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Assessing European electricity policy goals and achievement levels

Abstract

Our aim in this research paper is to assess the evolution of European Union's electricity policy ambition. To find its electricity policy ambition we identify the targets and objectives of EU legislation and analyse their evolution in time, for the four main pillars of the EU electricity policy and for our selected categories.

The assessment is based on a policy density and policy intensity analysis. The empirical research resulted in about 300 pieces of binding EU legislation in the electricity sector, reuniting around 700 targets and objectives, during 30 years of collected data.

The policy density analysis covered several dimensions: stages, overall numbers, EUR-Lex placement, pillars and categories. The research found that legally-binding legislation has an upward trend from 1986 to 2018. Almost half of the EU electricity legislation classifies as environment legislation, if analysed from the pillars of energy policy viewpoint. If a more nuanced filter is used, categories, then environment and nuclear legislation make about two thirds of all EU electricity-relevant binding legislation.

The policy intensity analysis revealed that, using a categories filter, environment and internal market are dominating, with the nuclear categories far behind. It reveals that there are many pieces of legislation in the nuclear sector, but they are generally less complex, with fewer targets and objectives than other fields.

Constructing a major targets/objectives and categories matrix, we found that the largest amount of financing is towards nuclear research. Most expansion of duties for the European Commission happened for the internal electricity market category, followed by, surprisingly, security of supply. Major developments took place mainly for environmental; energy efficiency and savings; and internal energy market categories.

1. Introduction - Status quo of the EU electricity system: from vertically-integrated to liberalisation

The purpose of regulation is to steer agents' behaviour towards the objectives desired by regulator (Pérez-Arriaga 2014). The regulator acts, in principle, as an agent of the government. Hence, regulation is, by definition, a political act, driven by the voters' electoral options. The objectives or pillars of an electricity system are generally divided between security of supply, environmental protection and affordability (European Commission 2017).

Further divided into specific objectives, regulatory concerns for the power system follow a variety of topics, including consumer prices, security of electricity supply, environmental impact of power generating activities, protection of disadvantaged categories, manufacturing industry support, energy independence, market structure, quality of service to consumers and so on (Pérez-Arriaga 2014).

The activities in the power system can be roughly grouped, following their activity, into:

GENERATION
TRANSMISSION OF ELECTRICITY
SYSTEM OPERATION
INTERMEDIARIES (TRADERS, POWER MARKETS)
DISTRIBUTION OF ELECTRICITY
RETAILING/CUSTOMERS

Two dimensions transcend the activities above (Pérez-Arriaga 2014): activities that have to be conducted separately (unbundling) and activities that are deregulated (competition).

From those two single dimensions, all the variety of regulatory models can be derived, from the vertically integrated monopoly to full retail competition.

The traditional model

Historically, since the 19th century, the power system started with private enterprises delivering electricity to a few customers. As electricity became vital for the economy, the government intervened strongly, putting the enterprises into the public domain, making investments in generating capacity, transmission and distribution, and regulating prices for utilities and tariffs for customers. In short, a vertically integrated monopoly regulatory system. The prices were created through a negotiation between the regulatory authority and the state-owned utility, based on a formula that reflected each year's costs.

The incentive-based regulation

Fast forward to 1981, when Chile, followed by the UK and Argentina, pioneered the first important change in the paradigm, with the creation of an electricity market. Problems regarding cost-efficiency with the traditional model were the reason for this change. The model itself did not change, just the method to pay the utilities. While in the traditional model there was a negotiation between regulator and utility based on each year's costs, now the utility received a price for electricity valid for a longer period, for example 5 years, allowing the utility to keep any profit during this period. Hence, the utility had an incentive to start operating more cost-efficiently.

Liberalisation

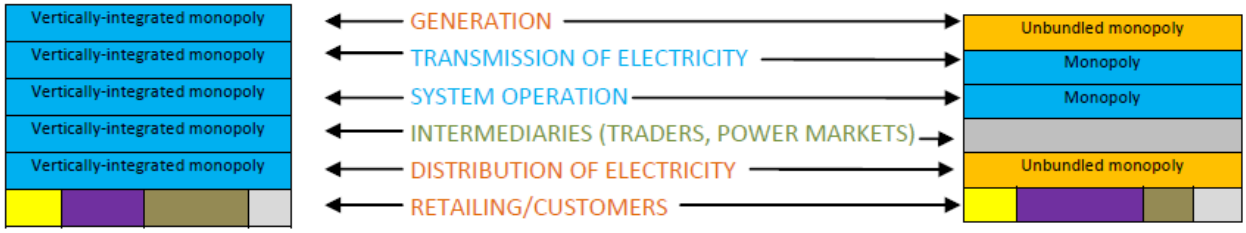
A number of criticisms appeared in the academia regarding this formula, but the real game-changer was the strong development of the grid. Several other factors enabled the transition, *e.g.* the development of new technologies, which reduced the so-called CoNE (Cost of New Entry). Particular to the European Union (EU), an additional enabling factor was the desire to create a single European market.

Liberalisation had two steps: unbundling and competition. Unbundling means breaking the activities of the vertically integrated monopoly into the power market activities: generation, transmission, system operation, distribution and retailing. The unbundling is made in several steps (degrees): account separation; management separation; legal separation; and, finally, ownership separation.

From this stage, the regulator takes the responsibility of transmission and system operation, having in mind to allow at a later stage competition at generation, distribution and retailing level. The intermediaries appear as a side-effect of market creation.

To sum up, from:

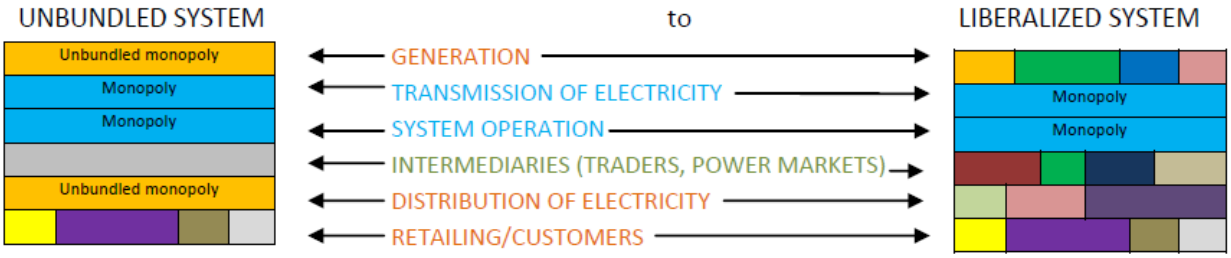
TRADITIONAL SYSTEM to UNBUNDLED SYSTEM



After unbundling, several organic developments are starting to appear: new generation companies; a single transmission company; intermediaries (traders, power markets); distribution companies (but heavily regulated) and retailers selling electricity to final consumers.

To sum up, from:

UNBUNDLED SYSTEM to LIBERALIZED SYSTEM



Status quo

A liberalized electricity system is the regulatory model pursued in the European Union. However, the implementation of climate legislation is starting to affect the model. Firstly, there is a decrease of remaining margins for load stabilizing generation, pushing national regulators into creating capacity remuneration mechanisms, distressing the internal electricity market. Secondly, there are increasing financial burdens on energy regulators supporting climate policy objectives. Thirdly, the convergence of electricity prices in European power exchanges is decreasing, a sign of market fragmentation, despite a

specific market design aimed to create a single internal energy market with close, but not identical, wholesale electricity prices.

What path will the European electricity policy take facing such a challenge? How will the regulatory model evolve? The next chapter, analytical framework, is trying to reply those questions by looking at the level of ambition of the European Union for environment, security of supply, affordability and internal electricity market, displayed in the last 30 years.

2. Analytical framework

Our aim in this research paper is to assess the evolution of European Union's electricity policy ambition, for the four main pillars of the EU electricity policy and for a more nuanced filter, categories.

To find EU's electricity policy ambition we propose, firstly, to identify the targets/objectives that are set for the main pillars of the EU electricity policy: affordability, security of supply, environment and internal market, and for our identified categories: Renewable Energy, Energy Efficiency and Savings, Internal Energy Markets, Security of Energy Supply, Environmental Protection, Nuclear Energy; Nuclear Research; and Research and Development.

Identifying the targets/objectives of EU electricity policy is pursued by quantifying all available binding goals of the European Union in the field of electricity, in a selected period of time. In terms of time limitation, we propose to start with 1986, widely taken as a starting point for a true EU policy by much of the literature (Black 2013, KU Leuven Energy Institute 2015) and continuing until 2018, the latest year available for data collection.

The official documents are all available online in a searchable format and can be freely consulted. This is an important aspect due to the sheer number of documents published by the Official Journal. Looking only at *binding* targets is an important filter, which is also used by other authors taking stock of existing targets (Kanellakis, Martinopoulos, and Zachariadis 2013, Pérez-Arriaga 2014).

To identify a legislative document as an electricity piece of legislation we look at documents approved by the Energy or Environment Council configuration, because those are the Council reunions with responsibility in the area.

Electricity legislation can have very different approaches, for example some regulation has quantifiable targets, other proposes research funds, some other increases the safety procedures or pollution control. A similar stocktaking exercise was done by Kanellakis, Martinopoulos, and Zachariadis (2013), who use a framework where they divide electricity policies into the following categories: Renewable Energy, Energy Efficiency and Savings, Internal Energy Markets, Security of Energy Supply, Environmental Protection, Nuclear Energy, and Research and Development. This is a framework that we use as well during our research, as it provides a comprehensive and accurate classification of legislation for our purpose.

In this respect, literature (Bauer and Knill 2014, Knill, Schulze, and Tosun 2012, Schaffrin, Sewerin, and Seubert 2015, Bondarouk and Mastenbroek 2017) is defining two types of policy approach: *policy density*, which is the number of policies put in place to reach a policy goal, and *policy intensity*, which focuses on the content of the policy instruments. We will treat both types of policy approaches in separate chapters.

Policy density and policy intensity offer an insight into the EU's electricity policy level of ambition. The two provide the analytical framework that will ultimately deliver the answer to our research question: what is the EU's electricity policy ambition?

Innovative in our approach is that we are not interested in the outcome of the policy (how the legislation is implemented), but at what happens afterwards, in the updating regulation (how the legislation evolves). If we have numerous pieces of legislation in a domain, with bringing numerous ground-breaking changes, then we can safely conclude that the ambition in that domain is high. Furthermore, the database will allow further research into the causes of the changes, using the collected data as a control group.

In the following chapter, methodology, we present in detail the steps we took for data collection and how we ensured accuracy, replicability and consistency of data.

3. Methodology

In order to measure the policy density and policy intensity of the European Union's electricity policy we need to build a database, quantifying the individual targets/objectives of EU binding legislation in the electricity sector.

