the low-carbon energy mix. Promoters of nuclear energy often refer to climate change and the decision of the *IPCC* to promote nuclear energy as a sustainable energy source, regardless of the problem of depleted uranium and its negative social impacts.

Nuclear energy: guarantor of energy independence

As stated above, the French State has promoted the development of nuclear energy for its capacity to reduce the energy dependence of the country. This argument also benefits from current international contexts, both economic (balance of trade in particular) and geopolitical (tension around gas supply from Russia). For instance, the French Nuclear Energy Society states that: “If today the electricity produced by nuclear power were to be replaced by gas, imports would rise each year to 8 billion euros. Nuclear energy supplies 30% of electricity in the European Union and even reduces the dependence on fossil fuels, polluting and imported”. However this speech does not mention the method of calculating the cost, the initial price of uranium imports, the cost of transportation, nor the cost of storing nuclear waste, nor does it compare nuclear against renewable energy sources, which would appear to be the only complete guarantee of independence.

Nuclear energy ensures a low energy price

An argument regularly put forward by nuclear promoters is the relatively low energy price of a KWh of electricity produced through the nuclear process. Nuclear energy is presented as a money saver which protects the purchasing power of households and industries. The social benefits of nuclear energy are often reinforced by price comparisons: “The French energy price is 35% lower compared to the European average (Le Monde, 2013)”. This number may be correct but it does not specify either the factors taken into account to determinate this price, nor the role of the State which imposes the energy price to guarantee its stability. Defenders of nuclear power also put forward the low volatility of nuclear-produced power, in comparison with the high cost volatility of fossil fuels (natural gas in particular) for power production.

Nuclear energy create jobs and economic value

Pro-nuclear stakeholders underline the economic importance of the nuclear sector which represents the “3rd most important industrial affiliates of the country with a total of 410,000 employees and more than 2500 companies in this sector ” (IRSN, 2009). Nuclear energy is presented as a sector of the future, able to create sustainable jobs in coming years: indeed, the governmental “Nuclear Strategic Committee” indicates, in its 2012 report, that the nuclear sector could employ 110,000 more people in France”. The pro-nuclear lobby also underline the indirect benefits of nuclear energy on the economic sector:

- The low energy price would be a vital asset of the economy ensuring the French industry’s competitiveness

- The stability of the price of nuclear electricity appears to be an attractive factor for foreign companies which would like to operate in France
- Nuclear energy not only creates new jobs but also saves employment by preventing delocalisation.

Additionally, given that the large baseload production can exceed the national demand, part of the production is exported, thus contributing positively to the balance of trade.

Nuclear energy: French sector of excellence

France is at the forefront of nuclear research, which promotes expertise on the entire nuclear chain, from uranium mining, nuclear power plant construction and operation, to reprocessing and storing of nuclear waste. This array of skills enhances the safety of a worldwide recognized production system. France wants to be perceived as the world expert on nuclear power, and it exports its expertise abroad.

These arguments represent the discourse produced by the nuclear lobby (Gay, 2015), which tends to minimize the potential risks associated with nuclear energy.

Pro-nuclear stakeholders' representation and motivations

The pro-nuclear actors may be distributed into different categories with specific and possibly diverging interests. Nonetheless, they are all connected in a mutually-sustaining network, which accords, more or less with their specific concerns. Even if each actor tries to prioritize satisfying its own interests, they eventually agree to operate together because they would have much to lose by unbalancing the system.

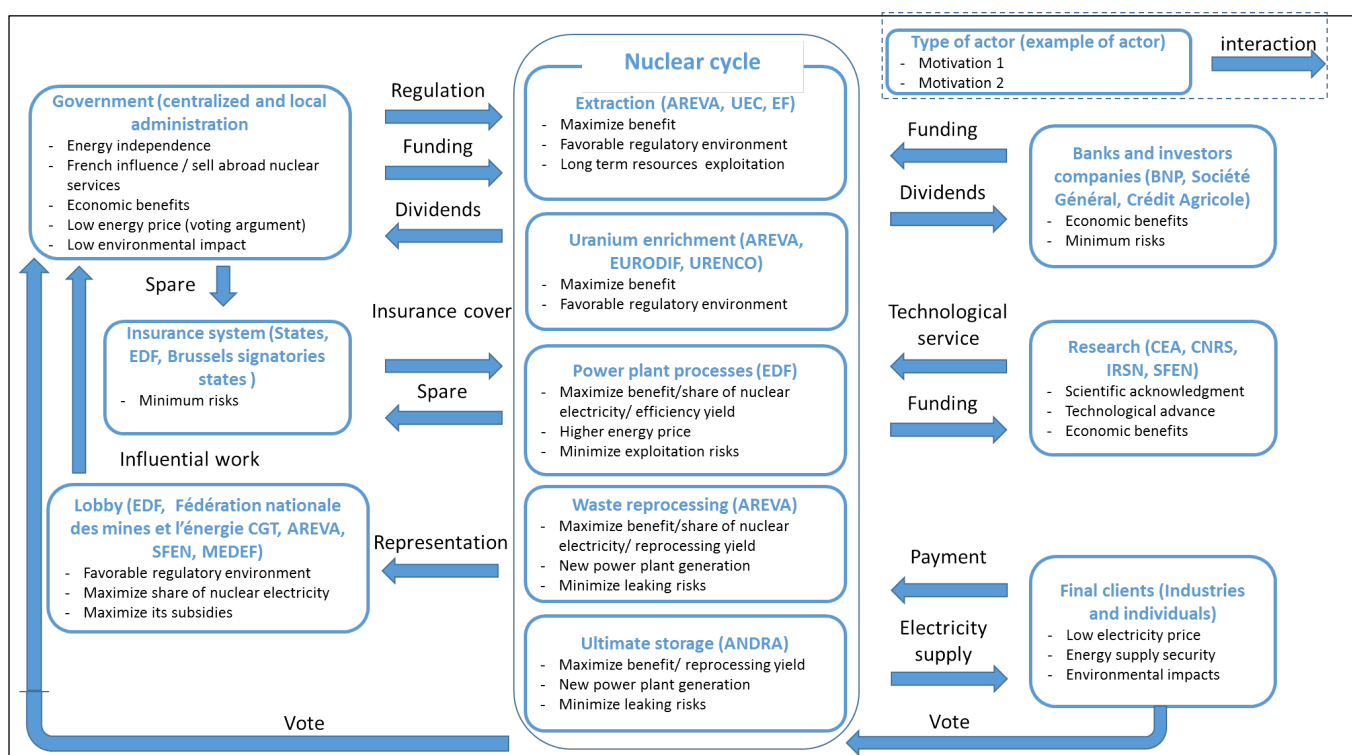


Figure 47: Representation of pro-nuclear stakeholders, France

The current French energy framework has been a vertical system so far where the State always occupies a dominant position due to the specific nature of French political and economic processes. On the political side, both centralisation and nationalisation mechanisms have tended to concentrate power into the State's hands. This is especially true under the French Fifth republic, with a strong presidential role. Under the direction of President De Gaulle, whose authority was almost entirely unchallenged, the PEON (Nuclear based Electricity Production) commission constructed the French nuclear strategy in 1955. Only composed of 15 "officials" and 13 individuals from the private sector (CGE, Framastone, Wilcox), all of whom were from the French engineering academic elite (Ecole des Ponts, Ecole des Mines, Ecole Polytechnique), the

French nuclear scheme relied on technical know-how rather than democratic decision-making (L'Express, 2011). This nuclear strategy is supported by the “Grand Corps de l'Etat”, whose graduates were placed in energy companies. The Communist party which formed the main opposition party at the time, aligned themselves with the strategy due to the prospect of the creation of massive public employment and the idea of national independence including nuclear views. On the union side, CGT⁹ which was historically linked to EDF – which paid it 1% of its turnover through the works council – approved the plan. Although ecologists and a number of institutions, like the College de France, demanded more transparency, and signed a petition requesting public debate on the issue, successive governments, whatever their political colours, have endorsed the nuclear strategy.

While the nuclear model is promoted via phrases that draw on the arguments above, such as: “In France we do not have resources but ideas”, or “it's nuclear or candles”; the setup of the nuclear energy model relies also on the technical and economic decisions of the state. In the first instance, it is important to bear in mind that the existence of operational actors in the nuclear cycle results from decision-making on the government level. The creation of both EDF and AREVA (COGEMA before 2006) was at the government's command, and they are still financed by public funds. In a country where interventionism from the government has been so important, it is not possible, either statutorily or economically, for an alternative energy model to emerge, as long as there is no Government will to change.

On another level, despite the events at Chernobyl and Fukushima, French civil society has not challenged the nuclear industry to any great extent. This silent assent of the majority of the population is either primarily money driven, or a consequence of the fear of there being no credible alternative. Maintaining a low energy price is crucial for both the state and the nuclear industry – for political parties, it is an essential (albeit biased) argument for re-election, and for both, it is a vital element in delivering sustainable energy in the climate change context.

More recently, the EU directive tried to loosen the monopoly of EDF on the French electricity value chain, demanding the separation of the production and distribution activities to enable competition and equality of access. To meet the EU regulations, the French state settled for the creation of RTE (transport of electricity) and ERDF (distribution of electricity), both are independent organizations, but affiliated to EDF.

In a nutshell, the French State and the nuclear industry sustain each other in a positive and multilevel feedback loop. This situation is reinforced by the government's desire to bring the activities of the two giants of the French nuclear industry EDF and AREVA closer.

3.8.4.5 The rise of an alternative model

Analysis of anti-nuclear speech

Nuclear is dangerous

The potential danger of nuclear is the main issue highlighted by the anti-nuclear associations. They underline how significant the damage caused by the nuclear industry can be: activities in the nuclear industry are likely to expose both humans and the environment to different levels of radioactivity. This danger, which is reinforced by both the imperceptible nature and the long-term scale of the radioactive risk, occurs at different stages of the nuclear cycle:

- Upstream: the extraction of uranium ore generates mining and residual waste. Moreover, activities of uranium enrichment include chemical risks
- Operation phase: (e.g. Chernobyl and Fukushima) Nuclear power plants face the risks common in industry in general, such as fire, power failure, etc.; as well as risks from natural disasters, such as earthquake, floods, etc.. For existing plants, the major risk is the meltdown of the nuclear reactor's

⁹ Labour General Confederation (Confederation Générale du Travail)

core containing the fuel – due to a sudden increase in power or a cooling failure. French nuclear power plants were designed to operate for 30 years. More than the half of them have already exceeded this duration, and the State has decided to extend the life of many of the older reactors by 10 years

- Downstream: the handling of plutonium and spent fuel generates risks associated with the use of irradiating high toxicity materials including: radioactive releases, criticality, explosion linked to radiolysis gases emitted, and equipment damage.

Beyond these intrinsic risks, the nuclear industry is vulnerable to both terrorist and hacking attacks. Anti-nuclear organizations regularly emphasize the weakness of sites' security by entering into nuclear enclosures. On a global scale, recourse to civil nuclear energy does not exclude nuclear proliferation, and consequently the occurrence of a nuclear war.

Although risks definitely exist, this partisan discourse does not mention the maintenance works carried out on plants, as well as the development of security measures to improve nuclear safety, and the existence of international regulatory authorities to regulate nuclear activity.

Nuclear power is a money pit

The anti-nuclear discourse also refers to the conclusion of the 2012 report released by the French “*Cour Des Comptes*”, which undermined the myth of cheap nuclear energy. The production cost of nuclear energy is expected to increase for a number of reasons:

- The commissioning of a new generation of power plants. For example, the budget allocated to the construction of the EPR at Flamanville continues to increase, growing from €3.3 billion initially to an amount of €8.5 billion today
- The increased lifespan of nuclear reactors represents a significant cost also. The EDF program to ensure the necessary maintenance and upgrading is estimated at €55 billion
- It is necessary to also take into account the cost of waste management, and nuclear decommissioning, which ranges to around €60 billion

While the price of uranium is less volatile than coal and oil, the great majority of French uranium is still imported from foreign countries like Niger, Kazakhstan, and Russia. The cost associated with these imports ranges between €500 million and €1 billion a year.

In considering the question of energy price, it is important to keep in mind that France is devoid of energy resources today. To impartially compare the price of nuclear energy, it is necessary to compare all technologies through the same benchmark, which is complicated (perimeter of scope, uncountable associated benefits, or disadvantages).

Nuclear power is not a factor of energy independency

The energy independence ratio officially reaches 50.1% according to the French authorities. However, this value comes down to 7% if nuclear imports are taken into account for the calculations. As mentioned above, today France imports 100% of its uranium ore, although there is a power plant located in La Hague dedicated to the recycling and the reprocessing of spent nuclear fuel.

Furthermore, the energy model is very often criticised by the anti-nuclear lobby owing to its lack of flexibility. Despite the large amount of energy produced daily, France is compelled to import electricity from its neighbours to cover its winter electricity demand. Hence the anti-nuclear lobby underlines the partial effectiveness of this energy model, which is also blamed for indirectly causing fuel poverty in the country.

Last but not least, nuclear power is only produced in 19 locations in France. This ultra-centralised power grid can be easily exposed to massive failures.

Decisions around Nuclear power do not follow standard democratic processes

The anti-nuclear lobby also contests the lack of transparency associated with decision-making on nuclear issues. They condemn the significant subventions to “buy” the support of local authorities; and they denounce the massive development of the French nuclear fleet, launched in 1974 without consultation with the citizens or the deputies. They also point out that nuclear energy is a burden on the shoulders of future generations since the majority of the nuclear waste that is produced is stored for lack of alternative solutions. This is what is at stake in Bures where the French government plans to build an underground nuclear waste facility. The government bypassed the French national assembly by adding a clause to legislation concerning growth and business development, an issue completely disconnected from the nuclear topic, and forcing it through without holding a debate or a vote on the issue.

Nuclear power is not a low-carbon technology

Classifying nuclear energy as a sustainable technology is a complete nonsense for several reasons, according to anti-nuclear groups:

- Nuclear power plants eject large quantity of water vapour, which is a greenhouse gas
- Even if nuclear generation has lower carbon emissions than generating electricity from coal, gas, and oil, the complete cycle of nuclear power generation cannot be counted as low-carbon. Nuclear power requires not only the extraction, transportation, and chemical transformation of uranium; but also large amount of concrete to build the reactors and the containment facilities for spent fuel.
- The geological disposal of nuclear waste represents a potential polluting threat to the ground in case of any leakage.

Anti-nuclear actors – representation and motivations

The French anti-nuclear movement is constituted by a large consortium of associations – (Greenpeace, Sortir du nucléaire, Stop Fessenheim, Bure Stop), media (Reporterre, Médiapart, Libération), professional and experts associations (Negawatt association), political parties (essentially, the French green party, EELV) – which advocates for an ecology transition and a “green” energy model. The movement can be described as a horizontal system of loosely aligned groups, without a clearly identifiable leader, representing a variety of interests who demand a new energy model.

Anti-nuclear actions started with the announcement of the construction of the Superphenix power plant in 1976 in Creys. This movement, largely inspired by the hippie culture as well as the counter-culture wave from post-68 magazines “Survivre” and “Hara-Kiri”, obtained their first victory in 1981 when the project to build the Plogoff nuclear plant was abandoned. Even though the anti-nuclear movement was weakened by “Rainbow Warrior gate” and the end of Greenpeace France activity, it rose from the ashes with the re-launch of nuclear testing in 1995 at Mururoa, finding support in wider society.

Since 2000, the movement changed its tactics. On the one hand, Greenpeace has used the methods of eco-warriors – like the human blockade of roads to prevent radioactive waste convoys leaving power plants, or intrusions into power plants. These actions allowed the movement to raise awareness, especially in the second half of the 2000s when environmental and ecological concerns were gaining ground in the public sphere. On the other, organizations have developed their technical and economic knowledge to challenge the discourse from the pro-nuclear lobby.

Today, the movement benefits from political recognition through the French green party EELV. Although its power is limited, it was recently part of the government for a time, however it failed to really voice its ideas.