To note, binding means only the EU documents with legal effects, Directives, Decisions and Regulations, and excluding Resolutions or Conclusions. We will group those targets/objectives identified in legislation according to the pillars and categories identified in the earlier chapter and tag them under several criteria, in order to be able to compare legislation.

The tagging criteria is a vital part of the empirical analysis, because this is the formula for creating comparable data. To sum up what we developed in the framework analysis, each identified target/objective will have:

- the *binding obligations/targets* in a short résumé;
- *quantifiable/not quantifiable* tag, to help our analysis;
- the *pillar* that is part of: affordability, security of supply, environment; and internal market;
- the *category* that is part of: Renewable Energy, Energy Efficiency and Savings, Internal Energy Markets, Security of Energy Supply, Environmental Protection, Nuclear Energy; Nuclear Research; and Research and Development;
- the exact *provisions*, quotes from legislation;
- the *importance*, added in order to differentiate the importance of regulations, given a grade from 1 to 4, where 4 is the highest;
- the *full title* of the legislation that is part of;
- the *link* to that legislation;
- the *stage* of the legislation, meaning in which energy package is the legislation part of;
- the *year* when the legislation was published;
- if still *in force* or by which legislation was *repealed by*.

Importance of the legislation is given by the following criteria:

- 1 – small: finance under 20 million EUR/year; minor development; foreign affairs;

- 2 – increasing: finance under 50 million EUR/year; MS to inform Commission; guidelines; Commission reporting; medium development;
- 3 – significant: finance under 100 million EUR/year; targets given/diluted; expansion of (Commission's) duties; new EU programme established; important development;
- 4 – large: finance over 100 million year; major expansion of (Commission's) duties; major development; new EU body (or scheme) established.

Each legislation could have one or more targets/objectives. The actual tagging is made by target/objective, not by legislation, to ensure that a policy intensity analysis is possible in the first place.

In order to ensure replicability of results regarding the importance of European obligations, explanations were given on how to tag different classes of obligations in the *Legend & Notes* sheet.

Non-binding indicators detailed in legislation were scrupulously eliminated from the database, despite providing concrete targets. This includes formulations such as “could be achieved by”.

To recall, all EU law is on the EUR-Lex website: http://eur-lex.europa.eu/advanced-search-form.html?action=update&qid=1494162853216

Research on the EUR-Lex website was done using the following criteria in the refine query:

- By domain: EU law and related documents; by subdomain: Legislation
- By type of act: all
- By author: Council of the European Union
- By year of document: each year was selected, in turn, from 1986 to 2018
- By directory code, 1st level: Energy, Search language: English
- By directory code, 1st level: Environment, consumers and health protection, Search language: English

Furthermore, to ensure a comprehensive and accurate database, a *legislative map* was created, with each piece of legislation being connected to its updating or repealing legislation. The pieces of legislation were colour-coded as well according to the pillars and categories. The lines drawn between various pieces of legislation were coded as well, according to the rank of reference, either as direct reference (repeal, update, part of a framework, etc.) or as mentioned/ related legislation. The “missing links” would signal missing legislation or human mistakes, that were corrected.

In the next three chapters, the overall results of the collection of data are presented, including the visual presentation of the results and the limitations of our research.

4. Empirical research

The empirical research resulted in about 300 pieces of binding EU legislation in the electricity sector, reuniting around 700 obligations/targets over 30 years, and over 8,000 tags that we can work with in our analysis. Each piece of legislation was read individually over the course of two years.

The MS Excel database resulted from the empirical research has about 700 lines and about a dozen separate sheets.

Please see below a print imagine of the database, as a sample (Fig.1):

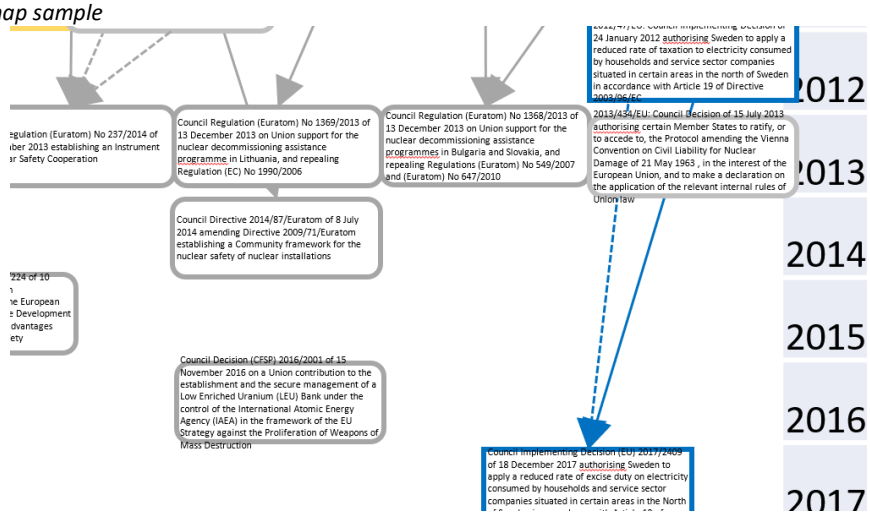
Fig.1: Database sample

Binding obligations/ targets	Quantifiable/ Not quantifiab	New binding obligations/ targets	Pillar	Category	Provisions	Importance (1min-4max)	Legislation	Link	Stage	Year	ture	Repealed by (follow up)
Cooperation with Canada in nuclear fusion research	not quantifiable		affordability	Nuclear Energy	*Cooperation in the field*	1-foreign affairs	Euratom: Council Decision of 20 January 1986 approving the conclusion by the Commission of a Memorandum of Understanding between the European Atomic Energy Community and the Government of Canada concerning cooperation in the field of fusion research and development	https:	1986-1989	1986		In force
Higher costs for oil burning, due to better disposal	not quantifiable		environment	Environmental Protection	*Member States shall ta*	1-minor development	Council Directive 87/101/EEC of 22 December 1986 amending Directive 75/439/EEC on the disposal of waste oils	https:	1986-1989	1986		No longer in force, Date of end of validity: 11/12/2010; Implicitly repealed by 32008L0098
Commission makes an inventory of measures that can be taken in case of oil spills	not quantifiable		environment	Environmental Protection	*An information system*	3-expansion of duties	86/85/EEC: Council Decision of 6 March 1986 establishing a Community information system for the control and reduction of pollution caused by the spillage of hydrocarbons and other harmful substances at sea	https:	1986-1989	1986		No longer in force, Date of end of validity: 27/12/2000; Repealed by 32000D2850
EU signs the protocol on long-range pollution	not quantifiable		environment	Environmental Protection	*The Protocol to the 197*	3-important development	86/277/EEC: Council Decision of 12 June 1986 on the conclusion of the Protocol to the 1979 Convention on long-range transboundary air pollution on long-term financing of the cooperative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe (EMEP)	https:	1986-1989	1986		In force

The legislative map was key in ensuring a consistent and accurate result. It unveiled missing legislation, helped in classification of obligations/targets, and facilitated in directing the analysis. The legislative map was done in MS PowerPoint, but even with a font size of 2 or printed on an A2 format paper, the details are still hard to read. Hence, we present below just a sample of the legislative map (Fig.2).

Despite this drawback, the legislative map is valuable, with a simple click the entire connecting eco-system of legislation becomes visible. Furthermore, the map is timeless, as it contains all legislation since 1986 to 2018, published in the Official Journal of the European Union.

Fig.2: Legislative map sample



The limitations of our research are mainly on two levels. Firstly, the increasing complexity of legislation makes difficult quantifying all existing targets/objectives from a piece of legislation. Best efforts were made to ensure all targets are tagged, but long and complex pieces of legislation could leave some minor objectives uncovered.

Secondly, there is the subjectivity of the researcher, as some objectives/targets could have different tags. However, detailed instructions were noted in the database for all decisions, to ensure replicability of results.

Other limitations are related to the EUR-Lex website, where some pieces of legislation that should have been in the Energy or Environment directories were not found.

The following chapter presents the results of the empirical research, from a policy density perspective.

5. Policy density

In this section, the analysis and conclusions resulting from the empirical research is presented. In contrast with the following section, policy intensity, every piece of legislation from this section is treated as a whole, with tagging involving the entire piece of legislation, not the particular EU energy policy targets/objectives.

The timeframe starts in 1986 and finishes in 2018, when the latest published legislative package was available, encompassing a period of about 30 years. 1986 is an important year for the EU energy policy, due to the adoption of the European Single Act.

The European Commission is proposing new energy legislation in packages. Hence, we divide this empirical analysis in stepping stones as well, according to consecutive energy packages. An energy package starts when the legislative proposals were adopted, not the year when they were proposed by the Commission.

Therefore, we have the following stepping stones: the first stage starting from 1986, with the the European Single Act; the second stage, starting in 1990 with the First Electricity Directive; the third stage from 1996; the fourth from 2003; the fifth from 2009 and finally, the latest, from 2015. In total, there are 6 stages, all building from the previous one, hence calling them stepping stones.

For *the first stage, 1986-1989,* a total of 134 documents in the Environmental section and 28 in the Energy section were found, of which 7 were electricity-related in the Environmental section and 18 in the Energy section, one document being in both sections. 18 pieces of legislation were legally-binding: 16 Decisions and 2 Directives.

For *the second stage, 1990-1995,* a total of 187 documents in the Environmental section and 36 in the Energy section were found, of which 11 were electricity-related in the Environmental section and 23 in the Energy section, one document being in both sections. 28 pieces of legislation were legally-binding: 18 Decisions, 7 Directives and 3 Regulations.

Although this stage has one extra year, the number of legally-binding decisions almost doubled from one stage to the other, in both Environmental and Energy sections. Most of the legally-binding legislation was Decisions.

For *the third stage, 1996-2002*, a total of 256 documents in the Environmental section and 68 in the Energy section were found, of which 45 were electricity-related in the Environmental section and 55 in the Energy section, seven documents being in both sections. 85 pieces of legislation were legally-binding: 58 Decisions, 12 Directives and 15 Regulations.

This stage is one year longer than the previous one. The number of legally-binding decisions again increased significantly, mainly electricity-related in the environmental section. Most of the legally-binding legislation was Decisions, but the number of Regulations overpassed the number of Directives.

For *the fourth stage, 2003-2008,* a total of 206 documents in the Environmental section and 50 in the Energy section were found, of which 26 were electricity-related in the Environmental section and 45 in the Energy section, four documents being in both sections. 68 pieces of legislation were legally-binding: 38 Decisions, 18 Directives and 12 Regulations.

This stage is one year shorter than the previous one. The number of legally-binding decisions decreased, mainly electricity-related in the environmental section. Most of the legally-binding legislation was Decisions, and the number of Directives was higher than the number of Regulations.