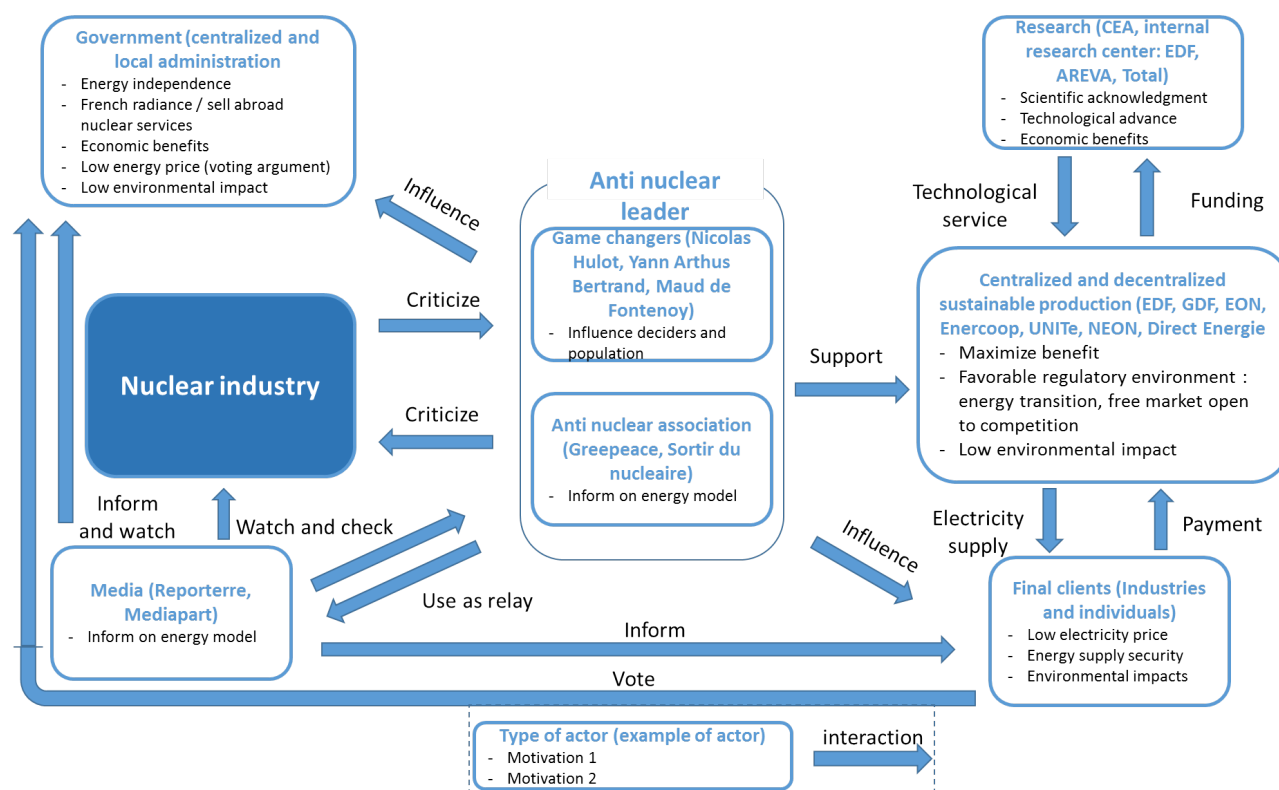


Figure 48: Representation of anti-nuclear actors, France

3.8.4.6 Nuclear speeches and facts

Table 11: Arguments pro- and anti-nuclear on various facts on the energy system

Arguments	Pro nuclear speech	Anti-nuclear speech	Facts
Risks	No clear communication on the number of accident. No risk zero	At least 135 accidents in France so far (<i>sortir du nucléaire</i>)	Hundreds of level zero and level 1 accident every year (ASN)
CO₂ emissions	Zero CO ₂ emissions during operation of the system	Nuclear energy emits more GHG than sustainable energy	6 g CO ₂ /kWh (Power plants construction and end of life of the building are not taken into account)
Energy independency	52% of energy independency due mainly to nuclear	If nuclear extraction is taken into account the energy independency level is around 7%	50% of energy independency due mainly to nuclear (MEDDE)
Electricity price	Of all energies available today, nuclear power is the cheapest (SFEN)	Renovation of the nuclear park exceeds billion of euro	€49.5 /MWh (Cour des Comptes en 2013)
Democracy	Effort for more transparency and information towards population	No consultation of civil society	List of public consultation inventoried by ASN
Waste	Only 4% of high-activity waste	Hundreds of thousands of tons since the launch of the nuclear industry not always legally stored	At the end of 2010, there were approximately 1.32 million m ³ in France of radioactive waste

3.8.4.7 Global system representation

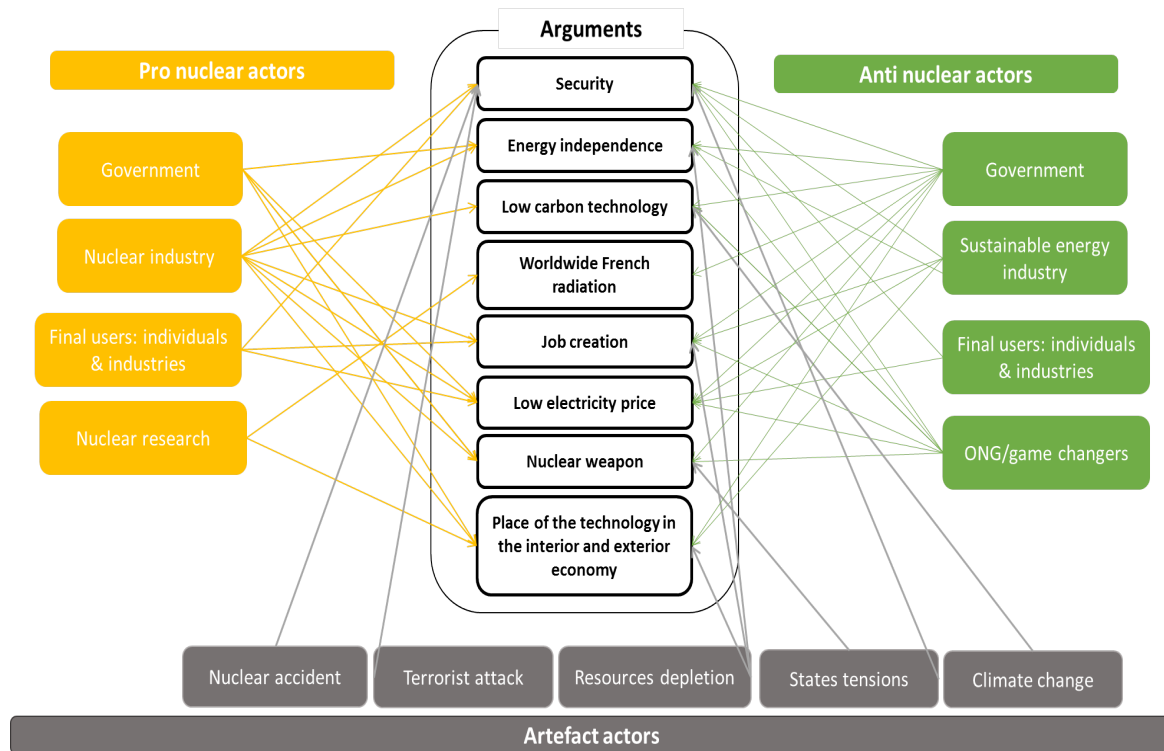


Figure 49: Representation of nuclear debate in France

To conclude, it is interesting to note that both movements develop almost the same kind of arguments and scientific proofs but in opposite directions, to promote their own ideology. What is also striking throughout this analysis is the duality of certain actors. For instance, the French government tries to protect a key industrial sector, which create jobs and economic value, while, at the same time, it is developing the renewable energy sector. Nuclear power plant operators are likewise the main renewable energy producers in the country through dedicated affiliates – EDF énergies nouvelles or AREVA sustainable units. These actors, benefiting from close relationships with policy makers, have dominated the sectors preventing the arrival of significant competitors. The dominance of these actors, who are able to act on both sides, could explain why there is no energy transition on the nuclear side.

The necessary dialogue to build and operate the energy transition in France is almost non-existent. Consequently, the controversy about the predominance of nuclear energy in the country results from an opposition between two ideologies, two versions of the reality which are not compatible. Looking to the future, the French energy system may remain a predominantly nuclear system for decades due to historical and economic reasons, as well as to the inertia related to the energy system. In these conditions, speaking about energy transition in the country does not really translate the reality of the situation: France extends its energy system rather than modifies it. The opening up of the French energy market, the potential nuclear risks, as well as the denuclearisation pathway decided upon by its neighbours, could move the lines.

3.8.5 Nuclear Phase out in Germany

3.8.5.1 Introduction

The current energy model in Germany sees a share of about 16% of its energy produced by nuclear technology. Despite this, Germany decided to phase out nuclear power by 2022 following deliberations in the public sphere and at a political level. The decisions taken by the different German governments in recent decades concerning the destiny of nuclear power production are still the subject of debate, and there are two different opinions on the issue, with the pro-phase out position gaining more and more

consensus, versus the against-phase out position. In particular, a poll early in 2007 found that 61% of Germans opposed the government's plans to phase out nuclear power by 2020, while 34% favoured a phase out. Another poll in mid-2008 showed that the pro-nuclear share had decreased to 46% of Germans.

Following the Fukushima accident, in September 2011 a GlobeScan survey showed 52% of Germans thought that nuclear power was dangerous and that plants should be closed as soon as possible (compared with 26% in 2005), only 7% supported building more nuclear plants, while 90% opposed building new nuclear plants. In response to the proposition that Germany could almost entirely replace coal and nuclear energy within 20 years by becoming highly energy efficient and depending on power from sun and wind, 62% agreed with it, and 26% disagreed.

In June 2012, a poll by the Institut für Demoskopie Allensbach asked: “Do you think the federal government took the right decision for Germany to phase out nuclear by 2022?” Here 73% agreed that it took the right decision, and 16% answered no.

An opinion poll commissioned by the German Atomic Forum (DAtF) and carried out by Forsa in September 2013 asked whether nuclear power plants should be shut down as planned (or even earlier) “or should the effects on a secure supply of electricity and on costs for consumers and industry be considered prior to future shut downs?” Here 59% opted for a conditional approach and 39% for the unconditional approach.

An opinion poll commissioned by the DAtF and carried out by Forsa in April 2014 showed that 72% supported a unified European energy policy and 56% opposed Germany reviewing its energy policy goals, *i.e.* the nuclear phase-out, the limitation of lignite mining, and the ban on shale gas extraction in the light of energy security of supply concerns raised by the Ukrainian political crisis.

The main aim of this report section is investigating the causes and consequences of the German government’s decisions on nuclear power decommissioning, the actors involved in the system and how are they interacting in this transition situation.

3.8.5.2 Historical context

Understanding the evolution of nuclear power in Germany since WWII up to today, it is necessary to go deeply into today’s debate and energy transition.

Energy model in the post-war period

During the post-war period, the huge damage inflicted by the war on industrial production, houses, and infrastructure were to be repaired in order to make the two new-born countries (West and East Germany) restart their life.

Due to the technology of the time, and to the availability of raw material, the major source of energy was brown coal, or lignite – the most abundant primary energy source on German soil then, and now. Coal was burned in large amounts in the post-war period, resulting in huge pollution problems in the following decades. This caused the decision-makers to start to think about alternative solutions for the increasing energy demand in the country during the economic recovery of the 1960s. As well as the new environmental sensitivity, there was also concern about the long-term availability of coal itself, and of oil (the main energy source in use after coal). Moreover, the vulnerability of being dependent on oil importation from abroad was demonstrated in the 1970s, when the Arab member countries of the Organization of the Petroleum Exporting Countries (OPEC) decided on an embargo to States that supported Israel, as the Western block countries (like BRD) did.

Nuclear power as energy issue solution

In this energy context, the most important actors in the energy scenario saw nuclear power as the best solution to the problem of using expensive, finite, and polluting energy sources. In particular, the German government aimed to develop a new energy system, thus allowing the country to become independent

from importing raw material from abroad, and maintaining the large power supply needed for the reconstruction after war damage, and for restarting the German economy. The science community also agreed with the government's approach to the energy problem, since nuclear energy was seen as the only science-based solution in an historical period when scientific research in the nuclear field was strongly pushed by governments – for both energy supply and defence purposes. Furthermore, the focus on the production of CO₂ and other greenhouse gases was another pro-nuclear argument since the long-term risk of pollution from radioactivity and nuclear waste were underestimated. Moreover, the media helped to shape the opinion in the public sphere that nuclear power was a cheap energy supply for households and industry, and that the country could import less oil and gas from abroad thanks to nuclear power.

The government developed its nuclear programme during the late 1950s and 1960s, opening its first commercial nuclear power plant in 1969, and in the following decades nuclear became one of the main energy sources for Germany, with a production peak of more than 160 billion kWh, representing about 30% of total energy consumption, in 2000.

Recent phase-out decision

Recently, some factors determined a complete change in the government's and the public's opinion on nuclear energy. One argument against nuclear power is economic: in the early phase of the nuclear era, the power plants' building and maintenance costs were underestimated, thus creating an economic problem for the German government in developing this kind of energy technology, thus making the switch to other potential solutions to meeting the energy demand for the country more feasible.

The increased awareness of environmental issues contributed to the energy transition too. Nuclear power was no longer seen as a clean energy source, since the radioactive waste – whose danger was underestimated in the early nuclear era – became a significant long-term pollution problem, even if nuclear power reduces greenhouse gases emissions when compared to burning fossil fuels. Since the 1980s, two catastrophic events pushed governments and public opinion all over the world to reflect on the real “price” of nuclear power, in terms of health and public safety – Chernobyl in 1986, and Fukushima in 2011.

Due to all these factors, in 2000 the German government and nuclear power industry agreed to phase out all nuclear power plants by 2021, and the nuclear power share decreased from 30% to 22% in 2010 to 18% today. Merkel's new government attempted to extend the life of nuclear power in September 2010, when it reached a deal which would see the country's 17 nuclear plants run, on average, 12 years longer than planned, with some remaining in production until well into the 2030s. However, following the Fukushima Daiichi nuclear disaster and subsequent anti-nuclear protests, as well as the great election result achieved by the Green Party, the government changed its mind again, deciding to proceed with the plan to close all nuclear plants in the country by 2022.

3.8.5.3 Nuclear energy system in Germany

An overview of the nuclear energy production and distribution chain is needed in order to clarify which actors are involved in the system, and their interest in nuclear energy use.

- **Raw materials:** Uranium is the raw material used to create energy in the form of heat from the nuclear fission process, which is the functioning principle of the nuclear power plants. East Germany was the largest European producer of uranium between the post-war period and the 1990s; the mining company Wismut extracted over 220,000 tonnes of uranium there. Because the vast majority of uranium was extracted in East Germany most of it was delivered to the Soviet Union. All the uranium mines were closed after German reunification, for both economic and environmental reasons. The country is now completely import-dependent for uranium to fuel the nuclear plants.
- **Production sites:** The nuclear era resulted in the progressive commissioning of 17 nuclear power plants, distributed over the West German territory. After the Fukushima nuclear disaster in 2011, eight reactors were immediately shut down: they were all the reactors that went online before

1981, and are represented in red on the map. A ninth reactor, Grafenrheinfeld, was shut down in June 2015. Currently, eight reactors are still working in Germany; the reactor B of Gundremmingen will be shut down in 2017, Phillipsburg 2 in 2019, Gundremmingen C, Grohnde and Brokdorf in 2021, finally Isar 2, Emsland and Neckarwestheim 2 in 2022, the final date of nuclear phase out in Germany.

- **Nuclear power providers:** Economic interests characterize the nuclear power system, and the companies in this sector are seeing their business seriously threatened by the nuclear phase out program; the phase out will also have an economic impact on the country in terms of turnover, taxes, jobs, etc. Pressure from these companies on the government resulted in the deal reached in 2010, where the government decided to keep the remaining nuclear plants online for an extra twelve years, on average. The Fukushima nuclear disaster had significant repercussions for the nuclear power market in Germany. It resulted in the engineering giant Siemens announcing a complete withdrawal from the nuclear industry; and the government changing its mind on the timing of the phase out – deciding to put all the plants offline by 2022. The remaining nuclear companies in Germany are E.ON Kernkraft GmbH, Vattenfall Europe Nuclear Energy GmbH, RWE Power AG, and EnBW Energie Baden-Wuerttemberg AG.
- **Waste material disposal:** The treatment of spent nuclear fuel is another important issue that concerns the public, particularly in terms of the long-term threat to health and the environment. After temporary storage by the nuclear power plant, the spent fuel, which is composed of radioactive material, is conditioned (in case of medium and high level waste) or directly transported to a final disposal site. Four such sites are present in Germany – two of which are operational: Asse II and Morsleben; and two of which are in the planning process: Schacht Konrad and Gorleben. There are significant safety concerns with regard to the long-term storage of radioactive material, as explained below.