For *the fifth stage, 2009-2015,* a total of 180 documents in the Environmental section and 50 in the Energy section were found, of which 27 were electricity-related in the Environmental section and 41 in the Energy section, one document being in both sections. 69 pieces of legislation were legally-binding: 32 Decisions, 15 Directives and 22 Regulations.

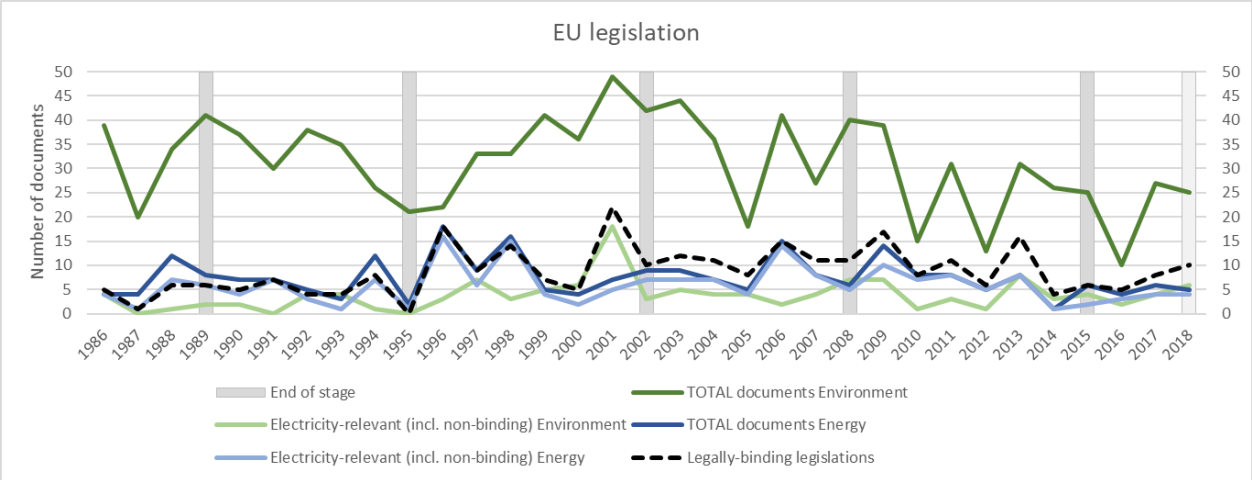
This stage is one year longer than the previous one. The number of legally-binding decisions remained roughly the same, just one more, despite being longer with one year. Most of the legally-binding legislation was Decisions, and the number of Directives was lower than the number of Regulations.

The years 2016, 2017 and 2018 were quantified as well, but they are not composing a stage, as it is not fully complete. Those three years were added in a database, in order to have the longest time series as possible, adding to the comprehensiveness of results.

Analysis by EUR-Lex directory classification

Plotted on a chart, the empirical research presents as following (Chart 1):

Chart 1: EUR-Lex directory classification of legislation



The results show that the electricity-relevant energy legislation has generally higher numbers than the electricity-relevant environment legislation, 193 compared with 128. The two are named as such according to the EUR-Lex directory where found. *In other words, EUR-Lex places more electricity-relevant legislation in the Energy directory than in the Environmental directory.*

To note, the division between energy and environment used by EUR-Lex is inconsistent, with documents found in both directories. Therefore, a more consistent classification is necessary.

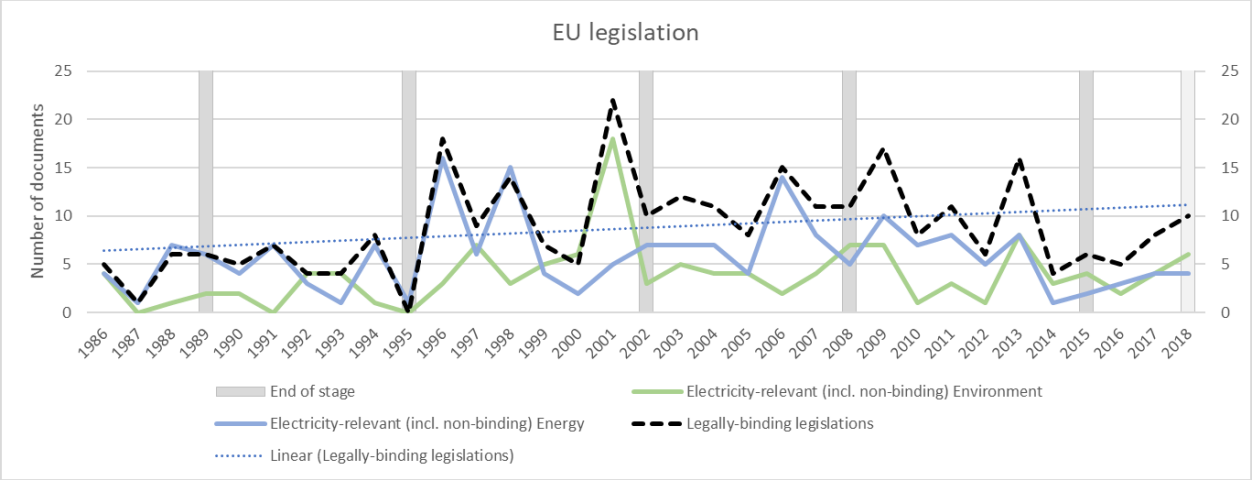
Analysis by legally-binding legislation

Nonetheless, the empirical research shows that the number of electricity-related legally-binding documents has roughly doubled since 1986. *In other words, there is increasingly more EU-binding legislation.* The highest number was reached in 2001, while the lowest was in 1995.

As many of the documents are both in the Energy and Environmental directories, we cannot display trendlines for pieces of legislation from those EUR-Lex folders.

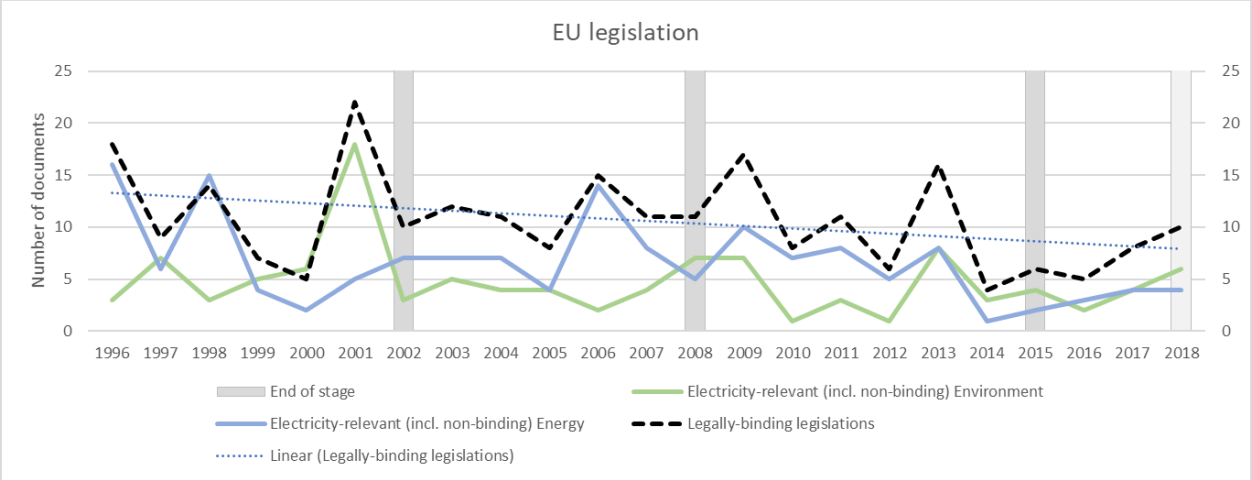
The chart below shows the results in a visual display, using a linear trendline (Chart 2):

Chart 2: Trends of electricity-relevant legally-binding legislation (1986-2018)



Remarkably, if we started counting since 1996, the number of legally-binding legislation is actually decreasing; there is less EU-binding legislation (Chart 3).

Chart 3: Trends of electricity-relevant legally-binding legislation (1996-2018)



Analysis by packages

The charts reveal that every stage or energy "package" starts with an increase of legally-binding electricity-related legislation. The literature divided stages based on the importance of the legislation that was approved. However, we can see that every new stage is determined by an increase of new legislation as well.

On a yearly average, most legally-binding electricity-related legislation was in the 3rd stage (1996-2002), 12.1, followed by the 4th stage (2003-2008), 11.3 and the 5th stage (2009-2015), 9.7. The legally-binding

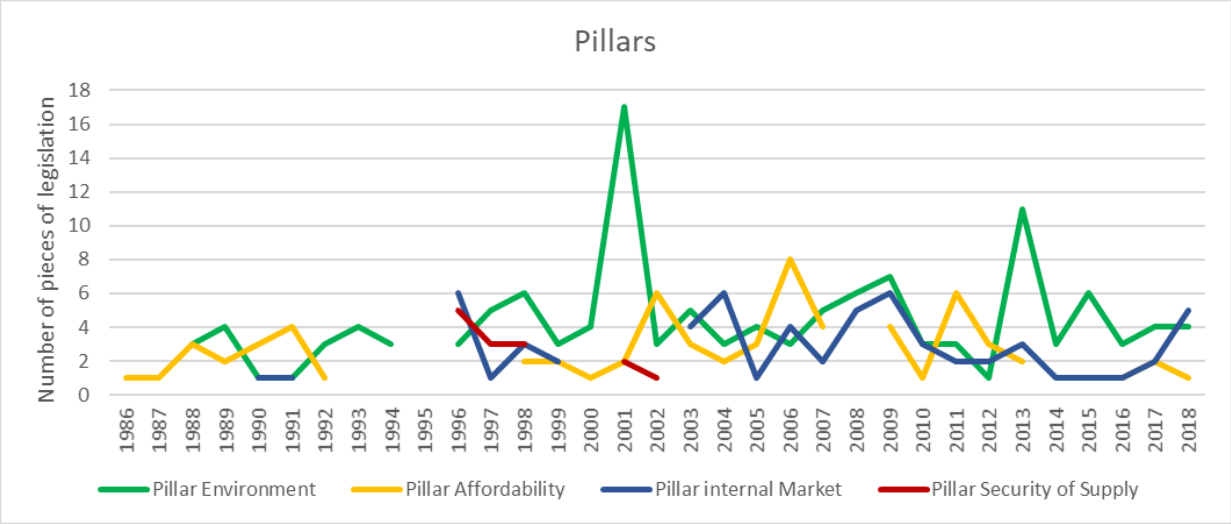
legislation is slowly decreasing by package. *This shows that the legislative path taken in the last decade by policymakers is not of new legislation, but of renewing and expanding old legislation.*

Analysis by pillars

As we showed in the methodology section, one of the main classifications used in quantifying legislation is by pillar, meaning: affordability, security of supply, environment and internal market. Those are the objectives or pillars of the energy sector.

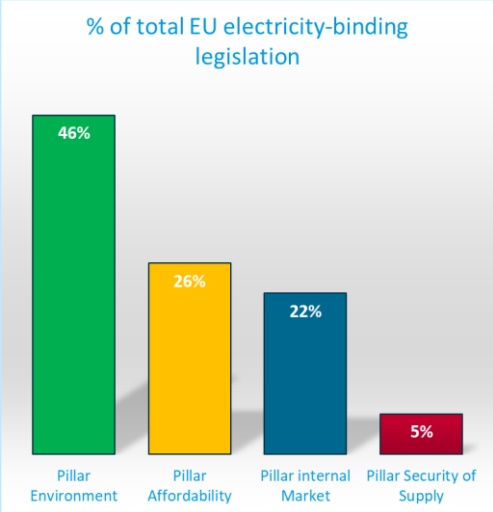
Plotted on a chart (Chart 4), the results show little in terms on chronological evolution, with no clear trend. The number of pieces of legislation is zigzagging and changing with no clear pattern.

Chart 4: Legislation analysis by pillars



In terms of volume (Fig.3), however, the analysis shows a strong dominance of the environmental pillar. Almost half of the EU electricity-relevant binding legislation is having environment as the main objective. Affordability and internal market follow with roughly equal shares, of about a quarter. Finally, few pieces of legislation, about 5%, are dedicated specifically towards security of supply.

Fig.3: % of total EU electricity-relevant binding legislation by pillar

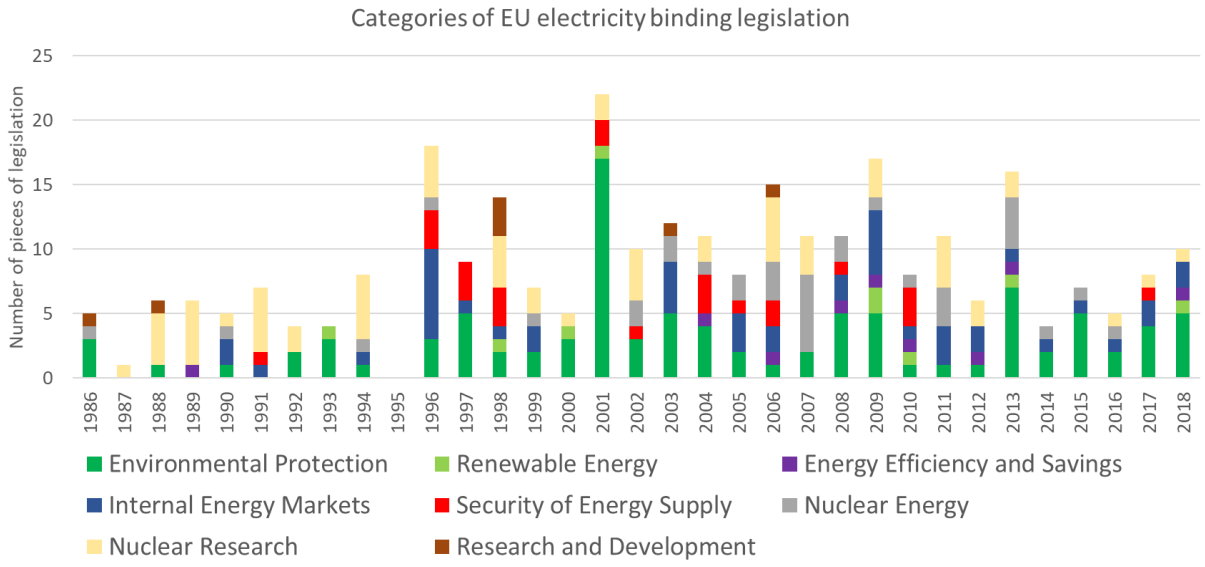


Analysis by categories

A more detailed classification, showing a more nuanced view of the EU electricity-relevant binding legislation, are the categories: Renewable Energy, Energy Efficiency and Savings, Internal Energy Markets, Security of Energy Supply, Environmental Protection, Nuclear Energy, Nuclear Research, and Research and Development. The choice of those categories was explained in the analytical framework section.

The results were plotted in the chart below (Chart 5):

Chart 5: Legislation analysis by categories



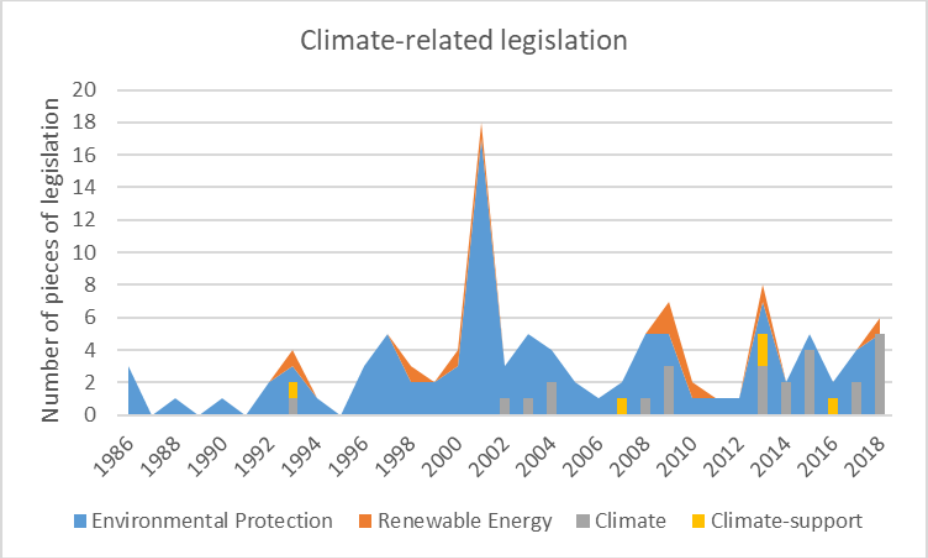
Consistent with the previous sub-section, analysis by pillars, the dominant category is *environmental protection*, with about 34% of all electricity-relevant binding legislation. *Nuclear research* makes a big part of the EU legislation as well, with about 22%. If *nuclear energy* legislation is added, about 12% of all legislation, then almost a third of all EU electricity-relevant binding legislation is dedicated to the nuclear sector. On the third place, with about 15%, there is the legislation dedicated to completing the *internal electricity market*. Finally, *security of energy supply*, makes about 8% of all legislation. All the other remaining categories, Renewable Energy, Energy Efficiency and Savings, Research and Development, are under 5%.

To sum up, environment and nuclear make the bulk of all EU electricity-relevant binding legislation, covering almost two thirds of all legislation.

Analysis by categories – climate

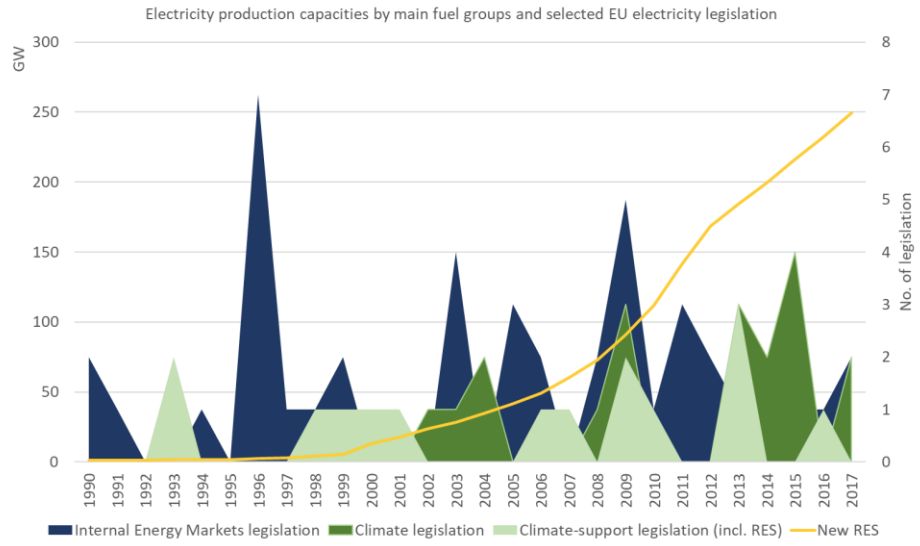
In this sub-section, a twist to the analysis is given, adding a new category, climate and climate-related legislation. The study results show that the EU environment-legislation is increasingly climate-legislation. This conclusion can be seen clearly from the chart below (Chart 6).

Chart 6: Climate legislation against environmental protection legislation



Using the same new categories to compare against capacity (GW) (Chart 7) and production (GWh) (Chart 8) of new renewable energy sources, with a 2-years delay, the analysis shows a moderately positive correlation, with a magnitude of over 0.5. *In other words, RES development is moderately driven by climate legislation.*

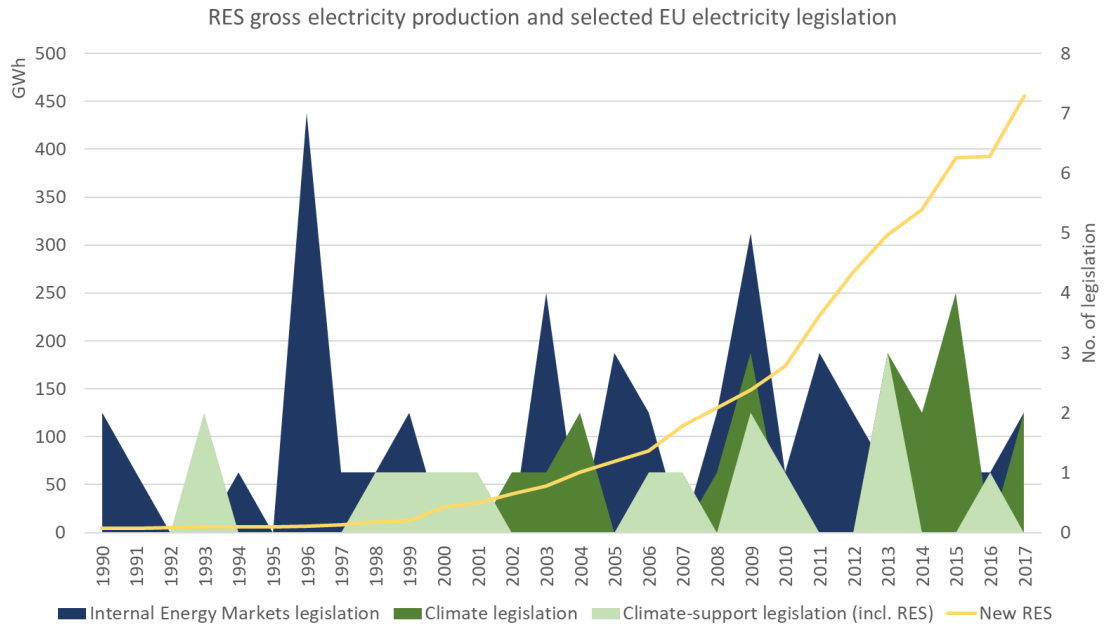
Chart 7: Climate legislation against new RES capacity



Correlation magnitude (CORREL function in MS Excel):

New RES-Internal market legislation	0,044
New RES-climate legislation	0,550
New RES-climate + internal market	0,302

Chart 8: Climate legislation against new RES production



Correlation magnitude (CORREL function in MS Excel):

New RES-Internal market legislation	0,048
New RES-climate legislation	0,548
New RES-climate + internal market	0,303

New renewable energy sources are identified as wind, solar thermal, solar PV and tidal and wave energy. To recall, a correlation coefficient is a statistical calculation that helps determine the relationship between two sets of data.