Asse II is an old salt mine in which approximately 126,000 drums with radioactive waste were stored in 13 chambers, between 1967 and 1978. Many of them were damaged during storage operations, and some waste was discovered to be incorrectly “conditioned”; there has also been a significant inflow of water, and some loss of stability in the mine which has resulted in radioactive brine leaching out of the mine.

Morsleben is an old salt mine, located in the former GDR, in which solid and liquid radioactive waste is stored – some of the solid waste was dumped loosely. The mine is in significant danger of collapse, and there is a problem with water influx in the mine. Current estimates to secure the mine are at €2.2 billion.

Schacht Konrad is a decommissioned iron ore mine and is currently being converted into a repository for radioactive waste. It is considered suitable for this purpose as it is exceptionally dry. Gorleben is currently used as an, above ground, interim storage facility for radioactive waste, including high-level radioactive waste. There are plans to use the nearby Gorleben salt dome as a deep geological repository for radioactive waste from nuclear reactors.

Given the established risk of barrel damage in the caverns, the danger of geological instability, and the possibilities for radioactive contamination of the groundwater – the long-term dangers related to nuclear waste are impossible to estimate. Nobody knows for certain how the geological formations will evolve in the remote future, and the subsequent chemical/physical reactions of waste and containers with the surrounding rocks and water are also unknown. These uncertainties concerning the future impact of long-term storage of radioactive material on the environment certainly increases the uncertainty about the wisdom, and ethics, of exploiting nuclear power.

- **Impact of nuclear energy in the German society:** Nuclear power provided for a large part of the German energy demand, having increased to a 30% share in the decades which preceded the government’s decision to phase it out. Of course, it has been (and still is) an important energy source for the growth of the German economy. Since the 1960s, Germans had a permanently available, cheap power source – which certainly had a positive impact on German society, industrial production, competitiveness, services, and everyday life. The new environmental awareness and

recent nuclear health and safety problems worldwide, together with the waste disposal issue, contributed to the shift in public opinion about the desirability of using nuclear power.

3.8.5.4 Pro-phase out speech

Some actors, who are against nuclear power in Germany, agree with the phase out program for a number of different reasons.

Pro-phase out arguments

The pro-phase out discourse is sustained by several arguments coming from a range of political groups, as well as from civil society.

- Price of nuclear power: In the early nuclear era, with the nuclear power plant commissioning programme, the real long-term costs for building and maintaining facilities were underestimated. Consequently, a large amount of public money is still spent in this field, making nuclear energy more expensive than anticipated. Furthermore, since 2008 spending on nuclear power has increased due to the total German dependence on uranium imports for its nuclear plants. This is different to what happened in the previous decades, when internal mining contributed to the fuel supply for energy production.
- Environmental risks: The danger of nuclear power is one of the most important arguments made by the pro-phase out position because of the potential damage to human health and the environment due to exposure to radioactivity during the operation of the nuclear plant. The fear is increased by the incomplete knowledge about the exact nature of the risk, as well the long-term outlook – as nobody really knows how the radioactivity will affect the natural habitat, or human health over future centuries. Further the risks connected to the everyday activities at nuclear facilities, such as a reactor core meltdown, would have catastrophic consequences – as happened in Chernobyl in 1986 and in Fukushima in 2011. The potential for these types of traumatic events to occur are an even stronger reason to shut down nuclear plants, from the anti-nuclear point of view.
- Nuclear waste disposal issue: A definitive solution to radioactive waste material management has not been found yet. At present, plutonium and other dangerous materials, which expose the handlers to chemical and radioactive risks, are stored in barrels or other containers and mostly stacked into ground cavities in order to prevent the radiation leaching out into the environment and interacting with the biosphere. In reality, there is no certainty about the long-term reliability of these storage sites, because of possible ground collapse, or water influx, with consequent damage to barrels, and the dispersal of waste material. Also the future geological evolution of such sites is not known in detail, so the storage sites do not represent a safe solution in the future.
- Democracy-driven decision: Although there has not been a proper referendum on the nuclear issue in Germany, the government's decision on decommissioning was driven by public opinion – which was expressed in two different ways. After the deal between the government and the nuclear companies to extend the life of the nuclear power plants for twelve years more than previously decided, the Fukushima disaster happened and shifted German public opinion to a renewed sensitivity on the theme of environmental safety. As a consequence, people demonstrated their disagreement with the government's new approach by means of public protests all over the country – with 90,000 people demonstrating on the streets of Berlin alone. In the same period, Germans expressed their anti-nuclear feeling democratically during the State elections – on this occasion, the Green Party obtained its best result ever, and for the first time in German history won an outright victory in the state of Baden-Württemberg. These events very well expressed to the government the position of the majority of people about nuclear power generation.
- Economic and social advantages: The new energy direction taken by German government focused on the growth of renewable sources – in order to compensate for the energy share which will no longer be produced by nuclear plants – and is creating new jobs for German people. In fact, the renewables industry employs many people, and the jobs attributable to the effects of this energy transition totalled 261,500 jobs in 2013, making unemployment reach an all-time low since reunification in 1990.

- **Pro-phase out actors:** The German government and its Federal Ministry for Economic Affairs and Energy are the main actors who directed the nuclear phase-out, by proposing the Energiewende as an anti-nuclear and pro-renewables programme to German Parliament. Certainly, after the State election in 2011, the large social consensus resulted in Angela Merkel's government changing its mind with respect to what had previously been agreed with the nuclear companies. At the political level, the German Parliament played another fundamental role in the nuclear phase-out decision, by voting on the new laws regulating the energy field, and then being the real decision-maker in the democratic system. Public opinion, given that the majority of Germans were against nuclear power production, strongly contributed to the final phase-out decision too. Environmental and human health reasons, together with a general fear of nuclear catastrophes, were the main motivations for these pro-phase out actors. Economic interests involved other actors in the pro-phase out discourse: this is the case for companies and research centres which invested money into renewable energies technologies, and who now see an increasing market for their business.

3.8.5.5 *Anti-phase out narrative*

Other actors do not agree with the nuclear phase-out decision, for a number of different reasons.

Anti-phase out arguments

A certain section of public opinion, media, and industry have different motivations for being against the government's decision to phase out nuclear power, and the new energy laws.

- **Bill prices:** The German people have always paid one of the highest energy prices for domestic consumption. This has become worse due to the Energiewende and the Renewable Energy Act, by means of which the government is maintaining the price of energy from renewable sources – in order to protect the investing companies, with a further added-taxation for non-renewables. As a result, Germans are paying higher energy bills than most other EU members, because of measures like nuclear phase-out. The high costs of technological research, and of operationalising renewable energies creates the risk of further increasing energy prices after the energy transition from nuclear to renewables is completed.
- **Costs of plants scrapping:** The government's decision to shut down all the nuclear power plants will have a cost. There is uncertainty about how much it will cost to dismantle the power plants, but the €34 billion set aside by plant operators for this purpose will not be enough to do the job, in the experts' opinion. Counting both reactors and power stations, there are 33 facilities to dismantle, and whose contaminated scrap will have to be disposed of. Nuclear operators made a plan to build up money reserves to finance the dismantling, but the new phase out program decided by the government after Fukushima disaster is not in keeping with this financial plan. It's not clear which money – public or private – will compensate for this.
- **Greenhouse gases emissions:** Germany's decision to phase out nuclear energy will limit the possibilities for reducing CO₂ emissions due to energy production. Some energy experts foresee that renewable sources will not be sufficient to cover the 18% of the energy share currently guaranteed by nuclear power, and this power amount will be compensated for by an increase in coal burning, with subsequent environmental problems due to GHG emissions.
- **Business reasons:** Private companies based their businesses on the nuclear energy market for decades. Clearly, the recent decisions at the political level seriously damage these companies and their employees.
- **Anti-phase out actors:** Certain sections of commentators are expressing their doubts about the future outcomes of the Renewable Energy Act and Energiewende, for both environmental and economic reasons. Media, such as web articles, are the main vehicles for these opinions. The most involved actors for the anti-phase out faction are the nuclear companies: they are E.ON Kernkraft GmbH, Vattenfall Europe Nuclear Energy GmbH, RWE Power AG, and EnBW Energie Baden-Wuerttemberg AG. They all are part of the German Atomic Forum (DAF). Even before the Fukushima disaster, these companies were building reserves to finance the dismantling of their reactors. Their reserves are estimated to be €18 billion by E.ON Kernkraft GmbH, €10 billion by

RWE Power AG, €3.6 billion by Vattenfall Europe Nuclear Energy GmbH. In addition to the need to shoulder these dismantling costs, their market will be closed by the nuclear phase-out.