Conclusions of policy density analysis

The policy density analysis covered several dimensions: stages, overall numbers, EUR-Lex placement, pillars and categories.

The analysis concludes that EUR-Lex is placing most of the electricity-related binding legislation into the energy directory. However, looking at the classification we made by the objectives or pillars of the energy policy, almost half of the legislation classifies as environment legislation. This means a bias of EUR-Lex classification towards the energy directory, while the reality is that a part of it should be in the environment directory. While it can be argued that all the electricity-relevant legislation that is not in the environment EUR-Lex directory should be the energy EUR-Lex directory, the difference in numbers is too large to annul this effect.

Looking at the volume of legislation and its chronological evolution, the legally-binding legislation has an upwards trend from 1986 to 2018. However, counting from 1996, the trend shows an actual decrease. This insight is given by looking at legislation from the prism of packages and checking their average legislative volume per year.

An explanation for this result is that by 1995 the building blocks of the EU electricity policy were put in place. Following that year, the EU policymaking focused not on new, originating legislation, but on modifying, updating or merging the existing building blocks.

Further into our research, the analytical framework proposed two sets of division: pillars and categories.

Looking at the classification by pillar, meaning affordability, security of supply, environment and internal market, almost half of the EU electricity-relevant binding legislation is dedicated to protecting the environment. The other pillars are at maximum half strength the environmental pillar in terms of number of pieces of legislative legislation.

The reason for this outcome is unknown at the moment but will be researched at a later stage. It could be related to the competences of the European Union, but if that is the case, then the internal market pillar should have shown higher numbers.

The more nuanced classification by categories shows that environment and nuclear legislation make the bulk of all EU electricity-relevant binding legislation, with about two thirds of all pieces of legislation being into those two groups.

The separate study on climate is creating two new categories, climate and climate-support. We find that the EU environment-legislation is increasingly climate-legislation. The new renewable energy sources, mainly wind and solar, show a moderately positive correlation with climate legislation.

In the next section, policy density, the research takes a deeper look into the individual EU energy policy targets and objectives.

6. Policy intensity

In contrast with the previous section, policy density, the analysis in this chapter involves the targets/objectives inside every piece of EU electricity-relevant binding legislation. It is a much deeper investigation than the previous chapter.

Policy targets or objectives mean measures clearly state in binding legislation, with a defined outcome. This outcome may be finance for projects, agreements with third countries, pollutant reduction targets, expansion of duties for the Commission, etc.

Within the 291 identified pieces of legislation, the empirical research noted 685 individual electricity policy targets/objectives. The increased complexity of legislation made identification of targets/objectives difficult, particularly since 2009.

The chapter is divided into three parts: a first part with an analysis of the number of policy targets; a second part with an analysis of the policy targets by importance; and a third part, with conclusions.

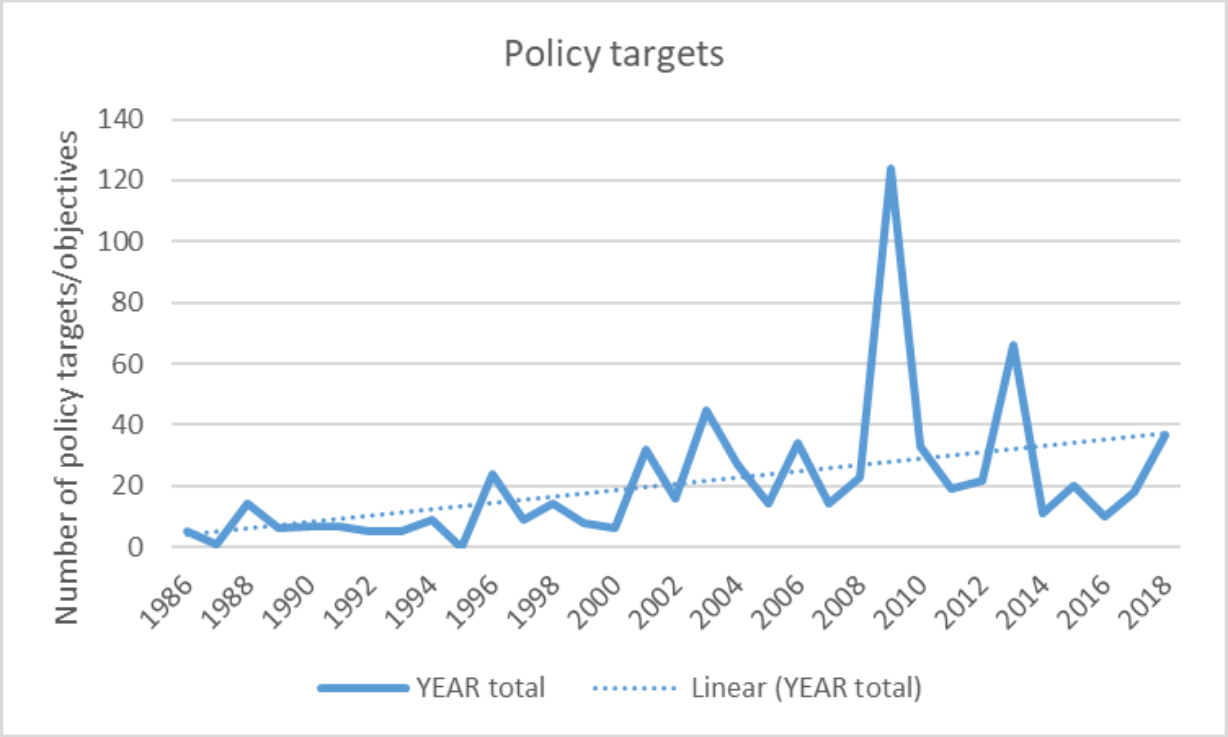
EU electricity policy targets/objectives: analysis by number of policy targets

Empirical research reveals that the number of electricity targets/objectives has a yearly upward trend (Chart 9). This confirms what was noted in the previous chapter, that the complexity of the EU legislation is increasing. *In other words, the EU electricity-relevant binding legislation has increasingly more targets and objectives.*

The year 2009 had a significant burst of targets/objectives, several pieces of legislation from that year including 15+ targets/objectives. Early years, the 1980s and 1990s had more single-dedicated pieces of legislation, while 2000s and 2010s tend to consolidate and update existing legislation. This observation confirms what was noted in the previous chapter.

At this moment, the reason for this burst in 2009 is unclear. It could be the outcome of a change in EU policymaking from the European Commission or resulting from a transformation in political power of different institutions.

Chart 9: Trends of electricity-relevant legally-binding legislation by policy targets/objectives (1986-2018)



Analysis by pillar

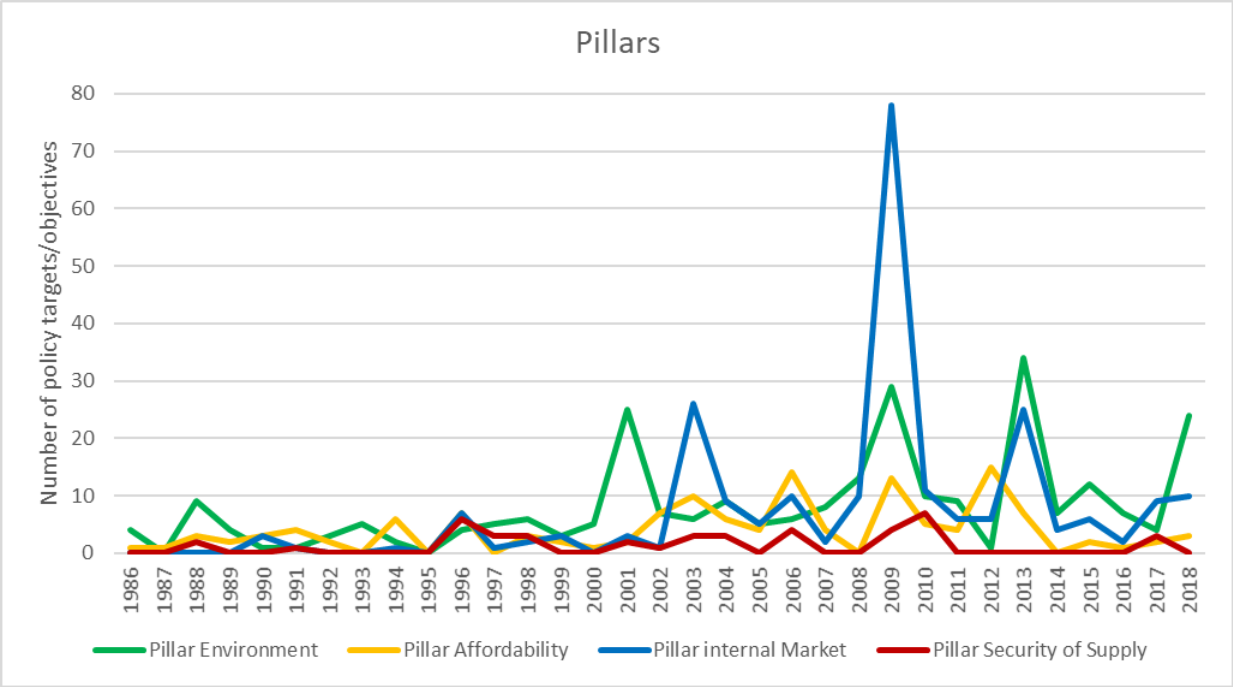
Looking at data from the filter of energy pillars, affordability, security of supply, environment and internal market, the evolution of each pillar is clearly visible (Chart 10).

In terms of percentages, 39% of all EU electricity targets/objectives are in the environment pillar, 35% in the internal electricity market pillar, 20% in the affordability pillar and 6% in the security of supply pillar.

The percentages are slightly different than the ones noted in the policy density analysis. However, roughly from the end of 2000s, Commission and Member States have much more reporting to do, which was tagged under “internal electricity market”. This is quantified as an objective because it means sharing of data and information at EU-level, but it does not have a major impact.