3.8.5.6 Nuclear phase out network

Focus on nuclear companies

The four nuclear companies mentioned have to deal with this transition in the German energy market: it is interesting analysing how are they reacting to this problem, and whether are they changing their business.

E.ON Kernkraft GmbH, which owned and operated six power plants in Germany with 2,600 workers, had two reactors shut down after Fukushima in 2011 – this, together with the added-taxation for nuclear fuel generated a loss of about €8 billion. The first countermeasure it decided on was to split the company into two parts, with a large part of the company, called Uniper, aiming to continue with non-renewable energy sources, while pursuing compensation through the courts. Later, the company announced that its nuclear power division would not be spun off into Uniper, due to political pressure from the German government. In order to meet with the new regulations E.ON is investing €1.2 billion into research projects in the renewables field, adding 274 MW of power production capacity through renewable sources such as solar, wind, and hydropower.

Vattenfall Europe Nuclear Energy GmbH, owns three nuclear facilities in Germany, has lost an estimated investment of €700 million due to the nuclear phase out, and the initial estimated financial damage amounted to €1.18 billion. As a countermeasure, the company took the first steps to initiate international arbitration against the German government.

RWE Power AG share price shed over 82% after the phase out decision. In reaction, the company took legal proceedings against the German government, and in a final appeal won their case to obtain compensation for damages, estimated at €187 million. The possibility of splitting into two companies in the future has been suggested by the company.

EnBW Energie Baden-Wuerttemberg AG has developed a new business strategy supporting the Energiewende, which foresees the expansion of renewable energies by another 19% to reach over 40% in total by 2020. Onshore wind farms are the main facilities for renewable energy production planned for the future of the company.

3.8.6 Short comparative analysis between France and Germany on the nuclear topic

Table 12: Short comparative analysis between France and Germany on the nuclear topic

Germany				France			
Original rationale for nuclear energy in Germany				Original rationale for nuclear energy in France			
Huge energy requirements to reconstruct the country after the war				Huge energy requirements to reconstruct the country after the war			
Strong dependency on fossil fuels in the post-war period				Low level of indigenous energy resources			
Negative forecasts on long-term availability of coal				French nuclear radiance			
Need for a science-based solution for the energy problem				Energy independency			
Oil crisis in '70s				Nuclear bomb program			
				Oil crisis in '70s			
Actors				Actors			
Name	Position	Argument(s)	Means of influence	Name	Position	Argument(s)	Means of influence
Politics (government) in 60s-70s	Pro	<ul style="list-style-type: none"> - Germany needs a huge amount of energy for reconstruction - Germany needs energy independence from foreign states 	Media	Politics (government) in 45s-70s	Pro	<ul style="list-style-type: none"> - Cover the energy demand for reconstruction - Energy independency - Nuclear weapon program - Low ground resources 	<ul style="list-style-type: none"> - Media - Nationalisation
Media in 60s-70s	Pro	<ul style="list-style-type: none"> - Nuclear power is cheap - Germany can import less oil and gas thanks to nuclear power 	Media	Media in (45s-70s)	Pro	<ul style="list-style-type: none"> - Cheap energy - National prestige 	
Scientists in 60s-70s	Pro	<ul style="list-style-type: none"> - Nuclear power is the science-based solution for the energy problem - Nuclear power is less polluting than fossil fuels 	Scientific publications, University teaching research, government consultancy	Union	Pro	<ul style="list-style-type: none"> - Cheap energy - Creation of jobs 	

Germany				France			
Politics (government) (now)	Against	- Environment issues - Economic issues: construction and maintenance costs of nuclear plants are high	Media	ONG 70s- Today	Against	- Risks associated - Environment issues - Economic issues: construction and maintenance costs of nuclear plants are high	Media
Public opinion (now)	Against	- Nuclear power brings the danger of environmental disasters - Radioactive waste materials are dangerous for health	NGOs, public protests, elections	Public society 70s-Today	Mixed	- Environment issues - Economic issues: construction and maintenance costs of nuclear plants are high - Cheap energy - Risks associated	
Factors explaining the current situation regarding nuclear energy in Germany				Factors explaining the current situation regarding nuclear energy in France			
High construction and maintenance costs for nuclear plants				States centralization decisions			
Resulting material disposal issue				EDF grip on the sector			
Chernobyl nuclear disaster in 1986 -> fear of a nuclear disaster in the public opinion				Low energy price in an economic crisis period			
Economically viable uranium reserves in Germany depleted				Lack of transparency and democracy			
Fukushima nuclear disaster in 2011 -> fear of a nuclear disaster in the public opinion				The electrical network			
State elections after Fukushima, with many votes to the Green Party				Importance of nuclear in the economy			
Protests against nuclear: 90,000 people in Berlin				Desire of independence			
Role of nuclear energy in the energy transition				Role of nuclear energy in the energy transition			
Nuclear energy is phasing out: nuclear power plants will be dismissed within 2022				Nuclear power should remain the first type of energy in the country due to its relatively low carbon emissions			
According to the foreseen energy transition, energy demand will be covered by the increasing production and distribution of energy from renewable sources				Increase of renewable energy production			

Germany	France
Civil society acceptance	Civil society acceptance
There is a generalized fear of environmental disasters and doubts on the disposal of radioactive material after the energy production. The public opinion is generally against the use of nuclear power and pro-transition to renewable sources, despite the short-term high prices of this kind of energy.	Survey often mixed on the nuclear topic Nuclear catastrophes like Fukushima did not have a major impact on nuclear acceptance in the country. No important manifestation to demand nuclear exit in the country. Lack of information on the nuclear risks in the country
Democratic consultation processes	Democratic consultation processes
2002: a law was passed by the Social Democrat-Green government, which pledged to close all nuclear power plants by 2022.	No referendum on nuclear energy programmed in the country after Chernobyl or Fukushima
2010: CDU government – industry deal to make the nuclear plants work 12 years longer than planned.	Local consultation of actors ensured by ASN
2011: state elections worked like a nuclear referendum, with the Green Party obtaining the best election result ever.	

4 Conclusion and synthesis

Task 2.1 and its ‘actors analysis’ is aimed at informing subsequent work packages in terms of mapping the energy system actors and their key interactions. In doing so, an extensive data gathering exercise was conducted to develop insights on the energy models of Ireland, UK, Spain, Italy, France and Germany, which in turn inform our understanding at the EU level. In addition, a number of energy topics were identified and studied in more detail, and a range of pertinent political discourses on the energy transition were mapped. An extended map for each of the six countries was produced. As a result, a typology of influences on the energy system has been produced and is presented in Table 23 and a typology of actors is presented in Table 24, both of which may be found in the appendices.

The data gathering exercise conducted allowed for variety of insights on energy to emerge. These ranged from nuclear phase out and its promotion, to fuel poverty and the deployment of renewable energy technologies, to issues around energy independence and security, energy economics, political discourses, and other influencing socio-eco-demographic factors. The multiplicity of fields that interconnect with, and within, the energy system indicates the complexity of the energy transition.

One perspective is to view the energy system as essentially an instrument of the economic sector. In this case, the need for its growth and competitiveness is emphasised and linked with the competitiveness of other sectors that depend on energy. The power purchase concerns of end-users are also an important variable, along with choices associated with fixing energy prices and the type of energy production technology employed.

From a political perspective, the energy system can be seen as having both potential weaknesses and strategic strengths, particularly in relation to an individual country’s level of dependency on energy imports, and its level of exposure to geopolitical disturbances that can arise in exporter countries. Political attention is also often directed towards managing the public health risks that are inherent in the current energy system configuration – such as the link between fuel poverty and rates of respiratory illnesses, as well as public concerns about the potential risks from nuclear power.

The question of a ‘sustainable’ transition is also very much at the core of political narratives on the energy transition, given the link between energy consumption, energy production, and a country’s sustainability in socioeconomic and environmental terms. The question of sustainability also arises in terms of managing existing energy resources, resource depletion, environmental degradation, and climate change. The word ‘transition’ may be problematic in and of itself since it may not convey the same meaning to everybody. Some may understand this term to mean a complete change of paradigm, while others may understand it to mean a gradual adaptation, including increased efficiencies, of the existing energy system. Considering this, one can also see the energy transition generating questions in terms of values, where values such as ‘responsibility’, ‘moderation’ and ‘individual freedom’ often inform how the transition will ultimately be realised.

The inherent complexity of the energy system is obvious when one acknowledges that all the six countries in this study have quite different energy models, even though they may share or have shared some similar characteristics – given the shared energy demands existing in each country. A notable example of this can be seen in France and Germany on the nuclear energy topic. Strongly affected by WWII, nuclear power was of strategic importance to both countries to aid rapid reconstruction, and to regain the competitiveness lost in the war’s aftermath. However, as mentioned earlier, both countries have diverged drastically with Germany opting to decommission its nuclear power infrastructure, while France continues to invest in, and develop nuclear energy.

From a transition perspective, we can conclude that while the energy models of all six countries are different, there are shared similarities in the experiences of each of them as they proceed with their own

transition. This is demonstrated by the fact that all the Member States under examination present similar discourses on the energy transition, and that, all countries have taken, at least some, steps towards a low carbon, sustainable energy system. However, it should also be noted that notwithstanding the moves to integrate EU energy markets, it does appear that national factors may result in member states making their own individual energy transitions, albeit in a some-what coordinated fashion. Similarities in experiences should not mask the (still) country-specific responses to energy choices – as exemplified by the differing ways in which countries have faced previous energy related challenges, producing quite different energy models.

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Appendices

Appendix 1 – Country overview

The country overview describes the energy model in each country in order to contextualise the analysis of the actors, and to identify actors external to the country that have an impact on internal actors in an individual country's energy systems.

1. Global overview of the energy sector
 - Energy history
 - A general history with an emphasis on the post-war period to the present: brief overview of the development of the current energy model and links with economy, crises, politics etc.
 - Local energy sources
 - Main energy sources (coal, oil, gas, uranium, renewable energy) available in the country: reserves, potential, date of expected resource depletion
 - The energy model
 - Quantity and type of energy produced; percentage in terms of 'energy mix'
 - The energy value chain and its main actors
 - Energy consumption per sector
 - Consumption comparison with other EU countries
 - Link with overall political and economic situations
2. Economics of the energy model
 - Energy price evolution
 - Energy importation and exportation, diplomacy/foreign affairs (if relevant)
 - Importance of the energy sector in the national economy: employment, GDP, energy intensity, economic opportunity associated with transition, and alternative energies
 - Energy dependent industries/sectors/businesses and their influence on energy prices
 - Tax, energy market and finance
 - Position vis-à-vis EU single energy market
 - Economic levers/barriers to operate the transition (monopoly, market barriers, fiscal system, regulation, etc.)
 - Market distortion and law application issues
3. Political energy framework and agenda
 - Overview of regulations impacting energy consumption by sector (building, energy, industry, transportation, etc.)
 - Energy independence, security, and associated risks
4. Socio-economic influences on the energy transition
 - Energy perspective for each sector
 - Main cultural features *vis-à-vis* energy: energy mix acceptance, energy decentralisation, level of fuel poverty in the population, awareness of climate change, key actors and change makers, opponents etc.

Appendix 2 – Energy system actors’ characterisation - spreadsheet based mapping

These tables present the categories defined for the spreadsheet based actors mapping. Most categories were defined before starting the mapping, but some categories were added and others modified as the mapping progressed. These tables present the final categories.

Table 13: Energy system actors characterisation, legal identity of actors

Type of actor: legal identity	
Category	Sub-category
Private organisation	Company, professional organisations, etc.
Public organisation	Central and local governments, justice authority, university etc.
Private-public organisation	Private-public company etc.
Other organisations and associations	NGO, consumer association, think tank, lobby, etc.
Individuals	Politician, religious leader, Facebook users etc.

Table 14: Energy system actors characterisation, function of actors

Function/role in the energy system and related type of actors			
Main Category	Secondary category	Tertiary category	Type of actors: examples
Conventional Energy Market actor(s): Offer	Energy as the business core/main product	Energy production, energy transport, energy sale, etc.	
	Energy as an indirect product	Offering piping, boilers, meters etc.	
Innovative Energy Market actor(s): Offer	Energy as the business core/main product		Energy cooperative, RES, ESCO etc.
	Energy as an indirect product		RES manufacturers, smart meters providers, energy auditors etc.

Function/role in the energy system and related type of actors			
Conventional Market actor(s): Energy Demand	Private/public building sector; private/public transport sector etc.		Businesses, public administration, individual citizen, construction material provider, car manufacturer, farmers, etc.
Innovative Market actor(s): Energy Demand	Energy Efficiency Building private/public sector, clean energy private/public transport etc.		
Energy market actor: Trading			
Other market actor: Trading (in another market than energy)	Housing trading etc.		
Support	Support for professionals, support for public organisations etc.	Energy production, construction skills, public procurement, research programmes etc.	
Research/Reflection	Energy production, energy consumption, social sciences, climate sciences etc.	R&D acceptance, research on energy efficient behaviour etc.	
Opinion	Environmental rationale, climate change denial, etc.		
Finance	Energy production finance, energy efficiency building finance		
Regulation/Standard/Certificat ion	Market regulation, fiscal system regulation, norm, label etc.	Energy efficiency norm, energy market opening law etc.	
Media	Social media, magazine, shows etc.	Environment promotion, society transition promotion, economy etc.	
Culture	Exhibition, events, festivals etc.	Environment promotion, society transition promotion etc.	
Education	Undergraduate, graduate, executive schools, etc.	Energy, social sciences, environment etc.	
Interests promotion	Pressure on relevant actor, live protest etc.	Energy source promotion, environmental promotion, NIMBY, etc.	

Appendix 3 – Results of brainstorming on energy system actors

Tables 15 and 16 present the results of the workshop that took place at the six-month plenary meeting. While the results have been organised into two main categories of “people and organisations” and “other factors”, this categorisation is done in order to facilitate ease of reference only. We fully acknowledge that dividing the energy system into a discrete binary of “people and organisations” and “other factors” does not reflect the empirical reality of the energy system itself where people, organisations, culture, technologies, global events *etc.*, that is to say the “human” and the “non-human” (See section 2.2), are entirely intersecting in multiple and complex ways.

Table 15: Results of the workshops: People and Organisations

Conventional Energy Market actor(s): Offer	Energy industry (big players)	Energy co-ops	Energy producers	TSO,DSO	Technology providers	Eni	Enel	Distribution network (nationally, locally)						
Conventional Market actor(s): Energy Demand	Property developers	Farmers	Commercial building leasees	Consumer associations	Building sector	Dwelling occupants	Rail transport companies	Hospitals	Automotive/transportation companies	Commuters	Energy communities	Communities	Local groups	End-user type/categories: industry, residential etc.
Research/Reflection	SOA, R&D, Acceptance	Neurocognitivism	Researchers on Energy	Researchers on Social sciences	Entrust participants	EU research programmes								
Opinion	Facebook users	Political opponents to energy types	Opinion formers in media etc. who push positive viewpoints of a particular energy	Think tanks										
Regulation/Standard /Certification	Regulators	Global deal/rational policy to address climate change e.g. Paris 2015/UK Climate change act 2008	Policy makers	Governmental institutions	Local governments	Standard bodies e.g M+V								
Media	Media	Opinion formers in media etc. who push positive viewpoints of a particular energy												
Culture & arts	Artists													
Energy market actor: Trading	Traders													
Other market actor: Trading (in another market than energy)	Energy auditors													
Education	Universities	School teachers												
Interests promotion	Private home/land owners	Lobby	Citizen action group	Conventional energy lobbies	Consumer associations	NGOs	Think tanks	Protest actors	Energy communities	Communities	Local groups			

Table 16: Results of the workshop: Other Factors.