Hence, an analysis of EU electricity targets/objectives by importance is vital, in order to have a balanced view of the EU electricity policy ambition.

Chart 10: Legislation analysis by number of policy targets/objectives and pillars of energy policy



Nonetheless, *the empirical research confirms the large effort done by the EU institutions in the environmental sector, while very little was done for security of supply.* The reasons for this outcome are unknown at the moment, but they will be part of a later research.

Analysis by category

A more nuanced view of the EU electricity-relevant binding legislation is through the filter of categories' analysis: Renewable Energy, Energy Efficiency and Savings, Internal Energy Markets, Security of Energy Supply, Environmental Protection, Nuclear Energy, Nuclear Research, and Research and Development (Chart 11).

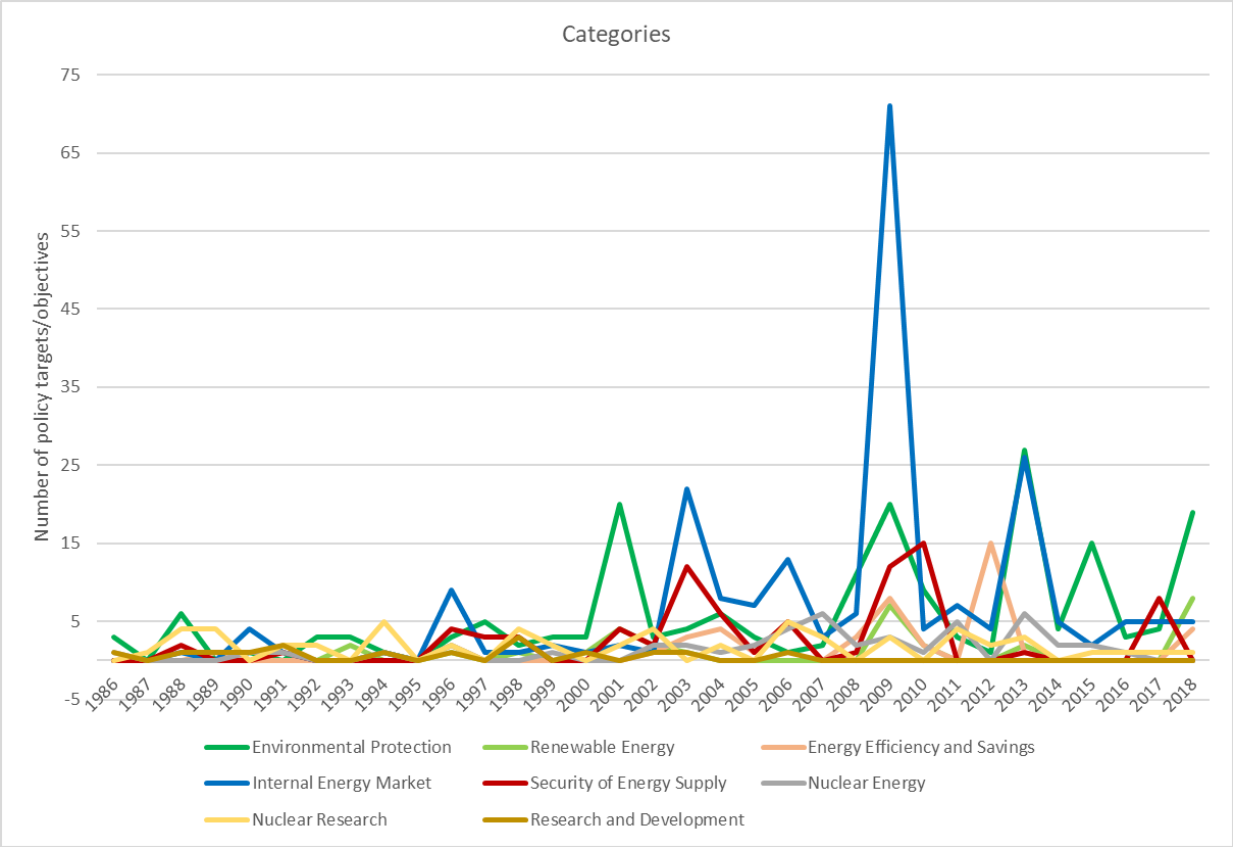
The research shows that most of the targets/objectives are categorized as "environmental protection", 27%, and "internal energy market", 32%. Far behind on the third place is category "security of energy supply" with 12%.

"Nuclear energy" and "nuclear research" categories make only 7% and 8% of targets/objectives. This outcome comes in contrast with the policy density analysis, which showed a much higher concentration. These results reveal that most of the nuclear legislation is single-targeted.

About 8% of the EU targets/objectives classify under "energy efficiency and savings" category, roughly in the same spot as in the policy density analysis.

All remaining categories, "renewable energy" and "research and development", are under 5%. This shows that the EU energy research is either focusing on nuclear research or it is not captured in the EUR-Lex Energy and Environment Directories.

Chart 11: Legislation analysis by number of policy targets/objectives and categories of energy policy



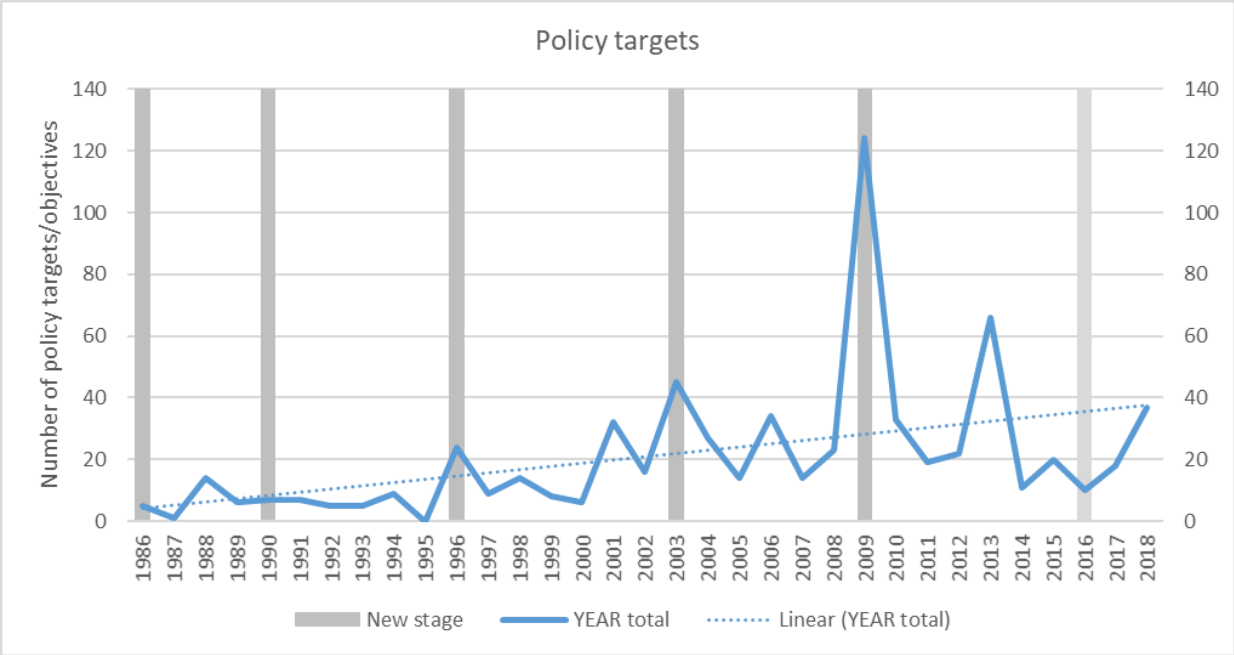
Analysis by stage

The literature on the EU energy policy identified several stages of EU energy policy development. This insight was integrated in the empirical data.

The identified stages in the literature fulfil neatly the spikes in targets/objectives from the chart below (Chart 12), hence confirming the accuracy of our data.

The analysis of spikes also reveals that *a new stage has likely started in 2013, making 2009-2012 a short stage, and new one is likely to appear in 2019*. Indeed, 2013 was the year of publishing in the EU Official Journal of the reformed EU Emission Trading System Directive and several other pieces of legislation. In 2019, there is the completion and publishing of the Clean Energy Package, a major reform of the EU energy policy.

Chart 12: Legislation analysis by number of policy targets/objectives and stages



However, diverse targets and objectives have a different weight, a different importance, *e.g.* some research programs have larger funding than others. The classification given so far masks those differences. Therefore, a tagging by importance was given to each EU electricity target/objective. The results are presented in the sub-section below.

EU electricity policy targets/objectives: analysis by importance of policy targets/objectives

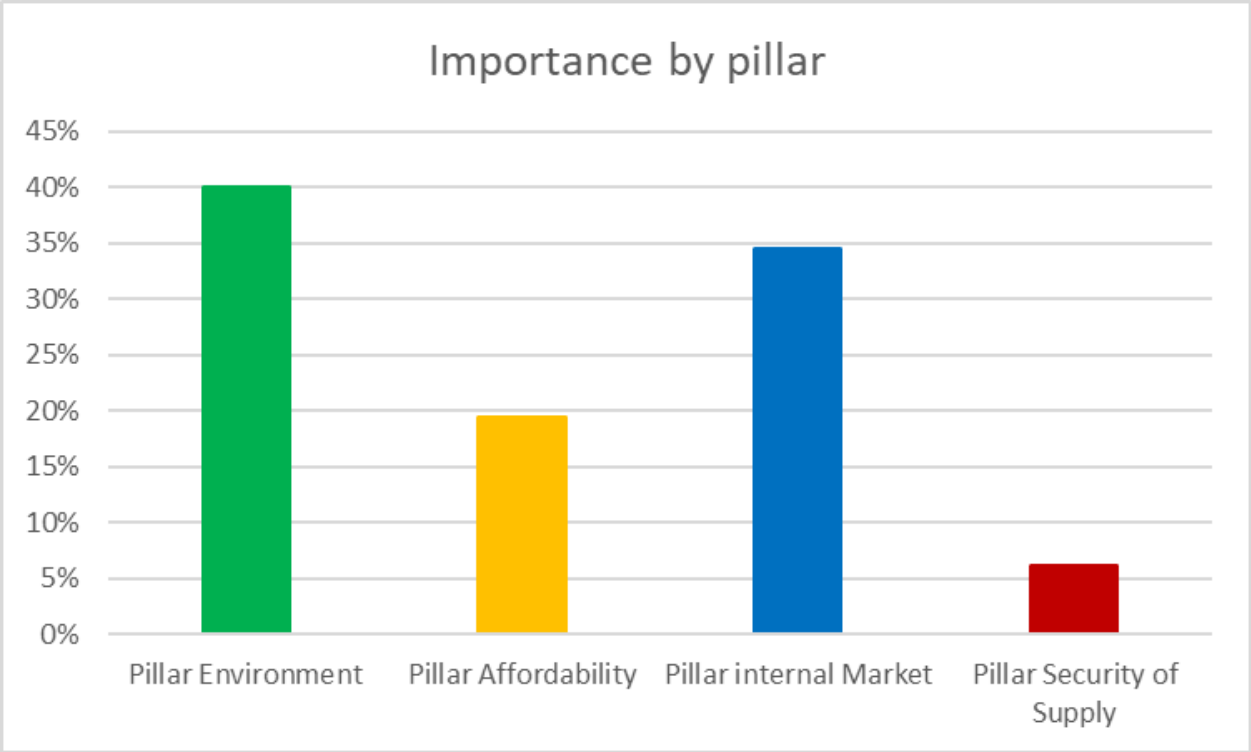
The targets/objectives identified in the empirical research were given a rank, from 1 to 4, where 4 is the highest, according to their importance. Importance was defined in a set a of rules, described in the methodology chapter.

Analysis by pillar

Out of the four pillars: affordability, security of supply, environment and internal market, the environment pillar has the most points, with a share of about 40% of total, followed by internal market, with a share of about 34% of total. Affordability was on the third place with about 19% and, finally, security of supply with only 6% (Fig.4).

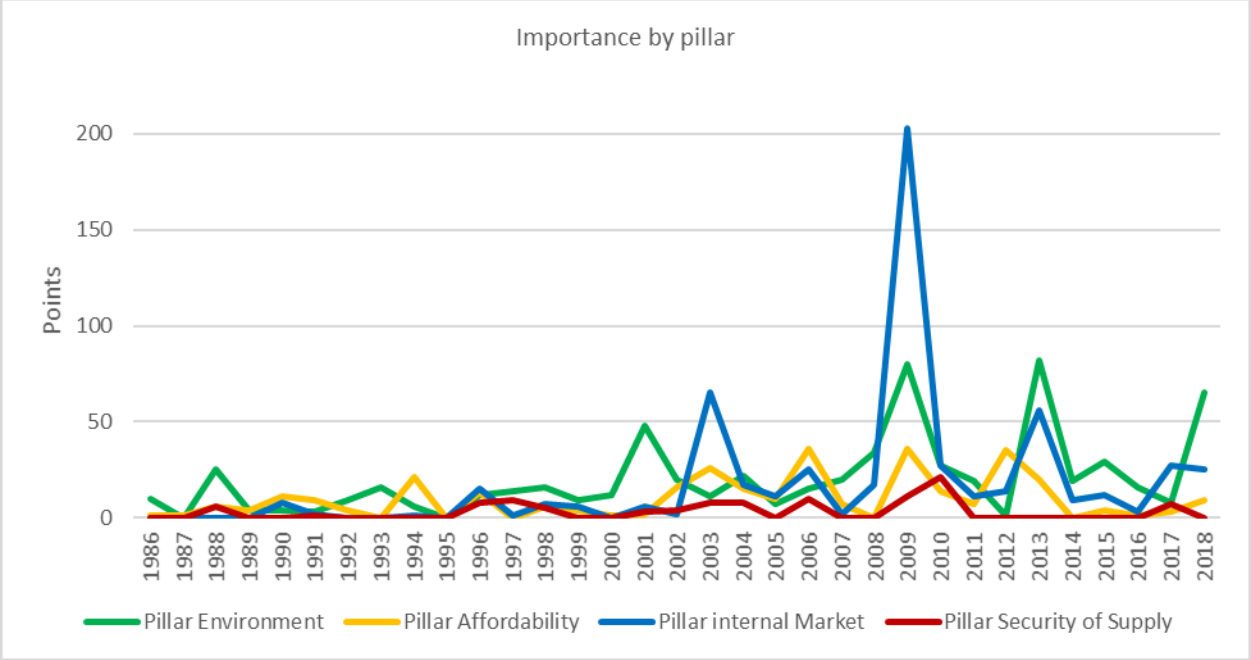
Those results show again the high importance given to the environmental protection. It also reveals that, *although internal market had relatively fewer pieces of legislation dedicated to it, their importance was higher than ones dedicated to affordability*.

Fig.4: % of total EU electricity-relevant binding legislation by pillar and importance



Looking at importance of targets/objectives by their evolution in time, we notice a similar display as in the density and intensity charts. This outcome is not revealing anything new, but confirms the consistency of the research (Chart 13).

Chart 13: Legislation analysis by importance of policy targets/objectives and pillars of energy policy



If the analysis focuses only on the most important, ranked 4, legislation, we find on the first place pillar "internal market" with 39 major targets/objectives. On the second place, the study reveals, surprisingly, pillar "affordability" with 32 major targets/objectives. The cause for this is that nuclear research projects over 100 million/EUR per year are ranked pillar affordability, ranked 4. We can safely conclude that *legislation dedicated to affordability tends to be high in volume (many pieces of legislation), with relatively few targets/objectives, but hard hitting (with high importance)*.

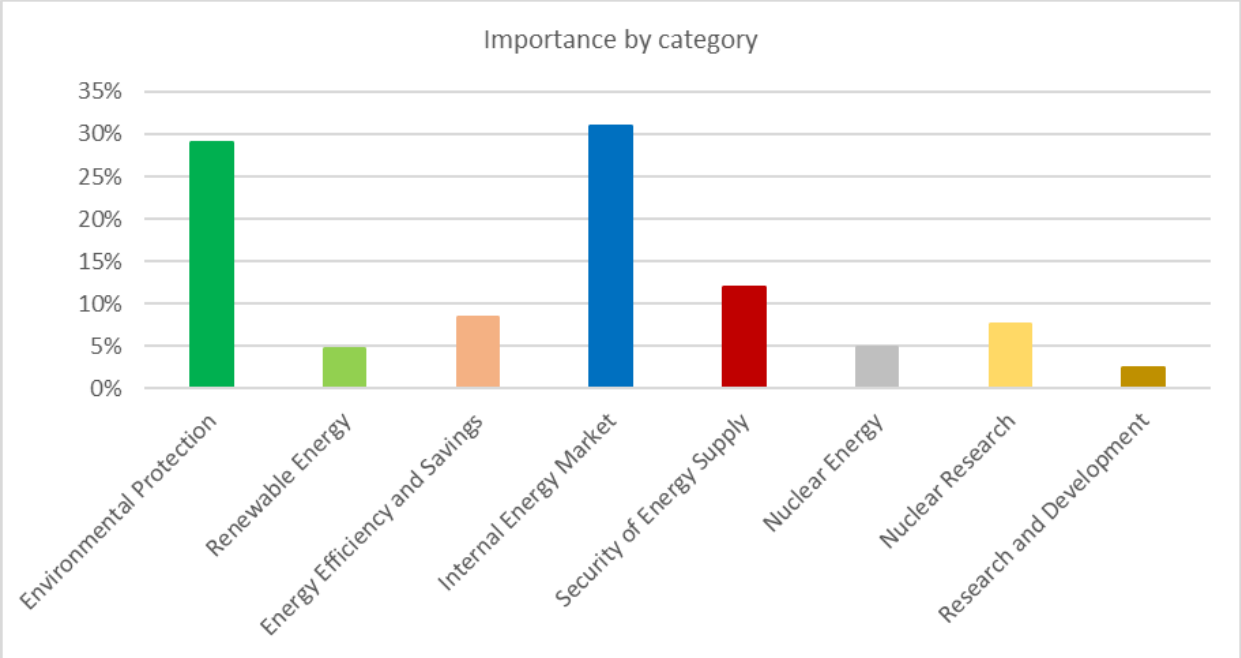
Closely following pillar "affordability" is pillar "environment" with 28 major targets/objectives. Finally, pillar "security of supply" with only 4 major targets/objectives.

If we add the targets/objectives ranked 3, pillar "environment" comes back with no less than 125 targets/objectives. Pillar "internal market" follows far behind, with only 37 targets/objectives. Pillar "affordability" has 33 targets/objectives and, finally, pillar "security of supply" trails behind with only 17 targets/objectives.

Analysis by category

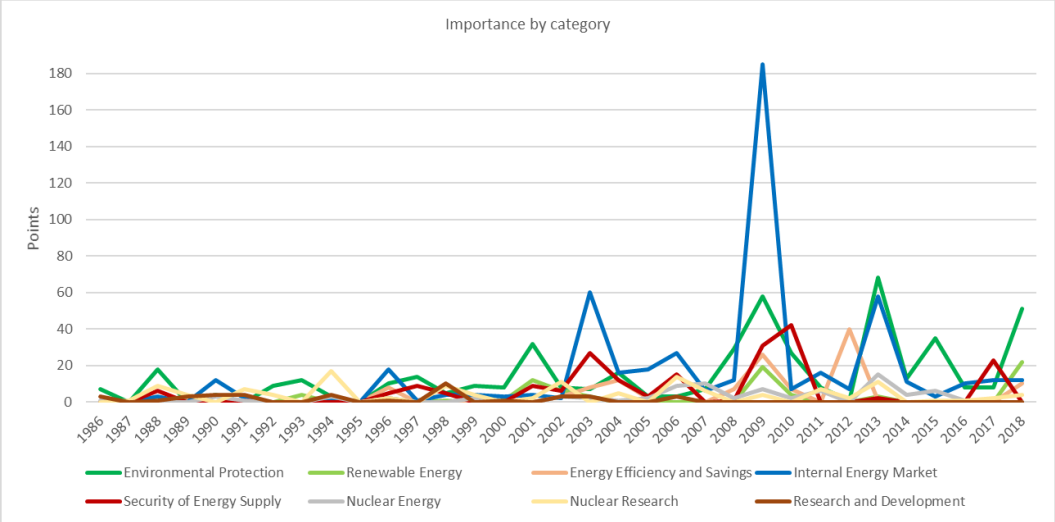
Looking at the importance of targets/objectives by category, the more nuanced filter, the results show a change of ranking with internal market being on top, with 31% of the total points, followed by environmental protection with 29%. On the third place, there is security of supply, with 12%. All the other categories are under 10% (Fig.5).

Fig.5: % of total EU electricity-relevant binding legislation by category and importance



The chronological evolution since 1986 shows similar results as in the filters developed earlier (Chart 14).