Cultural influences	Cultural responses to energy use & climate change: short term vs long term perspectives, conservation practices, comfort, habitual behaviours	End user type: e.g. what time people watch TV (popular shows, sports events), how/when they use energy	Comfort expectations						
Natural resources	New techniques e.g. fracking	Environment: resource available/impacts							
Climate	Climate and climate change	Non human actor: climate of a region. Energy use can increase or decrease depending on season	Time of year: seasonal	Climate events (ozone depletion)	Weather e.g. hurricane season				
Accidents	Fukushima/Tchernobyl	Natural disasters: destruction of infrastructures							
Political landscape	Short vs long term policy	Acceptance of Climate Change + RES in energy infrastructure	Political leadership style --> reactive vs proactive, crisis management approach						
Technologies and products	Lifecycles of materials, gadgets etc. Short "life" = more consumption	Expediency: default to cheapest							
Opinions	Social movement, environmental NGOs								
Social	Media	Associations	NGOs	Individuals	Consumer behaviour	Social mindset	Energy communities	Communities	Local groups
Mindset	Systemic inertia, expertise + skills availability	Infrastructure: - existing, - ability to change - willingness to change - different actors (at different levels, local to national-international)							
Economic	Model/type of society	Global framework	Price	Financial					

Appendix 4 – Case Study Guidelines

Guidelines were prepared for the preparation of the case studies to facilitate a coherent and consistent approach. These guidelines can be summarised by the following points:

1. Define the question that sustains your case-study
2. Once the question is set, explain why there was/is this problem and possible associated opportunities
3. Define the system related to your study
4. Describe the actors that needed/need this question to be solved and who have/had an interest in having this question answered
5. Explain the advantage of the current system, the current solution to the question, and the reasons why it has been chosen
6. Describe the formation of the actor-network(s) that is/are responsible for the current state of the system described – place this actor-network(s) formation within its timeframe
 - Who are the actors that started to promote the chosen solution? What were/are their interests? How did the solution match with their values?
 - How did they promote the solution? What were/are their main arguments?
 - How the actor-network(s) structured over time to promote the chosen solution?
 - If several actor-networks: how do they interact together?
 - How did/do it/they maintain their/its key role in the system being described?
7. Controversies and allies: describe the main counter arguments to the mainstream thinking established by the previous studies of actor-network(s), which include the controversies and allied discourse if any.
8. Describe the formation of the actor-network(s) that is/are against the system, as locked by the actor-network(s), which advocate(s) the studied solution or replaces this actor-network(s) formation within its timeframe.
 - Who are the actors that are opposed to the solution? What were/are their interests? Why did the solution not match with their values? What were/are their main arguments?
 - What do they propose to do otherwise?
 - How are the actor-network(s) structured over time to counter the solution and/or to promote alternative ones?
 - If several actor-networks are present, how do they interact with each other?
 - How did/do it/they maintain its/their key role in the system being described?
9. System representation is essential for developing insights into actor interactions, with communities of energy use and the energy supply chain seen as a cascading, interlinked ecosystem/network of linked and interacting actors. Describe:
 - The various actors, the actor-network, and their ‘critical strategic points of interactions’
 - Identify ‘border objects’ that link several actor-networks even if they keep their individual strategic lines.
 - Represent the antagonism between rival networks – such as the criticisms expressed of an actor-network who is said to be ‘in the system’, and those who are described as ‘alternative’
 - Identify which networks have the most power and assess how those that don’t have it try to be heard.

The information and documentation used to meet the guidelines included personal knowledge, research papers from the literature, online magazines, position papers, and various organisations’ websites.

Appendix 5 – Indicative typology of energy system actors and influences

Table 17 and

Table 18 synthesise and categorise all influences on and actors of the energy system that have been identified throughout the deliverable process.

Table 17: Indicative influences on the energy system

Economics	Politics	Lobbies/Opinion leader from	Energy system design	Socio-eco-demographics
Country's economic situation	Centralisation VS decentralisation	Big energy companies and energy intensive companies	Heavy infrastructures path dependency	Cultural responses to events
Cost of new technologies	Privatisation VS nationalisation	NGOs & civil society involvement	System dimensioning	Cultural energy usages
Economic theories	Citizens consultation	Protest movements	Inter-countries connection	Demographics
Economic weight of the energy sector	Sectoral policies with a link on energy	Religious leaders <i>e.g.</i> , Pope Francis	Health and environmental hazards	Not in my backyard thinking (NIMBYism)
Purchase power	Energy market structure	Social theorists <i>e.g.</i> , Jeremy Rifkin	Power grid structure, age and RES integration	Technology fears
Rise of collaborative and cooperative economy	EU integration			Fuel poverty definition
Energy actors power games and competition	Subsidies and investment support			Population awareness
Energy price components	Ideas of national prestige			Capacity to change
Attracting foreign investment	Strategic decision on independence and security			Environmental awareness
Energy trading	Technology driven decision-making			Government distrust
Bank finance	Definition of energy independence			Fuel poverty caused mortality
Technologies abandon costs	Global deals			Different understandings and opinions

Economics	Politics	Lobbies/Opinion leader from	Energy system design	Socio-eco-demographics
Unemployment rate	Stable energy strategy VS regulation short term changes			
	Political announces VS concretisation			
	Nuclear military force			
	Tax system			
	Need to join forces at EU level to address environmental and global competition challenges			
	Administrative barriers to EU law			
	Lack of policies integration			
	Political priorities: environment, competitiveness, etc.			
	Energy citizenship			
Uncertain events	Energy consumption and end-use design	Other influences	Energy resources	
Energy infrastructure accidents	Growth of energy dependent appliances	Internet revolution	Natural resources	
Geopolitics events and crises	New technologies and materials growth	Media	Resources accessibility	
Climate change	Products lifecycle	Past wars		
Global and sectoral economic crises	Building standards			

Table 18: Indicative typology of energy system actors

Energy production and sale	Construction sector / indoor energy users	Other energy users	Regulation and administration of the energy system	Finance and funding linked with energy	Monitoring and control over the energy system	Knowledge and innovation production linked with energy	Consumers – rights & market power	Influencers over the energy system	Employment in the energy system
Large diversified energy firms	Building regulations; Advisory groups	Construction material firms	EU bodies	Banks	Statistics bodies	Public Universities	Consumer support organisations	NGOs, charities, etc.	Energy workers' unions
Utilities	Building standards & certification organisations	Chemical & metallurgy sector	National Government	Corporate investment	Environment 'observers'	Scientific Professional Associations	Energy consumer cooperatives	Consumer awareness groups	Unemployed
Renewable energy firms	Building control agencies	ICT firms	Judicial system	Investment funds	Banking 'observers'	Public research organisations	Advocacy groups	Religious leaders	Specialist Energy recruiters
Smaller energy Firms	Energy Advice centres	Transit & Haulage firms	National enforcement agencies	Public economic development bodies		Private Universities	Price comparison websites	Think-tanks	Workers' groups
'Prosumers'	Architects	Farmers				Independent research organisations	Consumer groups	Media	
Energy Cooperatives	Construction companies	Military	Local government	Private finance		Corporate research & development organisations		Artists	
Extraction &	ESCOs	Commuters	Local enforcement	Research funding		Start-ups		Not-for-profits	

Energy production and sale	Construction sector / indoor energy users	Other energy users	Regulation and administration of the energy system	Finance and funding linked with energy	Monitoring and control over the energy system	Knowledge and innovation production linked with energy	Consumers – rights & market power	Influencers over the energy system	Employment in the energy system
mining firms			agencies	schemes				organisations	
Energy Traders	Facilities Management	Finance & Insurance firms						Social communities	
TSO	Energy Auditors	Industries						Online communities	
DSO	Developers	Public Sector						Lobbyists	
Pipeline agency	Owners & Occupiers	Car owners & sharers						Energy Communities	
	Energy Engineers	Retail & service firms						Eco-villages	
		Social housing providers						Change-makers	
		Health Organisations						Citizen groups	