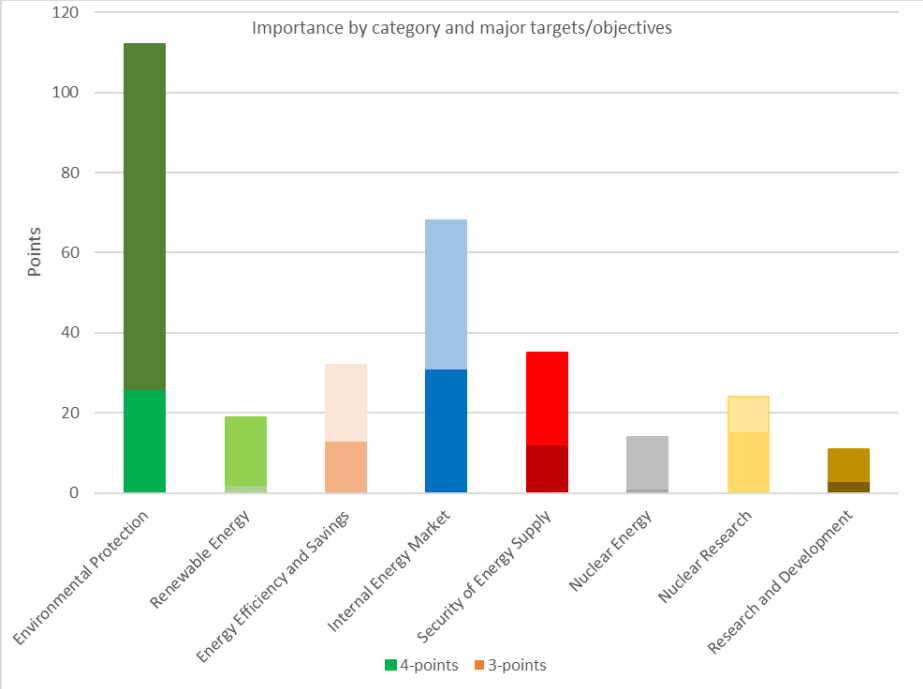
Chart 14: Legislation analysis by importance of policy targets/objectives and categories of energy policy



As in the pillar analysis, if the analysis focuses only on the most important, ranked 4, legislation, we find on the first place category "internal energy market" with 31 major targets/objectives. On the second place, there is the category "environmental protection" with 26 major targets/objectives. On the third place, there is category "nuclear research" with 15 major targets/objectives.

If we add the targets/objectives ranked 3, category "environmental protection" comes again back with 86 targets/objectives. Category "internal energy market" follows with, coincidently, 37 targets/objectives. Finally, on the third place, there is category "security of supply" with 23 targets/objectives (Chart 15).

Chart 15: EU electricity-relevant binding legislation by category, and importance of main targets/objectives

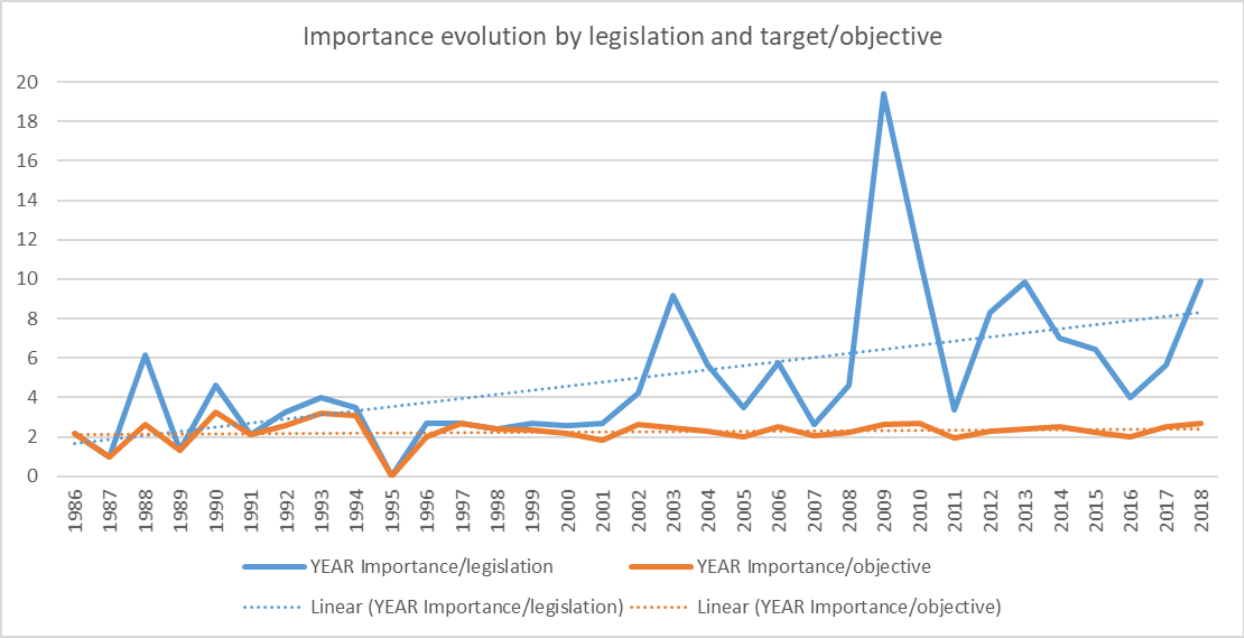


Analysis by major targets/objectives

Previous analysis showed at every step that the EU electricity related legislation is becoming more complex, on a yearly basis, with more pieces of legislation, more targets/objectives and pieces of legislation with more importance.

However, looking at the importance of targets/objectives on a yearly basis, the consistency of the EU electricity legislation remarkable, being almost flat, with no change in 30 years, except 1995. It was a stable push towards new electricity legislation for an entire generation (Chart 16).

Chart 16: Importance of targets/objectives and of legislation on a yearly basis



Analysis by major targets/objectives and categories

If a matrix of major targets/objectives and categories is created (Table 1), we find that nuclear research received by far the largest amount of financing. Maybe as expected, the Commission received most expansion of duties for the internal electricity market. However, on the second place is security of supply. Major developments took place mainly for environmental, energy efficiency and savings, and internal energy market categories.

Table 1: Matrix of major targets/objectives and categories

	finance over 100 million year;	major expansion of (Commission's) duties;	major development;	new EU body (or scheme) established;	TOTAL	
	4	6	14	2	26	***Environmental Protection***
	1	0	1	0	2	***Renewable Energy***
	0	2	11	0	13	***Energy Efficiency and Savings***
	1	16	10	4	31	***Internal Energy Market***
	0	8	4	0	12	***Security of Energy Supply***
	1	0	0	0	1	***Nuclear Energy***
	14	0	0	1	15	***Nuclear Research***
	2	0	1	0	3	***Research and Development***
TOTAL	23	32	41	7	103	

Most important pieces of legislation

With the available data, an important outcome can be determined: the most important EU electricity-relevant binding pieces of legislation in the last 30 years. For that, we took all pieces of legislation over 20 points, to eliminate pieces of legislation with one single, but major target. We divided the total number of points per legislation to the number of objectives. We selected the top 4 pieces of legislation, as there is an equality for the next 3.

Results show that *the most important EU electricity-relevant binding pieces of legislation are*:

- Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003;
- Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005;
- Council Directive 88/609/EEC of 24 November 1988 on the limitation of emissions of certain pollutants into the air from large combustion plants;
- Regulation (EC) No 1228/2003 of the European Parliament and of the Council of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity (Text with EEA relevance).

Unsurprisingly, these pieces of legislation were key in the development of the internal gas and electricity markets.

Conclusions of policy intensity analysis

Policy intensity analysis covered, as in the previous chapter, several dimensions: stages, overall numbers, pillars, categories and importance.

The first finding is that the complexity of the EU legislation is increasing. The EU electricity legislation has gradually increased the number of targets and objectives from 1986 to 2018. However, the average yearly importance of targets and objectives remained remarkedly stable, being almost flat since 1986.

Looking from the pillar perspective, most of the EU electricity targets/objectives are in the environment and internal market pillar. This confirms the conclusion drawn in the policy density chapter, that the EU regulatory effort was largely in the environment sector, while little was done for security of supply.

Looking from the more-nuanced category perspective, the targets/objectives related to nuclear have a lower percentage than it was concluded in the policy density analysis. It shows that most of the nuclear legislation is rather single-targeted. Legislation dedicated to affordability tends to be high in volume (many pieces of legislation), with relatively few targets/objectives, but hard hitting (with high importance).

Regarding policy stages, our data fits the timeline identified in the literature. Furthermore, the plotted chart reveals that a new stage has probably started in 2013, and a new one is likely to appear in 2019.

In the major targets/objectives and categories matrix, the largest amount of financing is shown to be towards nuclear research. The European Commission received the most expansion of duties for the internal electricity market. However, on the second place for expansion of duties, there is security of

supply. Major developments took place mainly for environmental, energy efficiency and savings, and internal energy market categories.

Finally, the results of the research show that the main pieces of legislation were on cross-border exchanges in electricity and gas markets; plus the Directive on the limitation of emissions of certain pollutants into the air from large combustion plants, the famous *Industrial Emissions Directive* (IED).

7. Conclusions

Our aim in this research paper was to assess the evolution of European Union's electricity policy ambition in the last 30 years.

From a policy density perspective, the research found that almost half of the legislation classifies as environment legislation, if analysed by pillars of energy policy filter. The classification by categories shows that environment and nuclear legislation make about two thirds of all EU electricity-relevant binding legislation.

From a policy intensity perspective, most of the EU electricity targets/objectives are in the environment and internal market pillar, similar to the policy intensity analysis. An analysis by categories shows a different result than what policy density shows, environment and internal market dominating, with the nuclear categories far behind.

An important result is the remarkable consistency of the average yearly importance of targets and objectives, almost at the same level since 1986. In order words, the European institutions are delivering new, impacting legislation at a stable rate for 30 years.

By constructing a major targets/objectives and categories matrix, we found that the largest amount of financing is towards nuclear research. The European Commission received most expansion of duties for the internal electricity market, followed by, surprisingly, security of supply. Major developments took place mainly for environmental, energy efficiency and savings, and internal energy market categories.

The main pieces of legislation that we could determine were on cross-border exchanges in electricity and gas markets; plus, the Directive on the limitation of emissions of certain pollutants into the air from large combustion plants, the *Industrial Emissions Directive* (IED).

Much more can be derived from the database we constructed; the 8,000 tags allow the discovery of many other insights. The consistent results found from different perspectives show a noteworthy accuracy of our data, despite the inevitable subjectivism. We highlight again the importance of the legislative map in correctly tagging the legislation.

However, the research adds even more questions. Why is there such an overwhelming support for environment? Why so much financing for nuclear research and not renewables, for example? Is the increase of European Commission's duties in the security of supply sector meaning more legislation to be expected in the domain? How effective were the major changes in the energy efficiency and savings domain?

Further research will focus on the factors which influence the changes we noticed in legislation. What determines spikes in particular type of legislation in some years? For example, why do we see an increase

in security of supply legislation in 2010? Why do we have stronger, major legislation in some years? What changes at European, national, level may influence European legislation? Using the database we constructed and the analysis we developed in this article, maybe some of those questions can be answered.

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